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Evaluation of two promising rapeseed mutants under on-station and on-farm trials

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Abstract: A field experiment was carried out with two mutants (MM014-02wf and MM2-16-98) of rapeseed and two check varieties (Binasarisha-4 and Barisarisha-15), with a view to study variability for seed yield and yield contributing characters and to select promising mutants having high seed yield with short maturity period. The parameters tested included: plant height, branches plant^{-1}, siliquae plant^{-1} and seeds siliqua^{-1}, days to maturity and yield ha^{-1}. Highly significant variations were observed both in individual locations and combined over locations for all traits except no. of siliquae plant^{-1} in both on-station and on-farm trial. On the other hand, highly significant variations were observed for all traits except plant height in on-station trial and number of siliqua plant^{-1} both on-station and on-farm trial in combined over locations. The mutant line MM2-16-98 produced higher seed yield (1606 kg/ha) in on-farm trial and higher siliquae (63) plant^{-1} and higher seeds (29) siliqua^{-1} and higher seed yield (1412kgha^{-1}) in on-farm trial than the others. Mutant line MM2-16-98 can be release as a new variety for the cultivation all over the country.
Key words: Mutants, rapeseed, on-station, on-farm

Introduction

Rapeseed (*Brassica napus* L., 2n=38) is an important oil seed crop belonging to the family Cruciferae. The seeds of mustard and rapeseed contain 42% oil and 25% protein. The oil is mainly used as food. Oil and fat are not only a source of energy but also contain fat-soluble vitamins A, D, E, and K. The oil cake contains proteins of high biological value and applicable quantities of calcium and phosphorus, and is used as a very good animal feed as well as fertilizer for various crops. The area and the production of rapeseed & mustard in the year 2006-007 are 5.2 lakh acres and 1.89 lakh m tons, respectively (BBS, 2008). Edible oil production can be increased by introducing and adapting the newly developed and high yielding genotypes of rapeseed-mustard (Ozer and Oral, 1997; Sharma and Manchanda, 1997; Khan *et al.*, 1998).

Genetic diversity is essential to develop cultivars with increased yields, wider adaptation, desirable qualities, and pest and disease resistance. Fundamental and applied aspects of experimental mutagenesis have been extensively reviewed (Gottschalk 1983, Yamaguchi 1991, Brunner 1991). About 3000 mutants varieties have so far been released, many of which have substantial economic value in different countries in the world (Micke, 1989). This experiment was undertaken to evaluate the performance of two newly developed mutants of rapeseed at sub-station farm of Magura, Ishurdi, and at farmers' field of Faridpur, Jhenaidah, Tangail and Sirajgonj districts.

Materials and Methods

Two promising mutants of rapeseed, MM014-02wf and MM2-16-98 were put into on-station and on-farm trials to assess their performances in respect of plant height, branches plant^{-1}, siliquae plant^{-1}, seeds siliqua^{-1}, maturity period and seed yield compared to the check varieties Binasarisha-4 and Barisarisha-15. The trials were carried out in BINA sub-station farm at Magura and Ishurdi and in the farmer's field at Faridpur, Jhenaidah, Tangail, and Sirajgong districts. The mutant lines and check varieties were laid out in a randomized complete block design with four replications. Seeds were sown during 25 October to 10 November 2007 with 30 cm row to row spacing and 6-8 cm from plant to plant within row. Unit plot size was 24m^2 (5m x 4.8m). Research management i. e., full package of recommended managements for on-station trials and farmers' practices with recommended doses of fertilizers, one or no irrigation with poor cultural managements for on-farm trials were followed. At maturity plot^{-1} and other parameters were recorded. Seed yield of plot was finally converted into kgha^{-1}. Mean differences of different parameters including seed were tested by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

The mean values for different characters of the mutant and check varieties of individual location and combined over locations both in on-station and on-farm trial are presented in Table 1. Results showed significant variation in most cases among the mutants and check varieties for all the characters at both locations and combined over locations.

Plant height: A significant variation was observed on the plant height both in individual locations and combined over locations. In on-station trial, check variety Barisarisha-15 produced the tallest plant (122 cm) at Magura while MM2-16-98 produced the shortest plant (105 cm) at the same location. In combined over locations, Barisarisha-15 produced the tallest plant (118 cm) followed by MM014-02wf (117cm).

In on-farm trial, Barisarisha-15 produced the tallest plant (126 cm) followed by MM014-02wf (124 cm) at Faridpur while Binasarisha-4 produced the shortest plant (91 cm) both in Jhenaidah and Sirajgonj locations. In combined over locations, MM014-02wf produced the tallest plant (112 cm) followed by Barisarisha-15 (110 cm) where Binasarisha-4 produced shortest plant (96 cm). These findings are in agreement with those of Guohuai *et al.* (2002).

Number of branches plant^{-1}: Number of branches plant^{-1} was significantly differed both in the individual locations and the combined over locations. In on-station trial, Barisarisha-15 produced the highest number of branches (8.2) followed by MM014-02wf (7.4) while Binasarisha-4 produced lowest branches (2.4) at Magura. In combined over location, Barisarisha-15 produced higher number of branches (6.0) plant^{-1} followed by MM014-02wf (5.8) whereas the control variety Binasarisha-4 produced lowest branches (2.4) (Table 1). These findings are in agreement with those of Vollioud (1982) and Santonoceto (1997).

In on-farm trial, MM014-02wf produced the highest number of branches (4.7) at Faridpur while Binasarisha-4 produced lowest branches (1.6) at Jhenaidah. In combined over location, MM014-02wf produced higher number of branches (4.4) per plant followed by Barisarisha-15 (4.2) whereas the control variety Binasarisha-4 produced lowest branches (2.3) (Table 1).

Table 1. Mean of mutant lines and check varieties for different characters in on-station and on-farm trials

Mutants/ varieties/ locations	Plant height (cm)	No. of branches plant^{-1}	No. of siliquae^{-1} plant	No. of seeds siliqua^{-1}	Days to maturity	Seed yield (kg ha^{-1})
On-station trial						
Magura						
MM014-02wf	119a	7.4a	96a	27b	81c	1695ab
MM2-16-98	105b	2.5b	59b	30a	83b	1955a
Barisarisha-15	122a	8.2a	116a	27b	80c	1663b
Binasarisha-4	108b	2.4b	60b	30a	87a	1925ab
Ishurdi						
MM014-02wf	115a	4.2a	55b	24b	83c	1194
MM2-16-98	110b	2.8b	68a	33a	85b	1256
Barisarisha-15	114a	3.8a	50b	24b	84bc	1063
Binasarisha-4	112b	2.6b	75a	33a	88a	1250
Combined means over locations for mutants/varieties						
MM014-02wf	117a	5.8a	76	25b	82c	1444bc
MM2-16-98	107b	2.6b	64	31a	84b	1606a
Barisarisha-15	118a	6.0a	83	25b	82c	1363c
Binasarisha-4	110b	2.5b	67	32a	88a	1588ab
Location means						
Magura	113	5.1a	83b	28	83b	1810a
Ishurdi	113	3.3b	86a	28	85a	1190b
On-farm trial						
Faridpur						
MM014-02wf	124a	4.7a	80b	25b	83d	1594
MM2-16-98	107b	3.0b	90ab	30a	90b	1684
Barisarisha-15	126a	4.4a	75b	23b	85c	1488
Binasarisha-4	107b	3.0b	99a	30a	91a	1588
Jhenaidah						
MM014-02wf	108a	3.8a	47	24b	80d	1089b
MM2-16-98	93b	2.2b	38	29a	85b	1431a
Barisarisha-15	108a	4.1a	46	24b	83c	1025b
Binasarisha-4	91b	1.6b	35	28a	88a	1313a
Tangail						
MM014-02wf	112a	4.4a	55	20b	82c	1006b
MM2-16-98	93b	2.9b	55	28a	93b	1142a
Barisarisha-15	109a	4.2a	59	21b	81c	1009b
Binasarisha-4	96b	2.7b	50	29a	95a	1127a

Contd. Table 1

Sirajgonj						
MM014-02wf	105a	4.6a	64	23b	82c	1221bc
MM2-16-98	97ab	2.2b	71	29a	86ab	1392a
Barisarisha-15	97b	4.2a	55	22b	83bc	1194c
Binasarisha-4	91b	2.0b	50	29a	87a	1341ab
Combined means over locations for mutants/varieties						
MM014-02wf	112a	4.4a	61	23b	82d	1227c
MM2-16-98	97b	2.6b	63	29a	88b	1412a
Barisarisha-15	110a	4.2a	59	22b	83c	1179c
Binasarisha-4	96b	2.3b	58	29a	90a	1342b
Location means						
Faridpur	106a	3.8a	86a	17	87a	1588a
Jhenaidah	100bc	2.9c	41c	26	84b	1214b
Tangail	103b	3.5ab	55b	25	87a	1071c
Sirajgonj	97c	3.2bc	60b	25	85b	1287b

Number of siliquae plant^{-1}: Number of siliquae plant^{-1}, one of the yield contributing characters in rapeseed significantly variation was found in individual locations while insignificant difference was found in combined over locations. In on-station trial, Barisarisha-15 produced the highest number of siliquae (116) per plant followed by mutant line MM014-02wf (96) at Magura while Barisarisha-15 produced the lowest number of silique (50) at Ishurdi.

In on-farm trial, number of siliquae plant^{-1} was insignificant at all the locations except Faridpur and location means. In location means, Faridpur produced height number of siliquae plant^{-1} (86) while Jhenaidah produced lowest number of siliquae plant^{-1} (41) (Table 1).

Number of seeds siliqua^{-1}: A significant variation was found on the number of seeds siliqu^{-1} a both in individual locations and combined over locations. In on-station trial, mutant line MM2-16-98 and check variety Binasarisha-4 produced the highest number of seeds (33) per siliqua while the lowest was found both in MM014-02wf and Barisarisha-15 (24) at Ishurdi. In combined over locations, Binasarisha-4 produced the highest number of seeds (32) siliqua^{-1} while the lowest was found both in MM014-02wf and Barisarisha-15 (25).

In on-farm trial, mutant line MM2-16-98 and check variety Binasarisha-4 produced the highest number of seeds (30) siliqu^{-1} a at Faridpur location while Barisarisha-15 produced the lowest number of seeds (21) siliqua^{-1} at Tangail. In combined over locations, both mutant line MM2-16-98 and check variety Binasarisha-4 produced the highest number of seeds (29) siliqua^{-1} while the lowest was found in Barisarisha-15 (22). Rai and Kumar (1998) also obtained increased number of siliquae per plant from the gamma ray.

Maturity period: A significantly difference was observed on days to maturity both in individual locations and combined over locations. In on-station trial, Binasarisha-4 needed long duration (88 days) at Ishurdi location while Barisarisha-15 was needed possible short duration (80 days) at Magura location. In combined over locations, Binasarisha-4 needed long duration (88 days) while both mutant line MM014-02wf and check variety Barisarisha-15 was needed possible short duration (82 days) (Table 1).

In on-farm trial, Binasarisha-4 needed long duration (95 days) followed by MM2-16-98 (93 days) at Tangail while MM014-02wf was needed possible short duration (80 days) at Jhenaidah. In combined over locations, Binasarisha-4 needed long duration (90 days) followed by MM2-16-98 (88 days) while mutant line MM014-02wf was needed possible short duration (82 days) (Table 1).

Seed yield: Seed yield is the most important characters in rapeseed, was significantly differed both in individual locations and combined over locations. In on-station trial, mutant line MM2-16-98 produced the highest seed yield (1955 kg ha^{-1}) followed by Binasarisha-4 (1925 kg ha^{-1}) at Magura whereas Barisarisha-15 produced the lowest seed yield (1063 kg ha^{-1}) at Ishurdi. In combined over locations, mutant MM2-16-98 produced the highest seed yield (1606 kg ha^{-1}) which was closely followed by Binasarisha-4 (1588 kg ha^{-1}) while Barisarisha-15 produced the lowest seed yield (1363 kg ha^{-1}). These findings are in agreement with those of Guohuai *et al.* (2002). In the two locations, Magura perform comparatively better (1810 kg ha^{-1}) than Ishurdi (1190 kg ha^{-1}) regarding seed yield.

In on-farm trial, mutant line MM2-16-98 produced the highest seed yield (1684 kg ha^{-1}) followed by mutant line MM014-02wf (1594 kg ha^{-1}) and Binasarisha-4 (1588 kg ha^{-1}) at Faridpur whereas MM014-02wf produced the lowest seed yield (1006 kg ha^{-1}) at Tangail. In combined over locations, mutant line MM2-16-98 produced the highest seed yield (1412 kg ha^{-1}) which was closely followed by Binasarisha-4 (1342 kg ha^{-1}) while Barisarisha-15 produced the lowest seed yield (1179 kg ha^{-1}). These findings are in agreement with those of

Vollioud (1982) and Santonoceto (1997). In the four locations, Faridpur perform comparatively better (1588 kg/ha) than the other locations regarding seed yield.

From the above experiment, it can be stated that mutation breeding is the most relevant tool to create genetic variations in quantitative characters of plant species which have narrow genetic base. Thus, plant breeders could get a good scope for selection of mutation with desirable characters, such as with early maturing mutants with tolerance to stresses (salinity and drought) and high seed yield and oil content yields. Rahman *et al.* (1992) reported that they have developed some high yielding rapeseed/mustard mutants which gave 3-30% more oil than the control. Development of early maturing mutants by using this technique was reported by many researchers like Miah *et al*. (1981).

In respect of plant height, number of siliquae plant^{-1}, number of seeds siliqua^{-1} and higher seed yield in mutant line MM2-16-98 can be release as a new variety for the cultivation all over the country.

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