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Effect of gamma irradiation on morphological traits of three varieties of sesame crop in M_1 generation (*sesamum indicum* L.)

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ABSTRACT

The main objective for plant breeding is to increase genetic diversity. Mutation induction is a method to increase genetic diversity associated with selection, recombination, or a combination of these approaches in plant breeding. The present research was aimed to compare efficacy of different doses of Gamma rays (150, 200, 250, 300 and 350 Gy and zero dose control) on the sesame morphological traits. Results of cluster analysis of single branch Naz variety to M1 showed that mutations were classified into 8 groups of genotypic and single branch Naz variety exhibited more variation as a result of mutation. The maximum scatter in the measure traits is related to yield per plant, number of capsules and capsule length with coefficients of variation of the 55.29, 47.64 and 39.61 respectively. Thus, these study can introduce a new source of germplasm in breeding programs to classical methods to be evaluated and exploited subsequent generations.

Key Words: Sesame, Mutation, Morphological characteristics, cluster analysis, Gamma Ray.

INTRODUCTION

Sesame (*sesamum indicum* L.) is an annual self-pollinated plant belonged to pedaliaceae family. Sesame seeds have widely industrial and nutritional applications and nearly 75% of which is composed of fat and protein (Shoot, 1995). It is one of the oldest crops in the world. Nowadays, sesame oil is used as an oil source. Sesame is an value oilseed adapted to environment and its oil varies 45 to 62 percent oil which is important due to a combination of antioxidants called phenolic sesamol and good stability (Spangnoletti and Qualset, 1987) and even in some poor countries it is used as a meat substitute and so it is merit more studies (Mohammad pour et al, 2009). Higher yield and more protein may be due to the activation of several mechanisms, associated with plant growth and metabolism (Bora and Sarma, 2006). Genetic variation is necessary for evolution of high-performance variety and highly induced mutations is used for crop genetic diversity. Researchers found by EMS in 11 macro sesame mutants that improved quality traits, including increasing the number of capsules per plant, number of seeds per capsule and oil and protein contents were increased (sengopta and datta, 2004). Wanny et al.(2008) using gamma rays and EMS in the high yield pea mutant lines and some morphological changes reported an increase in size and number of seeds, leaf, flower, pod and seed yield , seed coating and hardness. results that showed that these mutants were affected by doses of 200 (PUSA-212 increased seed size, leaf, flowers and pods

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compared to control) and 400 Gy (PUSA-212C doubling the number of seed pods flowers, leaves and yield were increased compared to control) and 300 Gy dose combination plus 02% 0 / EMS (PUSA-212F high performance hard seed coat).Ahmed et al. (1991) evaluated effect of UV radiation on microspore culture of Brassica napus. Microspores were highly sensitive to radiation. The LD50 was measured 20 seconds after irradiation. Microspores death was not immediate but occurred in later stages. None of the embryos were generated from microspores and after UV irradiation did not show significant morphological variation. Many plants were regenerated and it was determined that a small number of these plants had resistance to Alternaria brassicicola. They suggested this method as an approach to infer genetic resistance to this pathogen. Researchers have made great efforts to achieve different varieties of sesames due to the diverse plant varieties in Iran. Therefore in order to achieve higher yield and new productive cultivars, creating a variety of different ways can be effective, including mutations of the X-rays, gamma rays, or Chemical material such as colchicine or EMS or DES among others. For this reason we try to make use gamma radiation inducing mutations and changes in the sesame plant in plant breeding methods can benefit of it as a tool to develop higher yield and quality plants.

MATERIALS AND METHODS

The present research was conducted in the Agricultural Sciences and Natural Resources, university farm of Sari, Iran, during 2012. Crop sesame cultivar seeds were prepared from Karaj, Single brunch Naz and Multiple brunch Naz were obtained from Seed and Plant modification institution and treated by Atomic Energy Organization of Karaj with 5 doses (150, 200, 250, 300 and 350 Gy) of gamma radiation and some seeds was considered as control. The seeds were planted in a field in row spacing of 20 cm and 10 cm in early May. The irrigation was longed for seven days and hand weeding was done about thrice during the experiment. During the flowering stage and physiological maturity of each cultivar, the number of 25 plants were selected differed much more than control and 12 traits were examined including height (cm), internode length (cm), main leaf length (cm), main leaf width (cm), petiole length (cm), number of capsules, capsule length (cm) , capsule width (cm) and after full maturity, number of seeds per capsule, number of seeds in row capsule, seed weight (g) and yield (g). Data and cluster analysis was carried out using software SPSS.

RESULTS AND DISCUSSIONS

Cluster analysis of morphological traits on Karaj variety and M1 progeny showed that the genotypes were classified in seven groups. Karaj parental variety with 5 other mutant genotypes were fall into seventh cluster and this group accounted for the highest number of genotypes. Compared to others, this group showed the highest level of genetic variations. Groups 2, 4 and 5 showed much more genetic similarity. As a whole, these groups accounted for 80% of genotypes 1 to 6 (Figure 1). Girija and Dhanavel (2013) reported role of wide variety of morphological traits in the induction of mutations Cowpea in M1 generation.

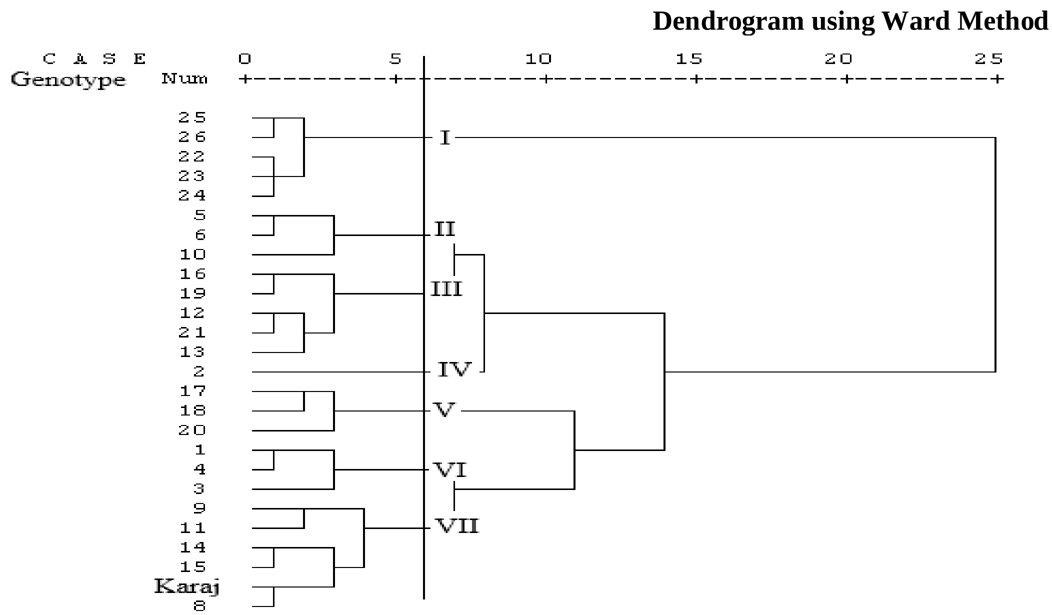

Figure 2. Cluster analysis of morphological traits to Karaj variety and M1 Progenies.

Single brunch Naz varieties classification to the M1 mutation progenies indicated that genotypes were classified into 8 groups. Accordingly, it was found that the variation in the number of mutations was more in single brunch Naz. Single brunch Naz varieties was separated alone in 8 groups of the dendrogram. Among the genotypes, genotype groups II, V and VIII had the greatest amount of genetic variations along with varieties single brunch Naz (Figure 2). In, Shah et al. 1990, Chuhan et al. 1986 obtained dwarf mutant with high yield potential through mutagenic treatments in a population of Brassica.

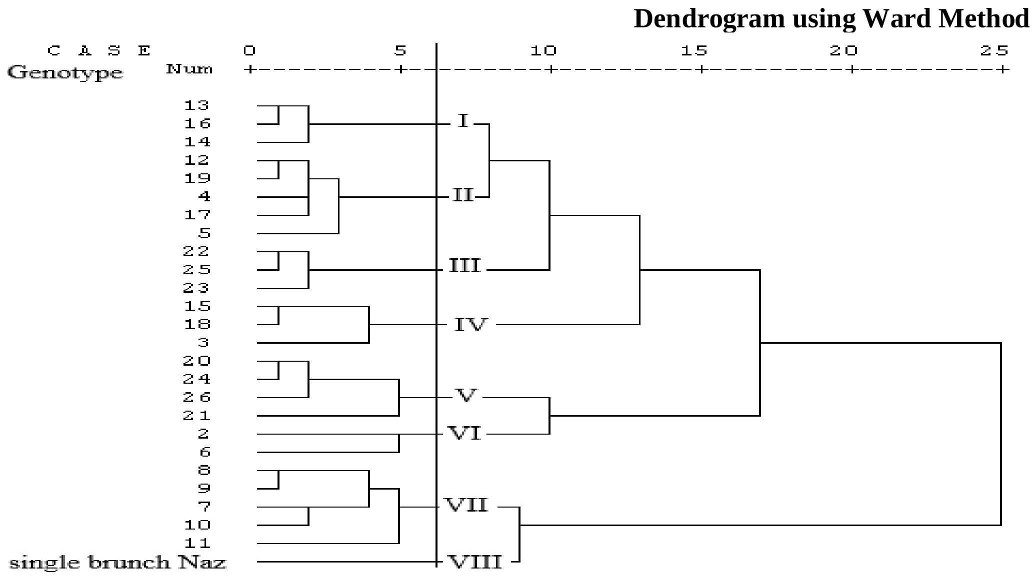

Figure 2. Cluster analysis of morphological traits to single brunch Naz variety and M1 Progenies.

Results of cluster analysis on multiple brunch Naz varieties and its M1 Progenies showed that genotypes were categorized in groups 7. Multiple brunch Naz parent variety with mutant genotype 8 were classified in two groups and this group had the highest number of genotypes. Group III, IV, VI and VII were more genetically similar to each other and more than 68 percent were fell into different genotypes that show the genetic diversity of mutations induced by gamma rays (Figure 3).

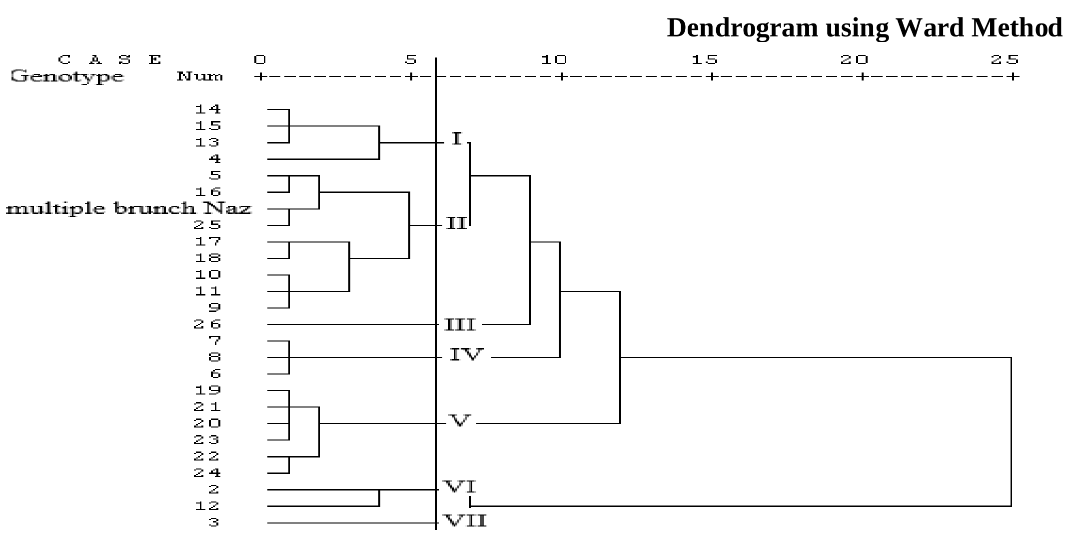

Figure 3. Cluster analysis of morphological traits of multiple brunch Naz variety and M1 Progenies.

According to the results of morphological characterization parameters for single brunch Naz varieties and M1 progenies in cluster analysis these groups exhibited the highest number of seeds per capsule (50.75) and number of seeds per capsule section (12.69) in the second cluster, the highest seed weight (4) in third cluster, the maximum length of internodes (5.08), length of the capsule (4.05), capsule width (1.22), the number of Capsules (165) and yield (26.48) and highest plant height of 180 cm is in cluster IV. The maximum length of the main leaf (12.13), the main leaf width (6.62) and petiole length (6.47) located in cluster VI. High yield in the IV is due to the high number of seeds per plant, seed weight and number of capsules. This group had desirable traits in terms effective yield and superiority. VIII group had the least yield among all groups. The low yield in this group was attributed to low number of capsules, number of seeds per capsule and seed weight. The third group had the highest seed weight genotypes and the lowest seed weight about 3.8 g. According to the results, the highest of scattering measured traits were the yield per plant, number of capsules and capsule length with a coefficient of variation of the 55.29, 47.64 and 39.61 (TABLE 1). The variation in these traits can be promising in breeding applications. Mutation breeding has been used to induce mutations in the genetic inheritance for many years in the field of plant breeding. Such research can introduce directly or indirectly a new variety as a new source of germplasm in breeding programs and subsequently be exploited in classical methods (Aref and Norozi, 1387).

TABLE 1. The minimum and maximum of morphological traits cluster analysis groups to single brunch Naz variety and M1 Progenies and some of parameters and morphological characterization

(gr) Yield	Seed weight (gr)	The number of seeds per capsules section	Number of seeds per capsule	capsules width (cm)	capsules length (cm)	Number of capsules	Petiole length (cm)	The main leaf width (cm)	The main leaf length (cm)	Internode (cm)	Height (cm)		Groups
8.36	2.98	9.50	38	0.80	2.65	62	4.55	3.42	7.50	4.49	61	Minimum	I
8.74	3.40	11.31	45.25	1.12	3.35	70	4.80	4.25	7.82	4.55	65	Maximum	
5.75	3	10.80	43.20	0.97	1.80	35	2.45	3.13	7.85	3.65	149	Minimum	II
10.92	3.80	12.69	50.75	1.30	3.55	82	4.95	4.47	10.85	4.80	160	Maximum	
12.17	3.80	10.75	43	0.55	1.62	68	3.72	3.22	4.77	3.45	120	Minimum	III
19.26	4	11.30	45.20	0.90	2.72	112	4.60	3.37	6.30	4.57	150	Maximum	
18.08	3.07	9.25	37	0.98	2.87	145	4.32	3.82	7.52	4.35	157	Minimum	IV
26.48	3.40	11.80	47.20	1.22	4.05	165	4.80	4.42	11.60	5.05	180	Maximum	
3.93	2.60	8.90	35.60	0.35	0.72	31	3.35	3.27	5.22	4.27	140	Minimum	V
9.68	3.20	12.20	48.80	0.70	2.47	85	4.75	4.55	8.35	4.97	157	Maximum	
3.40	2.63	6.56	26.25	0.46	0.88	37.40	0.48	0.68	3.92	2.12	82	Minimum	VI, VII, VIII
20.09	3.22	11.12	44.50	0.97	4	150	6.47	6.62	12.13	4.67	160	Maximum	
10.69	3.22	10.18	40.74	0.81	2.55	80.17	3.96	3.58	7.65	4.04	133.15		Average groups
1.16	0.10	0.28	1.13	0.05	0.20	7.49	0.23	0.21	0.39	0.15	6.55		Standard error
3.40	2.60	6.56	26.25	0.35	0.72	31	0.48	0.68	3.92	2.12	61		Minimum
26.48	4	12.69	50.75	1.30	4.05	165	6.47	6.62	12.13	5.08	180		Maximum
23.08	1.40	6.13	24.50	0.95	3.33	134	5.99	5.94	8.21	2.96	119		Range
5.91	0.35	1.43	5.74	0.27	1.01	38.19	1.17	1.05	1.98	0.74	33.40		Standard deviation
55.29	10.87	14.05	14.09	33.33	39.61	47.64	29.55	29.33	25.88	18.32	25.08		CV

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