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YIELD PERFORMANCE OF MUTANT BLACKGRAM VARIETY Binamash-2 OVER LOCATIONS IN BANGLADESH

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Abstract

Blackgram is one of the most important pulse crops extensively grown in Bangladesh with multiple uses. An experiment was conducted to examine the suitability and productivity of a gamma irradiated pulse variety Binamash-2 in Kharif-II season for two consecutive years 2021 and 2022 over four locations, Mymensingh, Chapainawabganj, Gopalganj and Magura districts. The experiment was consisted of two varieties *viz.* Binamash-2 and BARI Mash-3. Binamash-2 produced higher seed yield than BARI mash3 at all four locations. Binamash-2 produced bolder seeds with early maturity than BARI mash3. The seed coat color and size of Binamash-2 was more attractive than BARI mash3 and farmers of four studied areas are very much interested to cultivate Binamash-2 in the upcoming years.

Key words: Binamash-2, blackgram, mutant, pod, yield

Blackgram (*Vigna mungo* L.) is one of the most important food legumes in Bangladesh. It is a healthy legume that is typically designed to withstand stress and is an affordable supply of vegetable protein, amino acids, and so on for the underprivileged. Due to capacity of fixing atmospheric nitrogen, the crop is very effective in increasing soil fertility. It is also well adapted for many cropping systems, including dry farming and intercropping. In Bangladesh during 2019-2020, blackgram was grown over an area of 0.467 lakh hectares with the production of 0.537 lakh metric tons where the average yield of 1150 kg ha^{-1} was low as compared to the cereal crops (BAS, 2021). In order to break the yield bottle neck in black gram, efforts are needed to develop high yielding varieties with better growth habit. Research on this species has lagged behind that on cereals and other legumes because genetic improvement is severely hampered by the crop's limited genetic diversity. Therefore, it is necessary to develop this crop by making use of the genetic diversity that is already there. A crop's genetic improvement for sustainable food supply and other features may be aided by increasing genetic diversity. Induced mutagenesis produces fresh variations in the qualities important for genetic improvement, such as increased yield and other polygenic traits, without altering the plant's fundamental chromosome structure. In order to improve cultivars in certain specific features and complement existing germplasm, mutation

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induction has established itself as a strategy in plant breeding. (Kurobane *et al.*, 1979). Mutagenesis has been widely employed as a potential and advance technique to increase diversity for crop development. (Singh and Singh, 2001). Genetic variation can be created through induced mutation utilizing physical and chemical mutagens, leading to the development of new variety with improved characteristics (Wongpiyasatid, 2000). In self-pollinated crops like blackgram, mutation breeding is an appropriate method for generating variety. Therefore, the current mutation breeding effort was started to find mutants with high yield potential, earliness, erect, and determinate type plant growth habits of blackgram. Many research institutions in Bangladesh are currently working to develop high-yielding blackgram varieties. Farmers still grow native varieties, which yield modest yields, however ignorance prevents them from doing so. As a result, utilizing the right production techniques on superior cultivars will assist farmers in Bangladesh in increasing yield and promoting blackgram production. Therefore, the aim of this study was to investigate the yield potential of gamma irradiated blackgram varieties developed by BINA under different agro-ecological conditions of Bangladesh.

The field experiments were performed at four agro-ecological zones of Bangladesh such as Mymensingh, Magura, Gopalganj and Chapainawabganj districts in Kharif-II (Agust-November) season of two consecutive years of 2021 and 2022. Seeds of Binamash-2 and BARI mash3 were used as planting material. The experiment was laid out in a randomized complete block design (RCBD) with three replications. Seeds were sown between 25 to 27 August in both years. Seeds were sown at a depth of 2-3 cm by line sowing. Unit plot size was 30 m^2. Distance between plant to plant was 5 cm in a row while line to line distance was maintained 40 cm. The trials were conducted in the farmers' field following farmers' management practices. A fertilizer dose of 15, 35 and 20 kg ha^{-1} of Urea, DAP and MoP, respectively were applied at the time of sowing as basal dose. Intercultural practices like weeding and thinning were done for its maximum growth and pesticide was applied to control diseases as and when necessary. Reaction to major diseases like *Cercospora* leaf spot, Powdery mildew and Yellow Mosaic Virus and insect-pests infestation under field condition were recorded in both years. At harvest, data on days to maturity, plant height, primary branches $plant^{-1}$, pods $plant^{-1}$, seeds pod^{-1}, 1000-seed weight and seed yield were recorded. Plot yield was converted to ton per ha and farmers' reactions were recorded on the basis of studied parameters. The collected data were analyzed statistically by using computer package program, MSTAT-C.

Considering mean over locations showed that varietal variation on days to maturity, number of primary branches and pods $plant^{-1}$, number of seeds pod^{-1}, 1000-seed weight and seed yield was significant at 1^{st} year (Table 1). But plant height variation was non-significant. Results indicated that Binamash-2 matured almost 3 days earlier than BARI mash3. Binamash-2 produced higher number of primary branches and pods $plant^{-1}$ and also produced bolder seeds than BARI mash3. There was significant difference regarding seed yield between the two tested varieties (Table 1). However, seed yield was apparently higher

in Binamash-2 (1.45 tha^{-1}) than BARI mash3 (1.39 tha^{-1}). The seed yield was higher in Binamash-2 than BARI mash3 might be due to greater number of pods $plant^{-1}$, higher number of seeds pod^{-1} and bolder seeds. On the other hand, pod number per plant was higher in Binamash-2 than BARI mash3 for greater number of branches $plant^{-1}$. Relevant reports (Nag *et al.*, 2000 and Amanullah *et al.*, 2016) have found genotypic heterogeneity with respect to yield attributes and seed yield which has corroborated currently conducted experiments. Farmers' also very much interested to cultivate Binamash-2 in those districts due to early maturity and bushy plant type.

Table 1. Yield and yield contributing characters of Binamash-2 over four locations during 2021

Location(s)	Variety(s)	Days to maturity	Plant height (cm)	Primary branches $plant^{-1}$ (no.)	Pods $plant^{-1}$ (no.)	Seeds pod^{-1} (no.)	1000-seed weight. (g)	Seed yield (tha^{-1})
Mymensingh	Binamash-2	75.4b	52.3b	3.72a	32.13a	6.50a	38.25a	1.40a
	BARI mash3	78.2a	54.0a	2.53b	25.50b	6.30b	35.20b	1.31b
Chapainawabganj	Binamash-2	74.80	35.3a	3.15a	41.76a	6.42a	42.30a	1.52a
	BARI mash3	76.5a	32.7b	2.35b	36.54b	6.15b	39.00b	1.45b
Gopalganj	Binamash-2	72.2b	50.5b	3.70a	38.62a	6.43a	41.76a	1.45ns
	BARI mash3	75.6a	54.4a	3.23b	32.58b	5.92b	38.42b	1.42
Magura	Binamash-2	73.4b	48.2a	3.52a	38.67a	6.25a	38.50a	1.41ns
	BARI mash3	75.3a	46.3b	3.15b	32.55b	5.85b	35.26b	1.38
Combined	Binamash-2	73.7b	46.6 ns	3.52a	37.80a	6.40a	40.20a	1.45a
	BARI mash3	76.4a	46.8	2.82b	31.79b	6.06b	36.97b	1.39b
	CV%	4.84	6.52	5.20	8.74	1.75	4.26	6.23

*Figures followed by same letter in a column did not differ significantly at 5% level

Regarding mean over locations showed that varietal variation on days to maturity, plant height, number of primary branches and pods $plant^{-1}$, number of seedspod^{-1} and 1000-seed weight was significant at 2nd year (Table 2). But seed yield variation was non-significant. Results indicated that Binamash-2 matured 2 days earlier than BARI mash3. BARI mash3 (47.58 cm) was taller than Binamash-2 (47.35 cm). Binamash-2 produced higher number of primary branches (3.71) and pods $plant^{-1}$ (41.21) and also produced bolder seeds than BARI mash3 (38.03 and 3.08 respectively). There was no significant difference regarding seed yield between the two tested varieties (Table 2). However, seed yield was apparently higher in Binamash-2 (1.45 tha^{-1}) than BARI mash3 (1.41 tha^{-1}). The seed yield was higher in Binamash-2 than BARI mash3 might be due to greater number of pods $plant^{-1}$, higher number of seeds pod^{-1} and bolder seeds. On the other hand, pod number per plant was higher in Binamash-2 than BARI mash3 for greater number of branches $plant^{-1}$. The current experimental results were corroborated by previous numerous reports (Ghafoor et al., 2005) that noted genotypic diversity with relation to yield attributes and seed yield. Farmers' were keen to cultivate Binamash-2 due to earliness and good pod numbers.

Table 2. Yield and yield contributing characters of Binamash-2 over four locations during 2022

Location(s)	Variety(s)	Days to maturity	Plant height (cm)	Primary branches plant^{-1} (no.)	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	1000-seed weight (g)	Seed yield (tha^{-1})
Mymensingh	Binamash-2	74.20b	50.23b	3.51a	37.56a	6.72a	41.25a	1.42ns
	BARI mash3	76.43a	51.76a	3.13b	29.63b	6.15b	37.45b	1.38
Chapainawabganj	Binamash-2	76.34b	41.12b	4.17a	43.35a	6.51a	43.23a	1.56a
	BARI mash3	79.40a	37.32a	3.81b	39.35b	6.23b	38.67b	1.46b
Gopalganj	Binamash-2	71.27b	52.33b	3.82a	41.34b	6.32a	41.67a	1.41ns
	BARI mash3	74.15a	53.70a	3.32b	43.62a	5.91b	39.78b	1.39
Magura	Binamash-2	70.41b	45.73b	3.35a	42.57a	6.45a	39.80a	1.42ns
	BARI mash3	73.47a	47.32a	3.10b	39.52b	6.12b	37.42b	1.40
Combined	Binamash-2	73.06b	47.35ns	3.71a	41.21a	6.48a	41.49a	1.45ns
	BARI mash3	75.86a	47.58	3.38b	38.03b	6.11b	38.33b	1.41
	CV%	3.92	5.45	4.85	7.26	2.10	5.27	4.14

*Figures followed by same letter in a column did not differ significantly at 5% level

Considering mean over locations and years showed that varietal variation on days to maturity, plant height, number of primary branches and pods plant^{-1}, number of seeds pod^{-1} and 1000 seed weight was significant (Table 3). But seed yield variation was non-significant. Results indicated that Binamash-2 matured 3 days earlier than BARI mash3. BARI mash3 (47.0 cm) was taller than Binamash-2 (48.8 cm). Binamash-2 produced higher number of primary branches and pods plant^{-1} and also produced bolder seeds than BARI mash3. There was no significant difference regarding seed yield between the two tested varieties (Table 3). However, seed yield was apparently higher in Binamash-2 (1.45 tha^{-1}) than BARI mash3 (1.40 tha^{-1}). The seed yield was higher in Binamash-2 than BARI mash3 might be due to greater number of pods plant^{-1}, higher number of seeds pod^{-1} and bolder seeds. On the other hand, pod number per plant was higher in Binamash-2 than BARI mash3 for greater number of branches plant^{-1}. Genotypic variation regarding yield attributes and seed yield was observed by earlier many reports (Sharma *et al.,* 2000; Sing and Sing, 2000 and Gupta *et al.,* 2007) that supported present experimental results. Interesting thing is that two varieties performance regarding seed yield of each location was almost similar. It means these two backgram varieties are highly stable over locations. Farmers' preferred Binamash-2 due to earliness and good pod numbers and pod sizes in those areas.

Table 3. Mean varietal variation on days to maturity, morphological, yield attributes and seed yield over locations and years

Location(s)	Variety(s)	Days to maturity	Plant height (cm)	Primary branches plant^{-1} (no.)	Pods plant^{-1} (no.)	Seeds pod^{-1} (no.)	1000-seed weight. (g)	Seed yield (tha^{-1})
Mymensingh	Binamash-2	74.8b	51.3ns	3.62a	34.85a	6.61a	39.75a	1.41a
	BARI mash3	77.3a	52.9	2.88b	27.57b	6.23b	36.33b	1.15b
Chapainawabganj	Binamash-2	75.6b	38.2a	3.66a	42.56a	6.47a	42.77a	1.54ns
	BARI mash3	78.0a	35.0b	3.08b	37.95b	6.19b	38.84b	1.46
Gopalganj	Binamash-2	71.8b	51.4b	3.76a	39.98a	6.38a	41.72a	1.43 ns
	BARI mash3	74.9a	54.0a	3.28b	38.10b	5.92b	39.10b	1.41
Magura	Binamash-2	71.4b	47.0ns	3.44b	40.62a	6.30a	39.15a	1.42ns
	BARI mash3	74.4a	46.8	3.16a	36.04b	6.00b	36.34b	1.39
Combined	Binamash-2	73.4b	47.0b	3.62a	39.50a	6.44a	40.85a	1.45ns
	BARI mash3	76.1a	48.8a	3.10b	34.91b	6.08b	37.65b	1.40
	CV%	3.51	5.72	4.45	6.92	2.13	4.89	7.72

*Figures followed by same letter in a column did not differ significantly at 5% level

Disease reaction against *Cercospora* leaf spot, Powdery mildew and Yellow Mosaic were examined under field condition during 2021 and 2022 at over four locations. Results were presented in table 4. There was not much disease incidence in Binamash-2 and check variety for *Cercospora* leaf spot and Powdery mildew in field. Binamash-2 along with check variety, BARI Mash-3 showed moderately susceptible to the diseases. All the tested entries along with a check variety, BARI Mash-3 showed moderately susceptible to the Yellow Mosaic Virus disease.

Table 4. Incidence of *Cercospora* leaf spot, powdery mildew and yellow mosaic disease in Binamash-2 over four locations for two consecutive years (mean: 2021, 2022)

Variety(s)	Location(s)	*Cercospora* leaf spot			Powdery mildew			Yellow Mosaic		
		PDI	DS	Reaction	PDI	DS	Reaction	PDI	DS	Reaction
Binamash-2	Mymensingh	54.23	32.35	MS	61.15	42.31	MS	6.41	17.23	MS
	Chapainawabganj	45.12	26.13	MS	49.42	35.17	MS	4.13	14.85	MS
	Gopalganj	51.57	28.92	MS	54.83	37.92	MS	5.65	15.48	MS
	Magura	53.78	30.75	MS	58.52	40.62	MS	5.96	16.38	MS
BARI mash3	Mymensingh	61.52	36.42	MS	62.43	45.28	MS	28.65	42.74	S
	Chapainawabganj	55.78	32.19	MS	55.76	38.67	MS	23.42	32.17	MS
	Gopalganj	57.42	35.15	MS	56.35	41.72	MS	25.31	35.85	MS
	Magura	60.20	35.85	MS	59.28	43.75	MS	30.83	45.21	S

MS = Moderately Susceptible, S = Susceptible; DS = Diseases severity; PDI = Percent Disease Index

Table 5. Infestation of hairy caterpillar in Binamash-2 over four locations for two consecutive years (mean: 2021, 2022)

Variety(s)	Location(s)	Hairy caterpillar	
		0-6 Scale	Reaction
Binamash-2	Mymensingh	03	MR
	Chapainawabganj	03	MR
	Gopalganj	03	MR
	Magura	03	MR
BARI mash3	Mymensingh	04	MS
	Chapainawabganj	03	MR
	Gopalganj	03	MR
	Magura	04	MS

MS = Moderately Susceptible, MR = Moderately Resistant.

Naturally low insect pest infestation is occurred in black gram and pod borer infestation was not found in black gram. The hairy caterpillar infestation was occurred in black gram during experimentation (Table 5). Tested varieties were moderately resistant and moderately susceptible to this insect pest. According to Sudhir *et al.* (2018) hairy caterpillars, galeruid beetle, stem fly and white fly, pod borer complex insects and yellow mosaic virus (YMV), *crcospora* leaf spots (*C. cruenta*) and powdery mildew (*Erysiphe polygoni*) disease are considered of major importance for black gram.

It may be concluded that high yielding cultivar, Binamash-2 has higher number of branches and pods plant^{-1}, higher number of seeds pod^{-1} with bolder seed size and also matured almost 3 days earlier than the low yielder, BARI mash3. Farmers of studied areas choice Binamash-2 in future cultivation for higher seed yield with early maturity that might be fit the existing cropping pattern in Bangladesh.

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