Published with Open Access at Journal BiNET
Vol. 32, Issue 01: 2629-2635
Journal of Bioscience and Agriculture Research
Journal Home: www.journalbinet.com/jbar-journal.html

Adaptive yield performance of BARI potato varieties at hill valleys of Bandarban

Mohammad Tanharul Islam[1], Fahim Arshad[1], Md. Imam Hossain[1], Riffat Afrin Kanta[2], A. K. M. Iamus Shaum[3] and A. F. M. Jamal Uddin[3]

[1]On Farm Research Division, Bandarban, Bangladesh Agricultural Research Institute, Bangladesh
[2]On Farm Research Division, Cox's Bazar, Bangladesh Agricultural Research Institute, Bangladesh
[3]Department of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh

✉ For any information: mdtanharulislam@gmail.com (Islam, MT)
Article received: 20.12.2023; Revised: 20.01.2024; First published online: 15 February, 2024

ABSTRACT

A varietal trial was conducted at farmers' fields of Reicha and Sharnamondir in the hill district of Bandarban, during 2022-23 to evaluate the performance of BARI Potato varieties. A total of ten varieties viz. BARI Alu-7, BARI Alu-25, BARI Alu-36, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-48, BARI Alu-56, BARI Alu-62 and BARI Alu-79 were tested in the farmer's field. The experiment was carried out in a randomized complete block design with six dispersed replications. Significant differences were found in different yield attributes among the potato varieties. The maximum yield per hill was obtained from BARI Alu-36 (550 g) and the minimum from BARI Alu-25 (230 g), while the overall highest yielder was BARI Alu-41 (32.35 t/ha) and the lowest was BARI Alu-7 (22.57 t/ha). From the farmers' perspective in the Bandarban region, they are interested in growing high-yielding potato varieties with different shapes and colors to meet various consumer demands. Therefore, BARI Alu-41, BARI Alu-79, BARI Alu-56, BARI Alu-40 and BARI Alu-37 can be recommended to guarantee them a higher income to improve their socioeconomic status.

Key Words*: BARI potato, Food security, Hill valley, Varietal trial and Yield potential.*

Cite Article: Islam, M.T., Arshad, F., Hossain, M. I., Kanta, R. A., Shaum, A. K. M. I. and Uddin, A. F. M. J. (2024). Adaptive yield performance of BARI potato varieties at hill valleys of Bandarban. Journal of Bioscience and Agriculture Research, 32(01), 2629-2635.
Crossref: https://doi.org/10.18801/jbar.320124.317

I. Introduction

Potato (*Solanum tuberosum* L.), an autotetraploid (2n = 4x = 48) plant from the *Solanaceae* family, vegetatively propagated, short-day, C_3 plant, yields edible tubers. It is grown in temperate, subtropical and tropical regions (Bali et al., 2018). Potatoes provide essential nutrients to the human diet and are considered wholesome, nutritious and non-fattening (Kumari et al., 2018). It is an essential part of the global food system that is sustainable and produces more food energy on a smaller area of land than maize, wheat and rice. In Bangladesh, potatoes are becoming the most popular food crop because of their numerous uses as vegetables and delicious processed goods (Saha and Hossain, 2011). Moreover, compared to other cereal crops, potatoes yield higher dry matter and protein per hectare (Kumari et al., 2018; de Haan and Rodriguez, 2016).

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2024 The Authors, Research paper

In Bangladesh, as a vegetable, potato accounts for up to 54% of the nation's yearly vegetable production. In terms of area and output, potatoes are the most popular and highest-yielding vegetable in Bangladesh, with a total production of 112 million metric tons on an area of 4,60,245 hectares and with an average yield of almost 23.50 metric tons per hectare (AIS, 2022). In our country, about 91 potato varieties are available (BARI, 2019). Comparing Bangladesh's average national potato yields to those of other potato-growing countries like France, Germany, the UK, the USA and the Netherlands, however, reveals a considerable difference; for instance, two and a half times more potatoes are produced in the UK than in Bangladesh (around 48 MT/ha) (Saha and Hossain, 2011). One way to reduce this yield gap could be to use high-yielding cultivars.

In Bandarban hill valleys, different local potato cultivars are being grown whose yield potential is very low. Bangladesh Agriculture Research Institute (BARI) has developed many high-yielding potato varieties. These varieties are well-known for their appealing color, form, extended shelf life and potential for higher yield, which also could lead to a rapid increase in farmers' income. However, their adaptation in this hilly region is unknown as no trial was conducted before. Hence, this varietal trial was carried out to determine the suitability of BARI-released potato varieties in the hill valleys of Bandarban.

II. Materials and Methods

Experimental site

Farmers' fields were chosen to conduct the trial in two different places, Reicha and Sharnamandir of Bandarban Sadar, in the rabi season of 2022-2023. The highest temperature during the experimental period was approximately 30.51°C and the lowest was 13.0°C. Total precipitation of approximately 40 mm and average humidity of 82% was recorded during the growing period.

Experimental design and treatments

Ten varieties were used as experimental materials viz. BARI Alu-7, BARI Alu-25, BARI Alu-36, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-48, BARI Alu-56, BARI Alu-62 and BARI Alu-79. These varieties were collected from the Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. The study was constructed with six dispersed replications in a Randomized Complete Block Design (RCBD). Unit plot size was 2 m × 3 m.

Crop management

Urea, Triple super Phosphate, Muriate of potash, Gypsum and Boron were applied to the plots for potato cultivation at the rate of 350kg, 200kg, 250kg, 100kg and 6 kg ha^{-1}, respectively along with 10 tons of cowdung per hectare (BARC, 2018). Half of urea and the rest of the fertilizers were added as basal doses during the final land preparation. The remaining urea was applied at 35 DAS (days after sowing). Potato tubers were planted as planting material with a 60 cm × 25 cm spacing on December 4, 2022. Weeding was done manually from 15 DAS until the final harvest to keep the plots clean. At the time of the final land preparation, Furadan (Carbofuran) 5 G@20 $kgha^{-1}$ was used to control cut warm. After 45 days of planting, light irrigation was given. Again, after 50 and 60 days of planting, a fungicide (secure@2 g/L water) was sprayed to avoid late blight infestation due to vulnerable foggy weather. The crops were harvested from 25 February 2023 to 29 February 2023.

Data collection and analysis

Data on different growth and yield contributing characters were recorded from the sample plants of each plot during the experiment. Ten plants were randomly selected from each plot to record data**.** The statistical analyses were conducted using the STATA 10 statistical program. The analysis of variance (ANOVA) was conducted to assess the differences between treatments. The Least Significance Difference (LSD) test, as Gomez and Gomez (1984) proposed, was employed at a 5% level of significance. The dendrogram was constructed by using SPSS statistical software (version 26).

III. Results and Discussion

Morphological characteristics

Great diversity was shown in the shape, flesh and skin color, of these potato varieties (Table 01 and Figure 01) at 90 DAP under experimental conditions. BARI Alu-40, BARI Alu-41 and BARI Alu-48 were round, while BARI Alu-7, BARI Alu-25, BARI Alu-36, BARI Alu-37, BARI Alu-56, BARI Alu-62 and BARI

Published with open access at journalbinet.com
EISSN: 2312-7945, © 2024 The Authors, Research paper

Alu-79 produced oval shape tuber. The skin red color was observed in BARI Alu-25, BARI Alu-36, BARI Alu-41, BARI Alu-56 and BARI Alu-79; the rest are light yellow. Alom et al. (2003) found different colors and shapes in different varieties of potatoes.

Table 01. Morphological characteristics of selected varieties under study.

Variety	Growth habit	Tuber shape	Skin color
BARI Alu-7	Spready	Oval	Light yellow
BARI Alu-25	Spready	Oval	Red
BARI Alu-36	Spready	Oval	Red
BARI Alu-37	Spready	Oval	Light yellow
BARI Alu-40	Spready	Round	Light yellow
BARI Alu-41	Spready	Round	Red
BARI Alu-48	Spready	Round	Light yellow
BARI Alu-56	Spready	Oval	Red
BARI Alu-62	Spready	Oval	Light yellow
BARI Alu-79	Spready	Oval	Red

Figure 01. Tubers of 10 selected potato varieties at 90 DAP under experimental conditions.

Plant height

There are significant differences in plant height between cultivars (Table 02). The BARI Alu-25 variety had the tallest plant (65.10 cm), whereas the BARI Alu-79 variety had the shortest plant (54.25 cm). Plant height variations within the same variety may have been related to planting materials in several studies. According to Alom et al. (2003), plant height ranged from 44.91 to 31.42 cm, with Chamak having the lowest height at 31.42 cm and Binella having the highest at 44.91 cm. Plant height is determined by the plant's genetic makeup and its appropriate growth. As salinity increased, plant height, leaf area and fresh weight accumulation decreased (Heuer and Nadler, 1995).

Number of stems per hill

There was no discernible difference in the number of stems per hill amongst the 10 chosen varieties (Table 02). The highest number of stems per hill (5.70) was found in BARI Alu-41, followed by BARI Alu-40 (5.60) and BARI Alu-37 (5.30). BARI Alu-36 has the fewest stems per hill (3.80). According to studies (Alom et al. 2003), different cultivars had stem per hill numbers ranging from 4.50 (Cardinal) to 1.5 (Charlotte).

Days to maturity

The differences between the required days for maturity were negligible. The variety BARI Alu-36 had a minimum maturity period of 86.30 days, whereas the variety BARI Alu-25 had a reported maturity period of 95.10 days, followed by the variety BARI Alu-7 (93.50 days). The trial revealed that BARI Alu-36 was the earliest variant and most instances required 86.30 days (Table 2). Days to maturity ranged from 75 to 94 days, with Heera having the lowest days to maturity (75 days) and KufriSindhuri having the highest days to maturity (94 days), according to Alom et al. (2003).

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2024 The Authors, Research paper

Number of tubers per hill

Varietal differences existed concerning the number of tubers per hill. The maximum number of tubers per plant was found in BARI Alu-56 (15.70) and the lowest was in BARI Alu-79 (5.60). Tesfaye et al. (2012) found significant variation among the cultivars for tuber number per plant, where the highest number of tubers per plant (10.93) was recorded from the Chala cultivar and the lowest (6.7) in the Badsha cultivar.

Tuber length and diameter

The highest tuber length was observed in BARI Alu-7 (9.57), although the highest tuber diameter was found in BARI Alu-36 (5.63). The lowest tuber length resulted from BARI Alu-41 (5.07) and the lowest tuber diameter was observed from BARI Alu-25 (4.10), these results varied from previous field trials (BARI, 2019) due to different soil textures in hill regions.

Table 02. Yield contributing characteristics of selected varieties under study

Variety	Plant height at 60 DAS	Number of stems per hill	Days to maturity	Number of tubers per hill	Tuber length (cm)	Tuber diameter (cm)
BARI Alu-7	60.40	4.70	93.50	7.50	9.57	5.27
BARI Alu-25	65.10	4.10	95.10	8.20	5.90	4.10
BARI Alu-36	61.55	3.80	86.30	9.60	8.30	5.63
BARI Alu-37	56.31	5.30	87.90	7.20	6.13	4.47
BARI Alu-40	62.74	5.60	86.40	9.00	6.87	4.57
BARI Alu-41	64.79	5.70	90.20	14.40	5.07	4.23
BARI Alu-48	59.88	4.20	88.90	11.80	5.80	4.80
BARI Alu-56	62.35	4.80	90.10	15.70	5.37	4.87
BARI Alu-62	60.09	4.20	92.80	8.40	6.87	5.10
BARI Alu-79	54.25	4.90	87.10	5.60	7.80	5.43
LSD (0.05)	3.70	0.82	2.90	1.31	0.48	0.29
CV%	11.91	14.30	9.04	13.57	7.91	8.95

Individual tuber weight

Individual tuber weights of the varieties varied markedly (Table 03). Individual tuber weight ranges from 44.80g to 111.30g. The maximum individual tuber weight was found from BARI Alu-7 (111.30 g) and the minimum individual tuber weight was BARI Alu-41 (44.80 g). Healthy tuber formation requires better vegetative growth, which can differ by the soil status of different regions.

Yield per hill

The yield per hill of the varieties varied markedly (Table 03). Yield per hill ranges from 550g to 230g. The maximum yield per hill was found from BARI Alu-36 (550 g) and the minimum yield per hill was BARI Alu-25 (230 g). The observations of this experiment support the results of Akassa et al. (2014), who reported that the tuber weight per hill ranged from 425.7 to 683.3 g.

Table 03. Yield performance of selected varieties under study

Variety	Individual tuber weight (g)	Yield per hill (g)	Dry matter % (tuber)	Yield (t/ha)
BARI Alu-7	111.30	430.00	12.89	22.57
BARI Alu-25	55.20	230.00	13.90	23.90
BARI Alu-36	110.10	550.00	15.31	26.41
BARI Alu-37	64.10	260.00	19.20	28.15
BARI Alu-40	68.10	350.00	20.91	30.98
BARI Alu-41	44.80	270.00	22.17	32.35
BARI Alu-48	62.70	430.00	16.10	30.15
BARI Alu-56	61.30	450.00	18.51	31.30
BARI Alu-62	102.60	460.00	16.91	26.76
BARI Alu-79	93.40	350.00	17.88	31.65
LSD (0.05)	21.75	48.13	1.97	1.55
CV%	11.09	15.62	10.84	14.37

Published with open access at journalbinet.com
EISSN: 2312-7945, © 2024 The Authors, Research paper

Percent dry matter content

The dry matter content (%) of the tuber of the selected 10 varieties varied markedly (Table 03). The maximum dry matter content (%) of tuber was found from BARI Alu-41 (22.17%) and the minimum individual tuber weight was BARI Alu-7 (12.89%).

Yield

In the case of tuber yield, different varieties display marked variation (Table 03). BARI Alu-41 yielded (32.35 t/ha) the highest. Conversely, the lowest yield was recorded from BARI Alu-7 (22.57 t/ha). The yield of most of the varieties was within the range of 22.57 to 32.35 t/ha (Figure 02). Rahman et al. (2021) also found a similar yield range from 20.98 to 29.75 t/ha in some BARI potato varieties grown under different saline conditions.

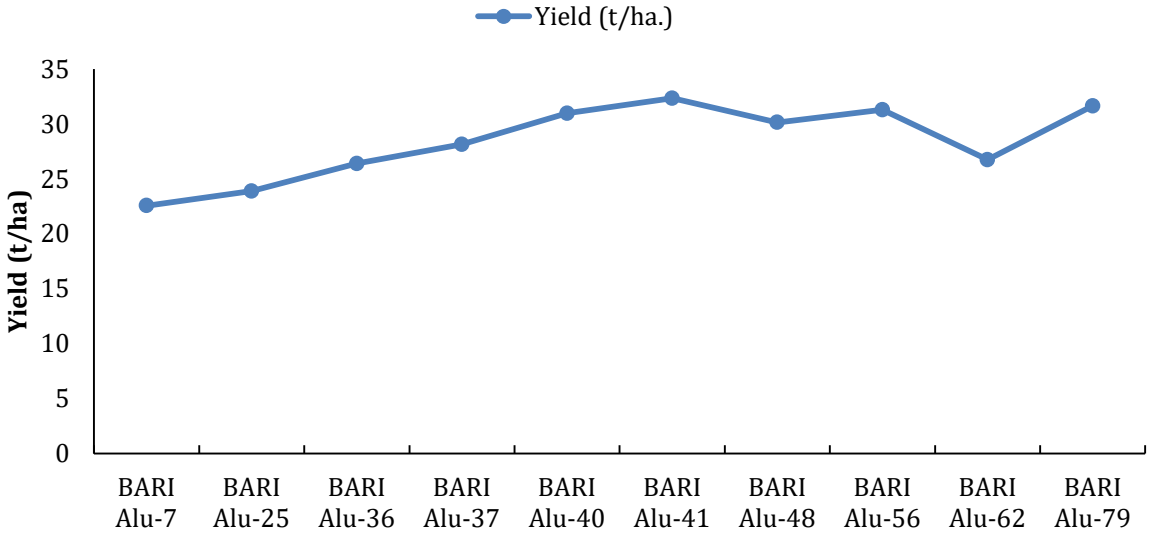

Figure 02. Varietal effect on yield performance

Bi-plot for selected 10 varieties shows a relatively positive trend for BARI Alu-25, BARI Alu-37, BARI Alu-40, BARI Alu-41, BARI Alu-56 and BARI Alu-79 indicates higher adaptability and positive yield performance in the hilly regions of Bandarban (Figure 03).

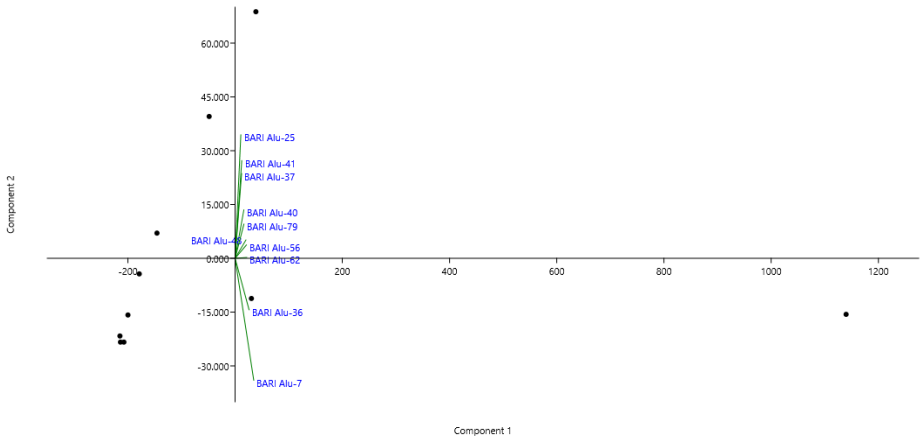

Figure 03. Bi-plot of yield and yield contributing characteristics of selected 10 potato varieties.

Clustering of Potato Varieties through Multivariate Analysis

Potato varieties must possess specific morphological and agronomic characteristics to be recommended to the farmers in the trial area. This makes gathering, describing and assessing remnant local yield performance necessary. The cluster analysis creates a hierarchical classification by visualizing many types based on similarities. (Haydar et al., 2006). To make statistically homogenous groups, cluster analysis was done using ten yield and yield contributing characteristics for clustering 10 potato varieties. So, the dendrogram was prepared on the basis of hierarchical clustering procedure and cluster analysis (Figure 04). Considering the selected yield contributing characteristics, 4 clusters were formed.

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2024 The Authors, Research paper

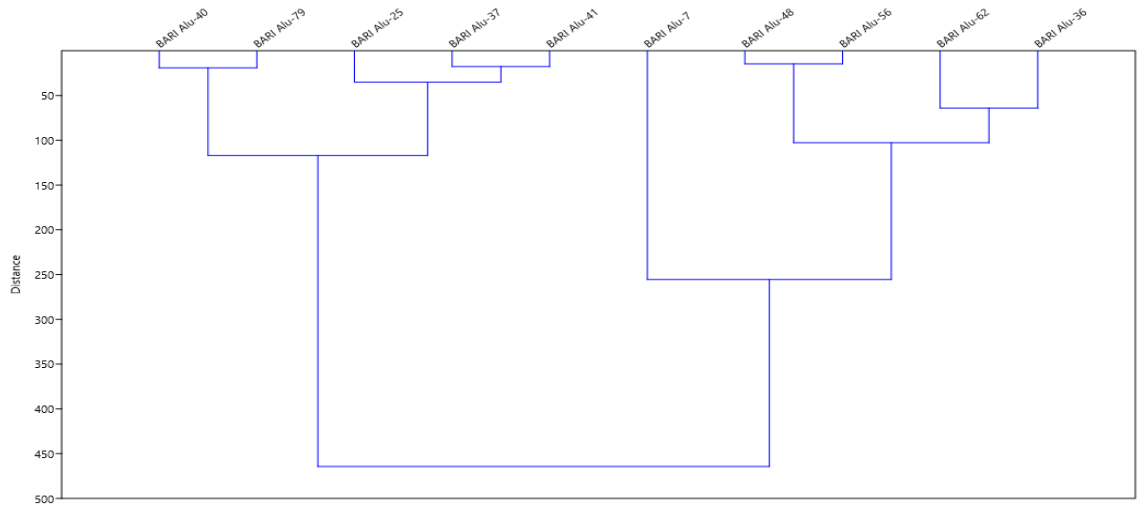

Figure 04. Dendrogram (Ward's method) of yield and yield contributing characteristics of selected 10 potato varieties.

Cluster I comprised two varieties, i.e., BARI Alu-40 and BARI Alu-79, representing 9.3% of the total plant materials. Cluster II contained three varieties, BARI Alu-25, BARI Alu-37 and BARI Alu-41, which account for 19.7% of the population. Cluster III includes one variety, BARI Alu-7, representing 5.0% of the total varieties. Cluster IV comprised four potato varieties, i.e., BARI Alu-48, BARI Alu-56, BARI Alu-62 and BARI Alu-36, contributing 66.0% of the total population. Similar trends were also observed by Kundu et al. (2019).

Farmers' opinion

Farmers in the Bandarban region are interested in growing high-yielding BARI potato varieties; hence, local cultivars have very low yield potential. They have high hopes that most of the BARI potato varieties will ensure higher productivity.

IV. Conclusion

In this study, BARI potato varieties have shown outstanding performance in terms of yield, attractive color and shape. Therefore, cultivating BARI Alu-41, Alu-79, BARI Alu-56, BARI Alu-40 and BARI Alu-37 varieties could ensure high farm productivity and income for the local farming community.

V. References

[1]. AIS. (2022). 2020-21, Orthobosore Nirdharito Lokkhomatra Orjon. Krishi Diary, Agricultural Information Service. Director of Agriculture Extension, 8-13.

[2]. Akassa, B., Belew, D. and Debela, A. (2014). Yield and quality of potato seed tuber as influenced by inter and intra row spacing at Bako, western Ethiopia. Journal of Biological Sciences, 14(6), 431-435. https://doi.org/10.3923/jbs.2014.431.435

[3]. Alom, M. K., Zaman, M. M., Nazrul, M. I., Alam, M. S. and Hossain, M. M. (2003). Performance of some exotic potato varieties under Bangladesh conditions. Asian Journal of Plant Sciences, 2(1), 108-112. https://doi.org/10.3923/ajps.2003.108.112

[4]. Bali, S., Patel, G., Novy, R., Vining, K., Brown, C. and Holm, D. (2018). Evaluation of genetic diversity among Russet potato clones and varieties from breeding programs across the United States. PLoS ONE. 13(8), e0201415. https://doi.org/10.1371/journal.pone.0201415

[5]. BARC. (2018). Fertilizer Recommendation Guide-2018. Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka 1215. 223p.

[6]. BARI Developed Technology, (2019). Bangladesh Krishi Gobeshona Institute kortik udhvabita Fasaler Jatsomuha, 54-55.

[7]. De Haan, S. and Rodriguez, F. (2016). Potato Origin and Production. In: Advances in Potato Chemistry and Technology. Academic Press, San Diego. p1-32. https://doi.org/10.1016/B978-0-12-800002-1.00001-7

Published with open access at journalbinet.com
EISSN: 2312-7945, © 2024 The Authors, Research paper

[8]. Gomez, K. A. and Gomez, A. A. (1984). Statistical procedure for agricultural research (2nd ed), 44(1–17), 28–192.
[9]. Haydar, A., Ahmed, M. B., Hannan, M. M., Razvy, M. A., Mandal, M. A., Salahin, M., Karim, R. and Hossain, M. (2007). Analysis of genetic diversity in some potato varieties grown in Bangladesh. Middle-East Journal of Scientific Research, 2(3-4), 143-145
[10]. Heuer, B. and Nadler, A. (1995). Growth and development of potatoes under salinity and water deficit. Australian Journal of Agricultural Research, 46, 1477-1486. https://doi.org/10.1071/AR9951477
[11]. Kumari, M., Kumar, M. and Solankey, S. S. (2018). Breeding Potato for Quality Improvement. InTech. https://doi.org/10.5772/intechopen.71482
[12]. Kundu, B. C., Kawochar, M. A., Naznin, S., Mostafa, M., Delowar, H. K. M. and Rashid, M. H. (2019). Morphological characterization and diversity analysis of some BARI released potato varieties. Azarian Journal of Agriculture, 6, 112-120. https://doi.org/10.29252/azarinj.015
[13]. Rahman, M., Rashid, H., Shahadat, M. K., Topu, A. A., Hossain, A. and Nihad, S. A. I. (2021). Field performance of some potato varieties under different saline conditions of Bangladesh. African Journal of Agricultural Research, 17, 1480-1487. https://doi.org/10.5897/AJAR2021.15578
[14]. Saha, K. M. and Hossain, M. S. M. (2011). An analysis of present production and marketing situation in Bangladesh. Newsletter - Hortex Foundation, 11.1-8
[15]. Tesfaye, G., Derbew, B. and Solomon, T. (2012). Yield and growth parameters of potato (*Solanum tuberosum* L.) as Influenced by Intra Row spacing and time of earthing up. International Journal of Agricultural Research, 7(5), 255-265. https://doi.org/10.3923/ijar.2012.255.265

HOW TO CITE THIS ARTICLE?

Crossref: https://doi.org/10.18801/jbar.320124.317

MLA
Islam, M. T. et al. "Adaptive yield performance of BARI potato varieties at hill valleys of Bandarban". Journal of Bioscience and Agriculture Research, 32(01), (2024): 2629-2635.

APA
Islam, M. T., Arshad, F., Hossain, M. I., Kanta, R. A., Shaum, A. K. M. I. and Uddin, A. F. M. J. (2024). Adaptive yield performance of BARI potato varieties at hill valleys of Bandarban. *Journal of Bioscience and Agriculture Research*, 32(01), 2629-2635.

Chicago
Islam, M. T., Arshad, F., Hossain, M. I., Kanta, R. A., Shaum, A. K. M. I. and Uddin, A. F. M. J. "Adaptive yield performance of BARI potato varieties at hill valleys of Bandarban". Journal of Bioscience and Agriculture Research, 32(01), (2024): 2629-2635.

Harvard
Islam, M. T., Arshad, F., Hossain, M. I., Kanta, R. A., Shaum, A. K. M. I. and Uddin, A. F. M. J. 2024. Adaptive yield performance of BARI potato varieties at hill valleys of Bandarban. Journal of Bioscience and Agriculture Research, 32(01), pp. 2629-2635.

Vancouver
Islam, MT, Arshad, F, Hossain, MI, Kanta, RA, Shaum, AKMI and Uddin, AFMJ. Adaptive yield performance of BARI potato varieties at hill valleys of Bandarban. Journal of Bioscience and Agriculture Research, 2024 February, 32(01): 2629-2635.

Published with open access at journalbinet.com
EISSN: 2312-7945, ©2024 The Authors, Research paper