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Assessment of M_6 Sesame Mutants Based on Growth Parameters and Genetic Evaluation for Yield and Yield Attributing Traits

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Abstract: Sesame is one of the major oilseed crops, becoming popular worldwide owing to its high oil quality and adaptation to various ecological regions. An experiment was carried out at the BINA sub-station farms, Magura and Ishurdi during kharif-I of 2014 to evaluate the performance of nine M_6 sesame mutant lines (SM-015, SM-016, SM-048, SM-053, SM-055, SM-058, SM-065, SM-067 and SM-075) along with two check varieties (Binatil-1 and Baritil-2). The parameters tested included: plant height, branches per plant, capsules per plant, seeds per capsule, days to maturity and yield per hectare. Highly significant variations were observed both in individual locations and combined over locations for all traits. In combined over locations, the highest number of branches (2.9) produced in mutant line SM-016 while the highest number of capsules (77) per plant was found in mutant line SM-067. The highest number of seeds per capsules (80) was found in Binatil-1 followed by mutant line SM-055 (71). Mutant line SM-016 produced the highest seed yield (2022 kg/ha) which was closely followed by SM-048 (2011 kg/ha) and SM-067 (1998 kg/ha) while SM-053 produced the lowest seed yield (1419 kg/ha). Between two locations, better seed yield (2147 kg/ha) with shorter maturity period (82 days) were observed at Magura.

Key words: Sesame · Mutants · Evaluation · Growth Parameters · Yield

INTRODUCTION

Sesame (*Sesamum indicum* L), an ancient oilseed, is one of the oldest cultivated plants in the world. And it is famous for its nutritional, medicinal and industrial uses [1] which leads to health promoting benefits and therapeutic potential against different metabolic, inflammatory and infectious diseases [2, 3]. It is a traditional source of edible oil yielding crop of Bangladesh grown in marginal land with minimum management practices. Average yield of this crop is low. Intermediate growth habit, dehiscence of capsules, susceptible to stem rot diseases and water logged conditions is the major constrains of yield in the existing sesame cultivars [4, 5]. Varieties which having resistant for these characters are rarely available in nature. In the meantime, improvements of characters in different crops have been developed by induced mutation [6-9]. Moreover, variability in the adapted cultivar in sesame through mutation breeding techniques has been successfully reported by many researchers [10-13].

The yield improvement of any crop is a very complex character, which depends on many independent contributing traits [14, 15]. Proper understanding of the relationship between the yield and yield contributing traits is crucial for selecting a potential crop improvement [16]. The yield of sesame is mainly depends on three major components viz., the number of capsules per plant, the number of seeds per capsule and seed weight [17, 18]. And some other influential factors such as plant height, the number of internodes, the first capsule axis height and capsule dimensions also noticed as strongly associated with seed yield in sesame [19]. Moreover, the growth

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habit of plant, branching capacity, capsule shattering, integrated management practices, biotic and abiotic factors also can virtually affect its yield [20]. In addition, improvements of disease and insect resistant sesame have been developed through induced mutation [21, 22].

Bangladesh is facing chronically deficient in edible oil production. Domestic production is hardly sufficient to meet 30% demand of the 160 million people. Thus, the country is constrained to import edible oil in large quantity from external sources. Under such a situation it is imperative to domestic oil seed production through varietal research and extension. Sesame is the second major oil crop in Bangladesh. The seeds contain very high quality poly-unsaturated fatty acids in the oil with long shelf life. Gamma radiation is potential mutagen for creating genetic variability in crop plants [23-25]. Realizing the importance of a increasing the domestic oil seed production, Bangladesh Institute of Nuclear Agriculture (BINA) has undertaken a varietal improvement program of sesame using gamma rays [4, 5, 7]. The main objective of the program was to develop sesame variety having earliness, short stature, suitable plant type, heavy bearing and high seed and oil content. This experiment was undertaken to evaluate the performance of nine M_6 sesame mutant lines in the farms of BINA sub-station at Magura and Ishurdi, Bangladesh.

MATERIALS AND METHODS

The trial was conducted at the farms of BINA sub-station at Magura and Ishurdi during kharif-I of 2014. There were nine M_6 sesame mutant lines (SM-015, SM-016, SM-048, SM-053, SM-055, SM-058, SM-065, SM-067 and SM-075) and two check varieties (Binatil-1 and Baritil-2) for conducting the trial. The mutants and check varieties were laid out in a randomized complete block design with three replications. Unit plot size was 12 m^2 (4m x 3m) keeping 25 cm spacing between rows and 8-10 cm between plants. Seeds were sown in the 22 February to 28 February, 2014 at both locations. The crop was fertilized with cow dung, urea, TSP and MoP @ 8 tons, 180 kg, 130 kg and 80 kg per ha, respectively. Recommended production package like weeding, thinning, irrigation, application of pesticide etc. were followed to ensure normal plant growth and development.

Data were taken for plant height, branches per plant, capsules per plant and seeds per capsule from 10 randomly selected plants from each plot. Maturity period was counted when 80% capsules were matured and turned into yellowish colour in each plot. Seed yield of each plot was recoded after harvest and then converted into kg/ha. Appropriate statistical analyses were performed and the mean values of each character were done for interpretation of results. Mean differences of different parameters were tested by Duncan's Multiple Range Test [26].

RESULTS AND DISCUSSION

In the field of plant breeding, induced mutation strategies has been used to induce mutations in the genetic inheritance since many years ago. And such type of research can introduce a new source of germplasm in breeding programs directly or indirectly as a new variety. In the present experiment, the mean values for different characters of the mutant and check varieties of two locations and combined over two locations are presented in according to their agronomic and genetic ability. Results showed significant variation among the mutants and check varieties for all the characters at both locations and combined over locations.

Days to 50% flowering of sesame were significantly different among the mutants and check varieties (Figure 1). Mutant lines SM-048 and SM-055 produced early 50% flowering (50 days) in Magura followed by SM-067 (51 days) while check variety Binatil-2 needed possible longest time to 50% flowering (58 days). But in Ishurdi location more days were needed for first 50% flowering ranged from 59 to 69 days. In combined over locations, SM-055 needed shortest time to produce 50% flowering (54.5 days). It indicates that there was substantial variation among the mutants to produce 50% flowering due to the genetic differentiation. Days to 50 % flowering showed positive and significant correlation with days to maturity as well as plant height and seed yield per plant. Bharathi *et al.* [27] and Sharma and Sayyed [28] also reported positive and significant correlation between days to 50% flowering and for days to maturity. Slightly earlier flowerings were noticed in some of the in determinates in the studied sesame genotypes [20].

A significant variation was observed on the plant height both in individual locations and combined over locations. At Magura, SM-065 and SM-075 produced the tallest plant (131cm) while SM-055 produced the shortest plant (97cm). At Ishurdi, mutant line SM-075 produced the tallest plant (121cm) while SM-058 produced the shortest plant (101cm). In combined over locations,

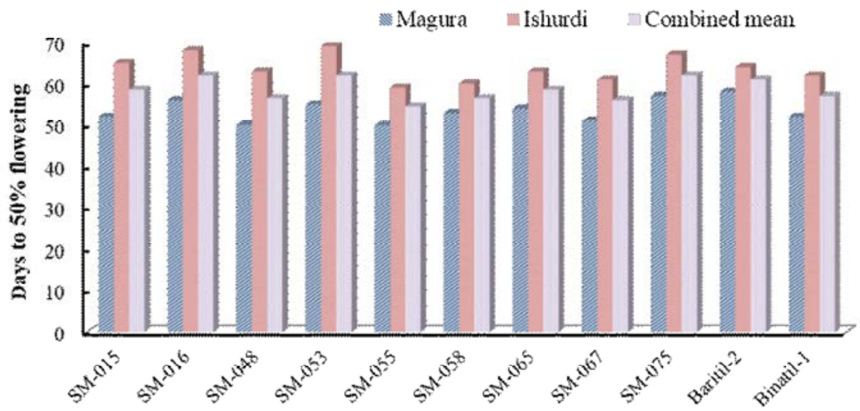

Fig. 1: Days to 50% flowering of sesame mutants with check varieties in different locations

Table 1: Mean of M_6 sesame mutants and check varieties for different quantitative characters

Mutants/ varieties	Plant height (cm)	No. of branches/ plant	No. of capsules/ plant	No. of seeds/ capsule	Days to maturity	Yield (kg/ha)
Magura						
SM-015	117ab	0.2d	58bc	65cd	79d	2205b
SM-016	124ab	1.9a	46de	64cd	88a	2127bc
SM-048	126ab	1.2b	66ab	66cd	81c	2789a
SM-053	128ab	0.3cd	41e	66cd	84b	1772d
SM-055	97c	0.0d	53cd	75b	76e	2259b
SM-058	113b	0.0d	52cd	60d	87a	2278b
SM-065	131a	1.0bc	43de	69bc	85b	1911cd
SM-067	118ab	0.9bc	58bc	66cd	77de	2596a
SM-075	131a	1.1b	50cde	62cd	85b	1844d
Baritil-2	126ab	1.1b	48cde	63cd	82c	1967cd
Binatil-1	119ab	0.0d	71a	87a	82c	2250b
Ishurdi						
SM-015	107c-e	0.4de	64cd	65bc	96ab	1411bc
SM-016	113a-d	3.8ab	73bc	64bc	92c	1917a
SM-048	107de	3.3bc	74bc	60c	95ab	1533b
SM-053	120a	2.9c	77b	70ab	96ab	1067d
SM-055	109b-e	0.9d	51e	68ab	88d	1410bc
SM-058	101e	1.1d	79b	60c	96ab	1211cd
SM-065	117ab	3.6a-c	75bc	68ab	96ab	1445b
SM-067	115a-c	3.3bc	95a	63bc	94bc	1400bc
SM-075	121a	3.6a-c	73bc	65bc	95ab	1167d
Baritil-2	102e	4.3a	65cd	60c	94bc	1433b
Binatil-1	116ab	0.0e	56de	72a	94bc	1478b
Combined means over two locations for mutants/varieties						
SM-015	112cd	0.3ef	61cd	65cd	87c	1808c-e
SM-016	119a-c	2.9a	60c-e	64cd	90b	2022a
SM-048	117bc	2.3bc	70ab	63cd	88c	2011ab
SM-053	124ab	1.6d	59cde	68bc	90b	1419f
SM-055	103e	0.5ef	52e	71b	82e	1834c-e
SM-058	107de	0.6e	65bc	60d	92a	1744de
SM-065	124ab	2.3bc	59c-e	68bc	91b	1678e
SM-067	117bc	2.1cd	77a	65cd	86d	1998a-c
SM-075	126a	2.4a-c	62cd	64cd	90b	1506f
Baritil-2	114cd	2.7ab	57de	62d	88c	1700e
Binatil-1	117a-c	0.0f	63b-d	80a	88c	1864b-d
Location means						
Magura	121a	0.7b	53b	68	82b	2147a
Ishurdi	112b	2.5a	71a	65	94a	1406b

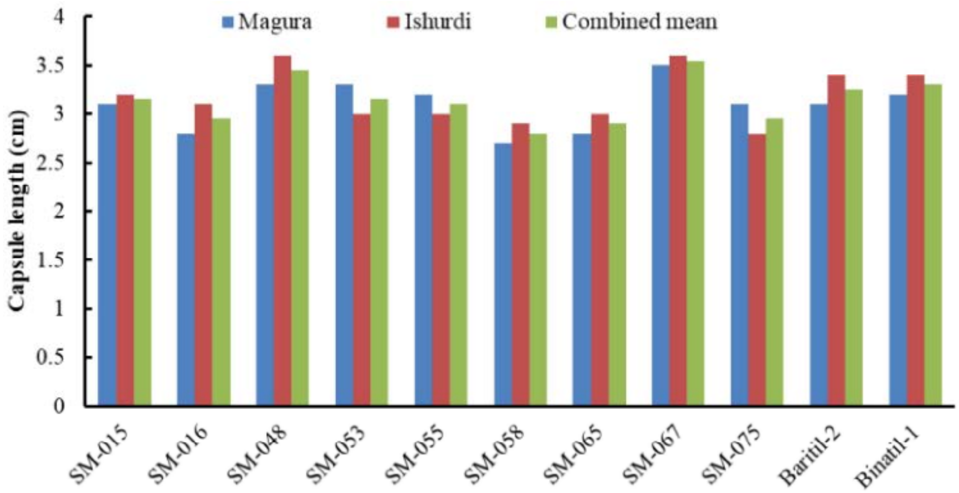

Fig. 2: Capsule length (cm) of sesame mutants with check varieties in different locations

mutants SM-016, SM-053, SM-065, SM-075 and check variety Binatil-1 produced taller plants, which ranged from 117cm to 126cm while the lowest in SM-055 (103 cm). It indicates that there was substantial variation among the mutants/varieties. Significant variations were found in respect of plant height after application of physical and chemical mutagens in sesame [29].

Number of branches per plant was significantly difference both in individual locations and combined over locations. In Magura, mutant line SM-016 produced the highest number of branches (1.9) while SM-055, SM-058 and control variety Binatil-1 was unicom. Baritil-2 produced higher number of branches (4.3) per plant followed by SM-016 (3.8) whereas the control variety Binatil-1 was unicom. Mutant SM-016 produced higher number of branches (2.9) per plant followed by Baritil-2 (2.7) whereas the control variety Binatil-1 was unicom in combined over locations (Table 1). Baraki *et al.* [15] and Malek and Monshi [4] found significant genetic variation for number of branches per plant.

Number of capsules per plant, one of the yield contributing characters in sesame was significantly difference both in individual locations and combined over locations. In Magura, Binatil-1 produced the highest number of capsules (71) per plant followed by mutant line SM-048 (66) whereas SM-053 produced the lowest number of capsules (41). In Ishurdi, mutant line SM-067 produced the highest number of capsules (95) while lowest was in SM-055 (51). In combined over locations, SM-067 the highest number of capsules (77) while lowest was in SM-055 (52) (Table 1). The above results indicates the presence of substantial variation among the mutants/varieties. Malek and Monshi [4] and Atikunnaher *et al.* [30] also found significant genetic variation for number of capsules per plant.

Capsule length of sesame was significantly different among the mutants and check varieties (Figure 2). The highest capsule length, which is the almost same, was found in mutant line SM-067 in both the location Magura (3.5 cm) and Ishurdi (3.6 cm) while the shortest capsule length was found in mutant line SM-058 in both the location Magura (2.7 cm) and Ishurdi (2.9 cm). The capsule length was also reported the significant influence of the sesame yield among the studied genotypes [18]. In combined over locations, mutant SM-067 produced the highest capsule length (3.55 cm) which was closely followed by SM-048 (3.45 cm) while SM-058 produced the shortest capsule length (2.8 cm). Differentiation of capsule length was occurred due to the genetic variation among the studied sesame mutants which is corroborated with the findings of Ghane *et al.* [31] and Abdelsatar *et al.* [17].

A significant variation was found on the number of seeds per capsules both in individual locations and combined over locations. In Magura, Binatil-1 produced the highest number of seeds (87) per capsules while lowest was found in SM-058 (60). In Ishurdi, the highest number of seeds (72) per capsules was produced in Binatil-1 followed by SM-053 (70) whereas lowest (60) was in SM-048, SM-058 and Baritil-2. The control variety Binatil-1 produced the highest number of seeds (80) per capsules while lowest was in SM-058 (60) in combined over locations (Table 1). One of the requirements for genetic improvement is the existence of genetic variation among the studied genotype [7]. Malek and Monshi [5] also reported the genetic variation among the studied sesame mutants.

A significantly difference was observed on days to maturity both in individual locations and combined over locations. Mutant line SM-016 needed long duration (88 days) followed by SM-058 (87 days) while mutant SM-055 was needed possible short duration (76 days) in Magura. Maturity days were needed more or less same ranges from 88-96 days in Ishurdi location. In combined over locations, SM-058 needed long duration (92 days) followed by SM-065 (91 days) while mutant SM-055 was needed possible short duration (82 days) (Table 1). It indicates that there was substantial variation among the mutants/varieties. A significant variation in respect of maturity period were found in sesame genotypes which all determinates matured later than their indeterminate counterparts as revealed by days to maturity [17, 20].

Seed yield is the most important characters in sesame, was significantly difference both in individual locations and combined over locations At Magura, SM-048 produced the highest seed yield (2789 kg/ha) followed by SM-067 (2596 kg/ha) whereas SM-053 produced the lowest seed yield (1772 kg/ha). At Ishurdi, SM-016 produced the highest seed yield (1917 kg/ha) followed by SM-048, which produced 1533 kg/ha. In combined over locations, mutant SM-016 produced the highest seed yield (2022 kg/ha) which was closely followed by SM-048 (2011 kg/ha) and SM-067 (1998 kg/ha) while SM-053 produced the lowest seed yield (1419 kg/ha). Similar trend of seed yield increases in the mutants of various crops was reported earlier by Malek and Monshi [4] and Malek and Monshi [5]. Between two locations, better seed yield (2147 kg/ha) with shorter maturity period (82 days) were observed at Magura (Table 1). Bharathi *et al.* [27] reported that they have developed some high yielding sesame mutants which gave 3-30% more oil than the control. Usually, a large portion of the phenotypic variance in seed yield components could be associated to the genotypic effects in sesame.

CONCLUSION

It can be concluded that gamma irradiation could create useful variability in most of the characters studied in sesame genotypes that helped in selection of promising mutants in M_7 generation. And understanding the genetic basis of seed yield and its associated components and applying that knowledge in sesame mutational breeding programs might be useful for developing higher yield producing sesame varieties.

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