



Research in

**AGRICULTURE, LIVESTOCK and FISHERIES**

ISSN : P-2409-0603, E-2409-9325

An Open Access Peer-Reviewed International Journal

Article Code: 421/2023/RALF

Res. Agric. Livest. Fish.

Article Type: Research Article

Vol. 10, No. 3, December 2023: 269-276.

## Assessment of Yard Long Bean Varieties for Optimal Cultivation in Tropical Conditions

Md. Liton Mia<sup>1,2</sup>, Shishir Kanti Talukder<sup>1,2</sup>, Nazmul Hasan<sup>2</sup>, Prantika Datta<sup>3,1</sup>, Ragibe Afser Shawon<sup>4</sup>, Md. Towhidul Islam<sup>4</sup>, Md. Rabbir Ahmed Rakiz<sup>4</sup>, Karen Wang<sup>5</sup>, Ahmed Khairul Hsan<sup>1</sup>, Md. Shafiqul Islam<sup>1\*</sup>, and Gazi Md. Mohsin<sup>2</sup>

<sup>1</sup>Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh; <sup>2</sup>Department of Agriculture, Noakhali Science and Technology University, Noakhali-3814, Bangladesh; <sup>3</sup>Department of Soil Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh; <sup>4</sup>Department of Agroforestry, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh; <sup>5</sup>Hefei Fengle seed Co. Ltd.

\*Corresponding author: Md. Shafiqul Islam; E-mail: shafiqagron@bau.edu.bd

### ARTICLE INFO

### ABSTRACT

#### Received

22 October, 2023

#### Revised

21 December, 2023

#### Accepted

29 December, 2023

#### Online

January, 2024

#### Key words:

Yard long Bean  
Winter season  
Evaluation  
Crop performance

Yard long bean (*Vigna unguiculata*) is an important leguminous crop in tropical countries. It is a very common vegetable cultivated by the farmers of the South Asian countries including Bangladesh. The popularity of this vegetable is increasing due to its good taste and nutritive value. An experiment based on Randomized Complete Block Design (RCBD) with three replications was conducted at the Agricultural Research Field, Noakhali Science and Technology University, Noakhali, Bangladesh, from October 2021 to December 2021 to evaluate the growth and yield performance of four varieties of yard long bean. The varieties were FLK-203, FLK-204, FLK-205, FLK-206. The study revealed that the highest plant height (261.8) was recorded in the Yard-long bean FLK-206 followed by FLK-203 (239.1). The first flowering (31.33 DAP) was found in variety FLK-203 followed by variety FLK-204 (36 DAP). The highest number of pods plant<sup>-1</sup> (25.33) was found in Yard long bean variety FLK-204 followed by variety FLK-206 (18.33) plant<sup>-1</sup>. Maximum fruit length (67.56 cm) was recorded in variety FLK-206 followed by yard-long bean variety FLK-204 (56.16). The highest pod girth (1.06 cm) was in the yard long bean variety FLK-203 followed by FLK-204 (0.8 cm). Maximum number of seed pod<sup>-1</sup> (20.66) was found in variety FLK-203 followed by FLK-206 (18.66). The highest weight of 10 seeds (2.21) was found in variety FLK-206 followed by variety FLK-204 (1.16). The highest fresh weight pod<sup>-1</sup> (32.4 gm) was in the yard long bean variety FLK-203 followed by FLK-204 (24.23 gm). The highest yield pod<sup>-1</sup> (690.26 gm) was in yard-long bean variety FLK-203 followed by FLK-206 (506.2 gm). The highest pod yield ha<sup>-1</sup> (82.73 t ha<sup>-1</sup>) was recorded in yard-long bean FLK-203 followed by FLK-206 (60.73 t ha<sup>-1</sup>). So, the variety Yard long bean FLK-203 was found superior based on the overall performance for cultivation under the Argo-climatic condition of Noakhali.

**To cite this article:** Mia M. L., S. K. Talukder, N. Hasan, P. Datta, R. A. Shawon, M. T. Islam, M. R. A. Rakiz, K. Wang, A. K. Hsan, M. S. Islam, and G. M. Mohsin, 2023. Assessment of yard long bean varieties for optimal cultivation in tropical conditions. Res. Agric. Livest. Fish. 10(3): 269-276.

**DOI:** <https://doi.org/10.3329/ralf.v10i3.70996>



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## INTRODUCTION

Yard long bean (*Vigna unguiculata*) is one of the most popular vegetables in many countries of Southeast Asia. It is an important leguminous vegetable which are grown very profitably all over Bangladesh. It is cultivated to be eaten as green pods. It is mostly grown in Chattragram, Chattragram Hill Tracts (CHTs), Faridpur, Noakhali, Cumilla and Rangpur districts. At present, it is extensively grown in Dhaka, Chattragram, Cumilla, Narsingdi, and Joshore districts and also other districts of Bangladesh. Edible beans are a nutrient-dense food that is rich in folate, iron, potassium, magnesium, protein, carbohydrate, minerals, and vitamins. After soybean and groundnut, mustard (*Brassica* spp.) is the third most significant oil crop grown around the world. In Bangladesh, mustard is in high demand as an element in cooking oil. In addition to supplying a substantial number of calories (approximately 9 kcal g<sup>-1</sup>), mustard is also a rich source of the fat-soluble vitamins A, D, E, and K. From a nutritional perspective, the average person's diet should obtain between 15 and 20 percent of its calories from fats and oils. The main edible oil we use is mustard oil, which is found in seeds in a ratio of 40–45% oil to 20–25% protein (Halim et al., 2023). The total fat, trans fat, salt, and cholesterol content of beans is also minimal (Haytowitz et al., 2019; Lourenco et al., 2019). The demand for tomatoes is rising daily due to population growth, producing and exporting high-quality bean and tomatoes is another way to make a significant quantity of foreign currency (Talukder et al., 2023). Due to the high concentration of health-promoting nutrients in beans, a diet rich in beans can promote health by lowering the risk of developing heart disease, obesity, and several types of cancer. The world production of yard long bean is roughly 13,450 kg ha<sup>-1</sup>, according to the Oregon State University Commercial Vegetable Production Guide; however it is only 3640 kg ha<sup>-1</sup> in Bangladesh (Huque et al., 2012). Yard long bean are required by the world market, especially for developed countries (Ellis et al., 2006). Benchasril, (2012) reported that yard long bean is a common vegetable in Asian markets. Agriculturalists, particularly in Southeast Asian, Chinese, and Filipino cultures, try to increase production to meet high consumer demand because of its economic importance. Along with yard long bean, other legumes are an important component in the diets of humans and animals throughout the world and are cultivated under a wide range of environmental conditions. With China, total global production reaches 17 million tons. The main producers and consumers of this crop are Indonesia, India, and Turkey (FAOSTAT, 2010). In the Noakhali district, Chittagong, Bangladesh, a study was carried out to ascertain how the onion responded to applied organic and inorganic fertilizers as well as on growth, yield, and yield components of bean and lal teer king hybrid onion. The goal was to choose the best fertilizer among organic and inorganic fertilizers that give higher yield with qualitative characteristics (Talukder et al., 2023).

The main cause of low yield and acreage of yard long bean is lack of good quality seeds of modern varieties and its high cost of cultivation due to staking. In Noakhali, especially in coastal part the yard-long bean production is less due to salinity. To overcome this problem, there is a crucial need for introducing new summer vegetables or developing enough number of year-round varieties of existing vegetables. Therefore, high-yielding yard long bean varieties need to be developed through utilization of valuable and overseas germplasm collections. Considering the importance of this vegetable in the life of people, it has become necessary to carry out research with a view to increasing its production while meeting the increasing demand for vegetables. High genotypic coefficient of variation values for yield plant<sup>-1</sup>, number of pod plant<sup>-1</sup>, pod length and pod breadth and wider range of variation indicate more opportunity for selection of better varieties (Rajesh et al., 1999; Ram et al., 2005). In nature, Yard long bean exhibits great morphological and genetic variabilities and could wide released from different organization Yard long bean variety. But their yield is not in satisfactory level. Varietal performance might be helpful to overcome this problem.

## MATERIALS AND METHODS

### Experimental site

The experiment was conducted at Agricultural Research Field, Noakhali Science and Technology University, Noakhali, Bangladesh in October, 2021 in the agroecological zone Young Meghna Estuarine Floodplain (AFZ 18). The experimental field belongs to the Argo-ecological zone of the Young Meghna Estuarine Floodplain (AEZ-18). This region occupies young alluvial land in and adjoining the Meghna estuary. The sediments are highly silty, finely stratified and slightly calcareous. They are also mainly slightly saline. This tract has mainly plain land and low land, small island type and is inundated by saline water. High tide and low tide are the main characteristics of this tract. The soil is saline and alkaline pH value 7.5

### Experimental treatment

There are four exotic varieties used in this experiment. Four varieties of yard long bean FLK-203, FLK-204, FLK-205, FLK-206.

### Experimental design

The single factor experiment was laid out following Randomized Complete Block Design (RCBD) with three replications. An area of 7 m<sup>2</sup> was divided into three equal blocks. Each block was divided into 4 plots where 4 varieties were allotted at random. Thus were 12(4\*3) unit plots altogether in the experiment field. The size of each plot was 1m x 0.5m. The distance between blocks and between plots was kept 0.25m and 0.25m, respectively.

### Land preparation

The land which was selected to conduct the experiment was opened on 1 October, 2021 with the help of a power tiller and then it was kept open to sun for 7 days prior to further ploughing. Afterwards it was prepared by ploughing and cross ploughing followed by laddering. Deep ploughing was done to have a good tilth. Which was necessary for getting better yield of this crop. The weeds and stubbles were removed after each laddering. Simultaneously the clods were broken and the soil was made into good tilth.

### Preparation of plots

Individual plots were prepared with basal dose of chemical fertilizers with the help of a spade. At the same time pre sowing final weeding was done to facilitate seed germination and minimize crop weed competition.

### Seed Treatment

Seed was treated with Vitavex-200 and it was followed by the rate of @2gm kg<sup>-1</sup> of seed also treated by sun drying of seed.

### Plant protection measures

The crops were infested by insects and diseases. The insecticide Marshall 20 EC @ 30 ml/10L water was sprayed during the later stage of crop to control pests.

### Manure and Fertilizer application

The Full amount of cow dung (5 MT ha<sup>-1</sup>) and one third of Urea (6.67 kg ha<sup>-1</sup>) was applied as basal during final land preparation. Full amount of TSP (150 kg ha<sup>-1</sup>), Gypsum (10 kg ha<sup>-1</sup>), half MoP (25 kg ha<sup>-1</sup>), one third Urea (6.67 kg ha<sup>-1</sup>) were applied basally in plots and mixed with the soil one week before seed sowing. The remaining amount of Urea (6.67 kg ha<sup>-1</sup>) and MoP (25 kg ha<sup>-1</sup>) were applied as top dressing at 20 days after transplanting.

### Harvesting

The pods were harvested at edible stage. Harvesting was started on last week of November 2021 and continued up to end of December 2021.

### Collection of data

The following observations were made regarding plant growth, yield and yield attributes as affected by different types of varieties. the following parameters were recorded: Plant height, Days to first flower open, Number of pods plant<sup>-1</sup>, Length of pod (cm), Pod girth, Seed pod<sup>-1</sup>, Weight of 10 seed, Individual pod weight, Yield plant<sup>-1</sup>, Yield (t ha<sup>-1</sup>).

### Statistical analysis

The recorded data of several parameters of the study were analyzed statistically by using Microsoft office and excel 2016. Analysis of variance of different parameters was performed by the "F and T" test at 1% level of significance. The mean difference was suggested by Gomaz and Gomaz (1984).

## RESULTS AND DISCUSSION

### Variability in Agro-Morphological Traits and Yield Potential of Yard Long Bean Varieties

#### Plant height (cm)

A significant variation was observed in the fresh pod weight among the four varieties of yard long bean (Figure 1). The plant height was higher (261.8 cm) in FLK-206. The lowest (239.1 cm) plant height was found in FLK-203. The FLK-204 (244.3 cm) and FLK-5 (257.1 cm) showed the plant height in different cultivars varied mainly due to variation in characters and variety, environmental interaction of different cultivars. Similar results of variation in plant height were recorded by Varghese and Celine (2015), Saurabh *et al.*, (2018).

#### Days to first flower open

The result revealed that there a significant variation in days to first flower open among the studied varieties. First flowering is an indication of earliness of a cultivar and is highly controlled by the genetic character. This might be influenced by the growing environment like temperature, soil moisture (low or excess) and nutritional status of soil, but day length effect was minimal as yard long bean is a day neutral plant in this study there was significant variation among the cultivars regarding the number of days required from sowing to first flower opening (Figure 1). The shortest time for flowering was observed in the variety FLK-203 required 31.3 days, FLK-206 required 33 days, FLK-205 required 34 days, FLK-204 required 36 days to first flowering respectively. The result was found significant in case of days taken to first flowering. The number of days required from sowing to first flowering varied from 31.3 to 36 days. The variation in days to first flowering among the cultivars was mainly due to the variation in genetic makeup of the different cultivars and environmental condition. These results are similar with the findings of (Hossain, *et al.* 2013). They worked with Fifty-six varieties of yard long bean (*Vigna unguiculata ssp.*) were investigated to understand the extent of genetic diversity through 20 agro-morphogenic characters and reported that the first flowering occurred from 30-40 days after sowing.

#### Number of pods plant<sup>-1</sup>

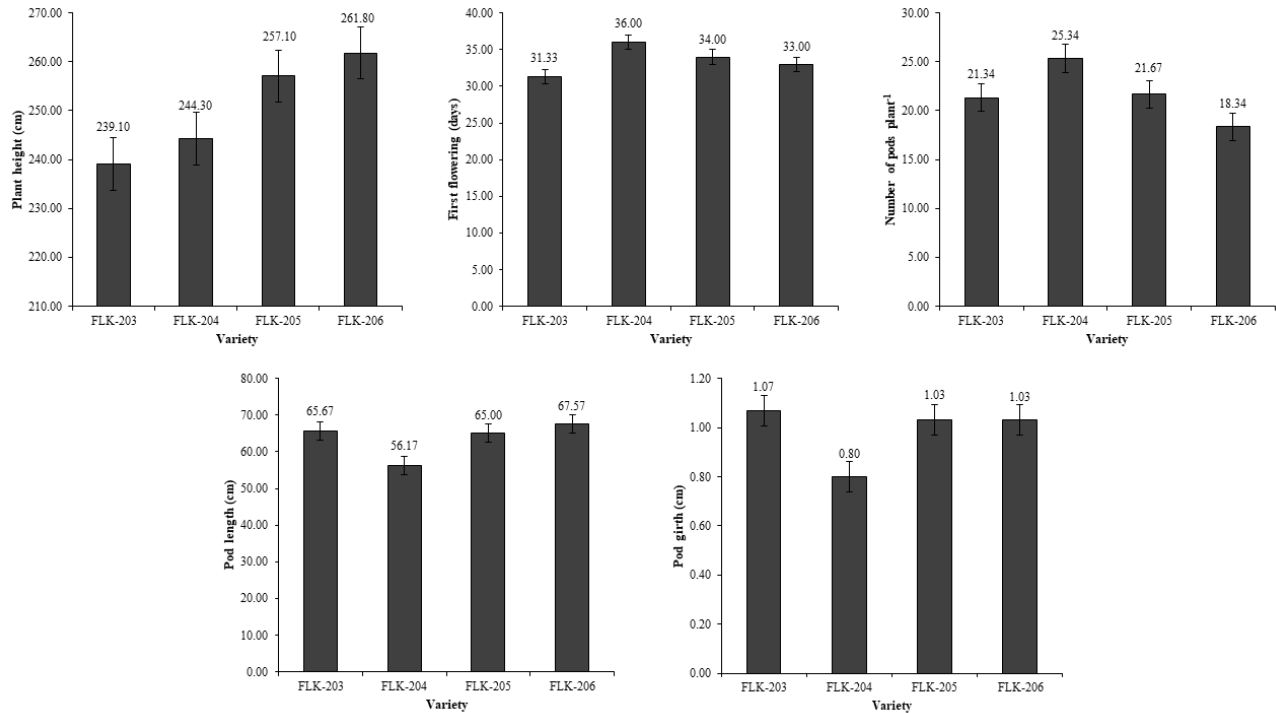
Number of pods plant is one of the most important yield components yards long and this can contribute maximum to the seed yield as well as fresh yield. The result revealed that there was a significant variation in number of pods plant<sup>-1</sup> among the varieties. The highest number of pods plant<sup>-1</sup> was obtained from yard long bean FLK-204 (25.34) plant<sup>-1</sup>. The FLK-206 produced the minimum number of pods plant<sup>-1</sup> (18.34) (Figure 1). Variation of pod number among the cultivars was possibly due to differences in genetic makeup of the different cultivars resulting from number of branches plant<sup>-1</sup> and environmental condition. These results are not similar with the findings of (Hossain *et al.*, 2013). They worked with Fifty-six varieties of yard long bean (*Vigna unguiculata ssp.*) were investigated to understand the extent of genetic diversity through 20 agro-morphogenic characters and reported that the fruit plant<sup>-1</sup> was recorded for Tokii (40.22), Saba (39.55), yard long bean 1070 (43.64), white Beauty (42.34) and Lalbeni (41.21).

#### Pod length (cm)

From the mean value of pod length of all four varieties we found out significant variation in fruit length of different varieties. Pod length of yard long bean contributes a lot to its fresh yield but very few to its seed yield because, pod length affects seed fruit<sup>-1</sup> very little, in this study the varieties showed significant difference, among them in respect of fruit length which varied from 56.16 cm to 67.56 cm (Figure 1). The highest pod length was found in variety of yard long bean FLK-206 (67.566 cm) while, the shortest pod length was observed in FLK-204 (51.16 cm). This variation in pod length might be due to the inherent genetic differences among the varieties and environmental condition. (Choudhury *et al.*, 2010) found that maximum fruit length was recorded in White Beauty (72.33 cm) and minimum fruit length was found in Ky Bush (40.7 cm). Hossain *et al.* (2013) found that fruit length in Lalbeni (49.577 cm), Tokii (63.76 cm), Saba (55.68 cm), Yard long bean 1070 (58.44 cm) and White Beauty (49.77 cm). These results were not similar with present study. It may happen due to difference of varieties as well as the environment and genotypic characters and environmental condition.

### Pod girth (cm)

A significant variation was observed in the fresh pod girth among the four varieties of yard long bean. The pod girth was higher (1.07 cm) in FLK-203 variety. The lowest (0.8 cm) was found in FLK-204. The FLK-205 variety (1.03 cm) and FLK-6 variety (1.03 cm) showed the pod girth (Figure 1). Pod girth in different cultivars varied mainly due to variation in characters and variety, environmental interaction of different cultivars. Similar results of variation in pod length and girth were reported by Vidya et al., (2002) Saurabh et al., (2018.)



**Figure 1.** Comparison on plant height (cm), days to first flower open, number of pods plant<sup>-1</sup>, pod length (cm), pod girth (cm) among different varieties of Yard long bean

### Seed pod<sup>-1</sup>

From the mean value of seed pod<sup>-1</sup> of all four varieties we found out significant variation in seed pod<sup>-1</sup> of different varieties. Number of seed pod<sup>-1</sup> significantly among the variety FLK-203 produced the highest number of seeds fruit<sup>-1</sup> (20.66) which is statistically superior to rest of the varieties. FLK-206 produced the lowest number of seed fruit<sup>-1</sup> (18.66) (Figure 2), while all other varieties produced statistically similar seed fruit<sup>-1</sup>. Though the number of seed fruit<sup>-1</sup> varied significantly the extent of variation is not much higher the character is strongly controlled by the gene action and did not influence considerably by the length of the fruit. The result indicates that the variation in seed fruit<sup>-1</sup> is mostly due to the differences of growing environment rather than genetic characters. (Haque et al., 2010) found that maximum seed fruit<sup>-1</sup> was recorded in White Beauty and Lalbeni (17.67) and minimum number of seed fruit<sup>-1</sup> was found in yard long bean 1070 (15.67). (Hossain et al. 2013) found that seed fruit<sup>-1</sup> in Lalbeni (16.155), Tokii, Saba, Yard long bean 1070 respectively (15.508) and White Beauty (15.407). These results were not similar with all of varieties seed fruit<sup>-1</sup>. It may be happened due to difference of varieties as well as the environment and different genotypic characters.

### Weight of 10 seed (gm)

10 Seed Weight of yard long bean was significantly influenced by different seed priming varieties (Figure 2). The value of 10 seed weight was higher (2.21g) in FLK-206 variety. The lowest (1.16g) 10 seed weight was found in FLK-204 variety. The FLK-203 variety (2.07g), and FLK-205 (1.33g) showed the moderate 10 seed weight.

### Individual pod weight (gm)

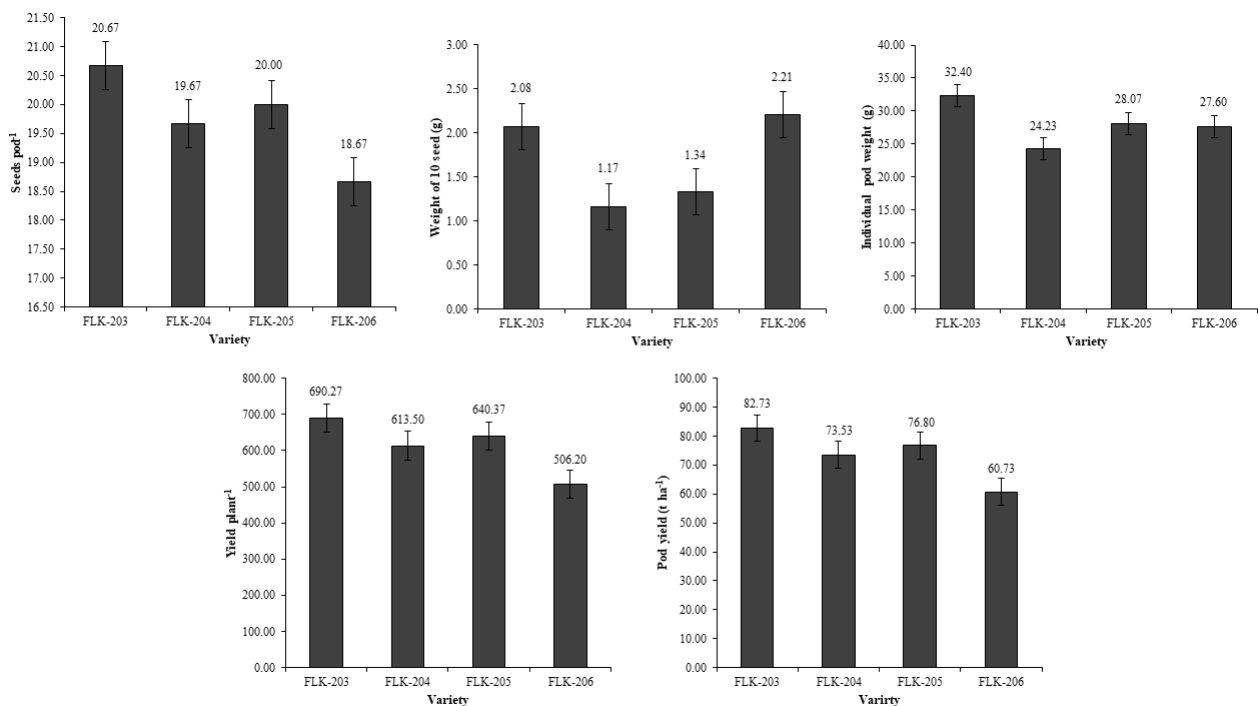
A significant variation was observed in the fresh pod weight among the four varieties of yard long bean (Figure 2). The highest fresh pod weight was found from varieties Yard long bean FLK-203 (32.4 gm) and the lowest fruit weight (24.23 gm) was found from FLK-204. Significant response was found in case of fresh weight of each fruit among different varieties. (Hossain et al., 2013) found that fresh weight fruit<sup>-1</sup> in Lalbeni (18.76 gm), Tokii, Saba, Yard long bean 1070 respectively (23.140 gm) and White Beauty (18.433 gm). The present results were not similar with all of fresh fruit weight of the study.

### Yield plant<sup>-1</sup>

Yield plant<sup>-1</sup> of yard long bean was significantly influenced by different seed priming varieties. The yield plant<sup>-1</sup> was higher (690.267 gm) in FLK-203 variety. The lowest (506 gm) yield plant<sup>-1</sup> was found in FLK-206 variety. The FLK-204 variety (613.5 gm), and FLK-205 (640.366 gm) showed the moderate yield plant<sup>-1</sup> (Figure 2). This might be due to some biochemical and physiological changes brought about by seed soaking (Khan et al., 2002).

### Pod yield (t ha<sup>-1</sup>)

The yield of the four varieties of yard long bean was shown in (Figure 2) graphically. Yield status of a crop variety is of prime importance as this indicates whether the variety could be satisfied through production or not in this study fruit yield ha<sup>-1</sup> showed significant variation due to cultivar differences. The highest fruit yield ha<sup>-1</sup> was found in Yard long bean FLK-203 (82.73 t ha<sup>-1</sup>) While the lowest yield ha<sup>-1</sup> (60.733 t ha<sup>-1</sup>) was produced by FLK-206. Another variety FLK-204 (73.53 t ha<sup>-1</sup>), FLK-205 (76.8 t ha<sup>-1</sup>) showed yield. Fruit yield in different cultivars varied mainly due to variation in characters and variety, environmental interaction of different cultivars. (Hossain et al., 2013) found that yield of fruit ha<sup>-1</sup> in Lalbeni (13.44 t ha<sup>-1</sup>), Tokii, Saba, Yard long bean 1070 respectively 14.55 t ha<sup>-1</sup>, 14.43 t ha<sup>-1</sup>, 15.33 t ha<sup>-1</sup> and White Beauty (14.21 t ha<sup>-1</sup>). The results were not matched with the present study. The present finding is significant in case of all reported varieties on yield ha<sup>-1</sup>. It may happen due to difference of varieties as well as the environment and genotypic characters. We may show this variation of yield ha<sup>-1</sup> by the following bar diagram. In which horizontal axis shows the varieties and vertical axis shows yield ha<sup>-1</sup>.



**Figure 2.** Comparison on seed pod<sup>-1</sup>, weight of 10 seed (gm), individual pod weight (gm), yield plant<sup>-1</sup>, pod yield (t ha<sup>-1</sup>) among different varieties of Yard long bean



## CONCLUSION

In conclusion among the four varieties most of the varieties perhaps were not able to show their full yield potentiality due to the new environment of the Experiment site in Bangladesh and during the experimental time yield performance of the varieties hampered due to heavy rainfall. It also indicated that the overall best performance and highest financial benefit could be obtained by Yard long bean FLK-203. So, it may be concluded that the Yard-long bean FLK-203 is the best variety among the four varieties for cultivation in Noakhali region.

## ACKNOWLEDGEMENT

The authors would like to thank the Department of Agriculture at Noakhali Science and Technology University for providing logistical help for this study.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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