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Effect of plant density and fertilizer rate on the performance of short duration mustard cv. BARI Sarisha-14

Jannatul Ferdous^{1*}, Chul-Hyun Ahn^{2*}, Md. Shazzadur Rahman¹, Fakir Muhammad Munawar Hossain² and Ahmed Khairul Hasan¹

¹Department of Agronomy, Bangladesh Agricultural University, Mymensingh, Bangladesh

²Department of General Education, Korea National College of Agriculture and Fisheries, Jeonju, Korea

³Planning Commission, Government of the People's Republic of Bangladesh

*Both authors contributed equally to this manuscript

✉ For any information: ask.author@journalbinet.com

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ABSTRACT

Effect of plant density and fertilizer rate on the performance of short duration mustard cv. BARI Sarisha-14 was investigated with an experiment from October, 2015 to June, 2016 at Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh. The experiment was laid out in split plot design with three replications. The experiment consisted of four plant densities: P₁: 56 plants/m² (30 cm × 6 cm), P₂: 67 plants/m² (25 cm × 6 cm), P₃: 80 plants/m² (25 cm × 5 cm), P₄: 100 plants/m² (25 cm × 4 cm) and four rates of fertilizer : F₀: Control (no fertilizer) F₁: 100% of fertilizer recommended rate (Fertilizer Recommendation Guide-2012) F₂: 120% of fertilizer recommended rate F₃: 140% of fertilizer recommended rate. The highest seed yield was obtained (1.60 t/ha) in plant density P₂: 67 plants/m² (25 cm × 6 cm) with the combination of high rates of fertilizer F₃: 140% of recommended fertilizer rate. The next best result was (1.50 t/ha) recorded in case of plant density P₁: 56 plants/m² (30 cm × 6 cm) with the combination of fertilizer rate F₃: 140% of recommended fertilizer rate. It indicated, high plant density with combination of recommended fertilizer reduce yield. It is concluded from the study thatf BARI Sarisha-14 in combination with plant density (25 cm x 6 cm) and high rates of fertilizer produced highest seed yield at agro- climatic condition of Mymensingh.

Key Words: Plant density, Fertilizer, Yield, Mustard and Bari Sarisha-14

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I. Introduction

Mustard (*Brassica* spp.) is one of the most important oilseed crops throughout the world after soybean and groundnut (FAO, 2010). It was originated in southern Europe from where it was introduced to

Asia and Africa (Downey and Robblene, 1989). Among the mustard producing countries, Canada occupies the first position followed by Nepal, Ukraine and Burma (FAO, 2010). Mustard covers 67% of the oilseed cropped area producing 56% of the total oilseed production (BBS, 2011). This quantity can only meet some 30% the country's edible oil requirements (BBS, 2011). Cultivation of low yielding local varieties, improper plant density and poor fertilizer management are major causes for poor yield of mustard in the country. Production of mustard can be increased by cultivating high yielding varieties. There are many varieties of mustard like Tori-7, Sonil sarisha (SS-75), Kallaynia (TS72), Sampad, Agrani, BARI Sarisha-6, BARI Sarisha-9, BARI Sarisha-12, BARI Sarisha-14, BARI Sarisha-15, SAU Sarisha-1, SAU Sarisha-2, BARI Sarisha-7, BARI Sarisha-8, BARI Sarisha-13, BINA Sarisha-3, BINA Sarisha-4. Among BARI released varieties, BARI sarisha-14 and BARI sarisha-15 are short duration which are cultivated within some 80 days. BARI sarisha-14 is cultivated in the cropping pattern of aman rice-mustard-boro rice. It is also a high yielding variety and farmers can meet their requirements within a very short period of time. Optimum spacing can play an important role in producing higher yield. Proper agronomic manipulation could elevate the yield of mustard. Poor fertilizer management also an important cause for having reduced yield of mustard. Usually, mustard is cultivated in marginal land with low fertility. By supplying proper amount of fertilizer, total production of mustard can be increased. It is reported that application of mixed fertilizers (NPKS) would help to increase seed yield in mustard (Jagvir et al., 2004). The plant density can be adjudged by the use of different doses of fertilizers. A very few research have so far been done with combined application of plant density and fertilizer doses in mustard. Therefore, the present study is undertaken to assess the effect of plant density and fertilizer rate on the performance of recently released mustard cultivar BARI Sarisha-14.

II. Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory of the Department of Agronomy, Bangladesh Agricultural University (BAU), Mymensingh, during the period from 2 October, 2015 to 17 January, 2016. The experimental site was a medium high land with well drained clay loam textured soil having 6.9 pH value. The site is located on the sub-tropical zone where temperature is moderately low and plenty of sunshine during Rabi season. BARI Sarisha-14, a new high yielding short duration variety under cruciferae family was used as test crop. Four plant densities viz., 56 plants/m² (30 cm × 6 cm), 67 plants/m² (25 cm × 6 cm), 80 plants/m² (25 cm × 5 cm), 100 plants/m² (25 cm × 4 cm) and four rates of fertilizer viz., Control (no fertilizer), 100% of recommended fertilizer rate (Fertilizer Recommendation Guide-2012) i.e; Urea = 200 kg/ha, TSP = 130 kg/ha, MoP = 120 kg/ha, Gypsum = 80 kg/ha), 120% of recommended fertilizer rate, 140% of recommended fertilizer rate were used in the experiment. The experiment was laid out in two factor split plot design with three replications. The unit plot size was 1.6m x 1.25m. Half of urea and full doses of TSP, MP and gypsum were applied as basal dose during final land preparation. Remaining half urea was applied as top dressing at the time of flower initiation stage (25 days after sowing). Hand weeding was done two times at 15 and 30 DAS. Thinning was done in all unit plots with care to maintain a constant plant population in each row. The crop was grown with all other agronomic managements as and when necessary. For the convenience of collecting data, five sample plants/plot were selected at random. The sample plants were uprooted prior to harvest and dried properly in the sun before collecting data. The seed and straw yield/plot were recorded after cleaning and drying them properly in the sun. All the collected data were analyzed with package MSTAT (Russel and Freed, 1986). The mean differences among the treatments were tested with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

III. Results and Discussion

Effect of plant density: All the crop characters were significantly influenced by plant density (Table 01). Significantly the highest seed yield (1.52 t/ha) was observed in plant density (25 cm x 6 cm) and the lowest seed yield was (1.36 t/ha) observed in plant density (25 cm x 4 cm). Seed yield variation due to different spacing was also observed by Begum (2005) and Alam (2004) in mustard. The highest Stover yield was (3.23 t/ha) observed in plant density (25 cm x 6 cm). The lowest stover yield was (2.90 t/ha) observed in plant density (25 cm x 5 cm). Number of branches/plant was significantly influenced by different plant density (Table 01). Result revealed that number of branches/plant

increased with increasing row spacing. The highest number of branches/plant was recorded as 5.0 in plant density (P₁= 30 cm× 6 cm) which was significantly greater than others. In contrast, plant density P₄ (25 cm x 4 cm) produced the lowest number of branches/plant (4.25). Similar result was also reported by [Oad et al. \(2001\)](#) in mustard who reported that increased row spacing also increased branch number/plant. Number of siliquae/plant varied significantly due to different plant density. The highest number of siliquae/plant was 52.25 in plant density P₂ (25 cm x 6 cm) and the lowest number of siliquae/plant was 43.25 in both plant density P₃(25 cm x 5 cm) and P₄ (25 cm x 4 cm).

Table 01. Effect of plant density on plant characters, yield and yield components of short duration Mustard cv. BARI Sarisha-14

| Plant density | Number of branches /plant | Number of siliquae/ plant | Siliqua length (cm) | Number of seeds/ siliqua | 1000- seed weight (g) | Seed yield (t/ha) | Stover yield (t/ha) | Biological yield (t/ha) |
|-----------------------|---------------------------|---------------------------|---------------------|--------------------------|-----------------------|-------------------|---------------------|-------------------------|
| P1 | 5.00b | 48.00b | 4.75b | 20.75b | 2.78b | 1.46b | 3.05b | 4.50b |
| P2 | 6.50a | 52.25a | 5.45a | 23.75a | 3.05a | 1.52a | 3.23a | 4.75a |
| P3 | 4.50c | 43.25c | 4.50c | 20.00c | 2.80b | 1.42b | 2.90c | 4.31c |
| P4 | 4.25d | 43.25c | 4.30d | 21.25b | 2.68c | 1.36c | 2.91c | 4.27c |
| LSD 0.05 | 0.12 | 1.32 | 0.14 | 0.71 | 0.09 | 0.05 | 0.09 | 0.12 |
| Level of significance | ** | ** | ** | ** | ** | ** | ** | ** |
| CV (%) | 4.02 | 3.03 | 3.37 | 3.54 | 4.21 | 3.12 | 3.95 | 3.01 |

**= Significant at 1% level of probability; P₁= 30 cm x 6 cm; P₂= 25 cm x 6 cm; P₃= 25 cm x 5 cm; P₄ =25 cm x 4 cm;

Effect of fertilizer: Different rates of fertilizer significantly influenced the number of seeds/siliqua (Table 02). The number of seeds/siliqua gradually increased with the increasing rates of fertilizer. The highest number of seeds/siliqua (24.75) was obtained with the application of 140% of recommended fertilizer rate. The lowest number of seeds/siliqua (18.50) was produced by the control treatment. [Mondal and Gaffer \(1983\)](#) observed that different levels of fertilizer dose had significant effect on number of seeds/siliqua. The highest seed yield (1.50 t/ha) was produced from 140% of recommended fertilizer rate (F₃). The lowest seed yield (1.36 t/ha) was found in the control treatment. The cause of yield increment might be due to higher nitrogen consumption and favorable effect of yield contributing characters of mustard. These results are in conformity with that of [Mondal and Gaffar \(1983\)](#), [Singh and Rathi \(1984\)](#), [Nang and Singh \(1985\)](#) who observed increased seed yield of mustard by increasing rate of nitrogen. Application of 140% of recommended fertilizer rate produced the highest Stover yield (3.22 t/ha) which was significantly different from all other treatments and the control treatment produced the lowest one (2.81 t/ha). [Roy et al. \(1981\)](#) and [Kumar and Gangwar \(1985\)](#) found higher dry Matter and seed yields with 120 kg N/ha respective of two spp. (*B. juncea* and *B. campestris*). Thousand seed weight of mustard was significantly affected by different rates of fertilizer dose (Table 02). The highest (2.97 g) 1000- seed weight was found in 140% of recommended fertilizer rate (F₃) and the lowest (2.62 g) 1000-seed weight was found in the control treatment.

Table 02. Effect of fertilizer rate on plant characters, yield and yield components of short duration Mustard cv. BARI Sarisha-14

| Fertilizer rate | Number of branches /plant | Number of siliquae/ plant | Siliqua length (cm) | Number of seeds/ siliqua | 1000- seed weight (g) | Seed yield (t/ha) | Stover yield (t/ha) | Biological yield (t/ha) |
|-----------------------|---------------------------|---------------------------|---------------------|--------------------------|-----------------------|-------------------|---------------------|-------------------------|
| F0 | 4.00d | 39.50d | 4.45d | 18.50d | 2.62c | 1.36c | 2.81c | 4.17c |
| F1 | 5.50b | 45.00c | 4.62c | 20.75c | 2.80b | 1.44b | 3.00b | 4.43b |
| F2 | 5.00c | 48.75b | 4.87b | 21.75b | 2.90a | 1.47ab | 3.05b | 4.52b |
| F3 | 5.75a | 53.50a | 5.05a | 24.75a | 2.97a | 1.50a | 3.22a | 4.71a |
| LSD 0.05 | 0.17 | 1.19 | 0.14 | 0.64 | 0.10 | 0.38 | 0.10 | 0.11 |
| Level of significance | ** | ** | ** | ** | ** | ** | ** | ** |
| CV (%) | 4.02 | 3.03 | 3.37 | 3.54 | 4.21 | 3.12 | 3.95 | 3.01 |

** = Significant at 1% level of probability; F₀ = Control; F₁ = 100% of fertilizer recommended rate; F₂ = 120% of fertilizer recommended rate; F₃ = 140% of fertilizer recommended rate.

Interaction effect of plant density and fertilizer: All the parameters showed significant variations due to combined effect of plant density and fertilizer except 1000 seed weight(g). Higher plant height of 82.13 cm was obtained when higher dose of fertilizer was applied. Lower plant height of 65.53 cm was found in control dose of fertilizer was applied. Rahman (2003) conducted an experiment on mustard with nitrogen and recorded the highest plant height with the plants treated with 100 kg N/ha (79.3 cm), which was about 29.36% longer than that of the control (61.3 cm). The data presented in (Table 03) showed that the number of branches/plant significantly influenced by interaction of plant density and fertilizer. The highest number of branches (7.00) was produced from the interaction of plant density P₂ (25 cm x 6 cm) and 140% recommended fertilizer. A lower number of branches/plant (3.0) was produced by the interaction of plant density P₄ (25 cm x 4 cm) and the control fertilizer. Highest number of siliquae/plant (60.0) was obtained by the combination of plant density P₂ (25 cm x 6 cm) and 140% recommendation fertilizer. The lowest number of siliquae/plant (35.00) was obtained by the interaction of plant density P₃ (25 cm x 5 cm) and the control fertilizer. Interaction of plant density and fertilizer doses was significant in respect of number of seeds/siliqua. The highest number of seeds/siliqua (26.0) was obtained in plant density P₂ (25 cm x 6 cm) with highest fertilizer rate (F₃) and lowest (17.0) was obtained in plant density P₃ (25cm x 5 cm) with the control treatment of fertilizer.

Plant density coupled with fertilizer rate showed significant effect on seed, stover and biological yields (table 03). The highest seed yield (1.60 t/ha) was obtained from the combination of plant density P₂ (25 cm x 6 cm) with 140% of recommended fertilizer rate (F₃). The lowest seed yield (1.20 t/ha) was obtained from the combination of plant density P₄ (25 cm x 4 cm) with the control fertilizer. The highest Stover yield was (3.52) found by the combination of plant density P₂ (25 cm x 6 cm) and the high rate of fertilizer (F₃ = 140%of recommended fertilizer rate). The lowest Stover yield was (2.77) observed in the combination of plant density P₄ (25 cm x 4 cm) and the control fertilizer.

Table 03. Interaction effects of plant density and fertilizer rate on plant characters, yield and yield components of short duration Mustard cv. BARI Sarisha-14

| Plant density x fertilizer rate | Plant height (cm) | Number of branches /plant | Number of siliquae/ plant | Number of seeds/ siliqua | 1000-seed weight(g) | Seed yield (t/ha) | Stover yield (t/ha) | Biological yield (t/ha) |
|---------------------------------|-------------------|---------------------------|---------------------------|--------------------------|---------------------|-------------------|---------------------|-------------------------|
| P1F0 | 70.30def | 4.00d | 40.0fg | 18.0hi | 2.6 | 1.42cde | 2.84d | 4.26de |
| P1F1 | 75.0bcd | 5.00c | 46.0de | 20.0fg | 2.8 | 1.45cde | 2.99cd | 4.44d |
| P1F2 | 78.30bc | 5.00c | 50.0c | 20.0fg | 2.8 | 1.48bcd | 3.00d | 4.48cd |
| P1F3 | 85.40a | 6.00b | 56.0b | 25.0ab | 2.9 | 1.50bc | 3.35ab | 4.85b |
| P2F0 | 65.40fgh | 5.00c | 45.0e | 21.0ef | 2.8 | 1.43cde | 2.85d | 4.28de |
| P2F1 | 75.50bcd | 7.00a | 50.0c | 23.0cd | 3.0 | 1.50bc | 3.20bc | 4.70bc |
| P2F2 | 86.70a | 7.00a | 54.0b | 25.0ab | 3.2 | 1.55ab | 3.35ab | 4.90ab |
| P2F3 | 90.10a | 7.00a | 60.0a | 26.0a | 3.2 | 1.60a | 3.52a | 5.12a |
| P3F0 | 62.40h | 4.00d | 35.0h | 17.0i | 2.6 | 1.39e | 2.78d | 4.17ef |
| P3F1 | 65.30fgh | 5.00c | 42.0f | 19.0gh | 2.7 | 1.40de | 2.89d | 4.29de |
| P3F2 | 70.10def | 4.00d | 46.0de | 20.0fg | 2.9 | 1.42cde | 2.92d | 4.34de |
| P3F3 | 74.10bcd | 5.00c | 50.0c | 24.0bc | 3.0 | 1.45cde | 3.00cd | 4.45d |
| P4F0 | 64.00gh | 3.00e | 38.0g | 18.0hi | 2.5 | 1.20f | 2.77d | 3.97f |
| P4F1 | 68.20efg | 5.00c | 42.0f | 21.0ef | 2.7 | 1.40de | 2.92d | 4.32de |
| P4F2 | 72.70cde | 4.00d | 45.0e | 22.0de | 2.7 | 1.41de | 2.95d | 4.36de |
| P4F3 | 78.90b | 5.00c | 48.0cd | 24.0bc | 2.8 | 1.44cde | 3.00cd | 4.44d |
| LSD 0.05 | 5.24 | 0.34 | 2.38 | 1.28 | 0.2 | 0.76 | 0.2 | 0.23 |
| Level of significance | * | ** | * | ** | NS | * | * | * |
| CV (%) | 4.21 | 4.02 | 3.03 | 3.54 | 4.21 | 3.12 | 3.95 | 3.01 |

** = Significant at 1% level of probability; * = Significant at 5% level of probability; NS = Not significant

P₁ = 30 cm x 6 cm; P₂ = 25 cm x 6 cm; P₃ = 25 cm x 5 cm; P₄ = 25 cm x 4 cm

F₀ = Control; F₁ = 100% of fertilizer recommended rate; F₂ = 120% of fertilizer recommended rate; F₃ = 140% of fertilizer recommended rate

IV. Conclusion

Plant density $P_2 = 67$ plants/m² (25 cm x 6 cm) and 140% of recommended rates of fertilizer were best for BARI Sarisha-14 for highest yield and it should be tested at different Agro-ecological Zones of the country.

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V. References

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