Performance of BAU Amloki-1 at three upazilla in northern region and BAU-GPC of Bangladesh

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Abstract: Experiments were conducted using BAU Amloki-1 at three upazilla of Northern region and BAU–GPC of Bangladesh during the period from July 2009 to June 2013 to study plant morphology, yield and yield attributing characters. Statistical analysis of the data revealed that BAU Amloki–1 were perform better under Palashbari, Gaibandha region than that of other studied locations as well as the tallest plant (1.99, 2.67 and 3.43 m), maximum leaves (803.25, 1242.20 and 1491.83 plant^{-1}), maximum branches (11.48, 20.79 and 23.16 plant^{-1}) and higher canopy (1.90, 2.45 and 3.56 m^3) were exhibited under this locations in 2010, 2011 and 2012m, respectively. Gaibandha Sadar had also showed superior results on fruits number at first (57.31 and 76.89 plant^{-1}) and second harvest (41.28 and 59.64 plant^{-1}), harvested (94.18 and 123.08 plant^{-1}) and fresh fruit (89.29 and 112.13 plant^{-1}) as well as higher fruit yield (1.99 and 2.57 kg plant^{-1}) in 2011 and 2012, respectively. From the above investigation, it was found that BAU-GPC released BAU Amloki–1 was the most productive due to its higher adaptability under Gaibandha Sadar area than other regions. So, therefore, Palashbari, Gaibandha was the most selective are for obtaining the greater yield of BAU Amloki-1.
Key words: Performance, BAU Amloki-1, Northern region, BAU-GPC.

Introduction

Aonla (*Emblica officinalis* Gaertn.) belongs to the family Euphorbiceae is indigenous to tropical Asia and it can be successfully grown in area where tropical as well as dry conditions prevail. It also known as Indian Gooseberry, is an important horticulture crop of India. In Bangladesh it is called Amloki but in India, it is called by various names such as Aonla, Nelli, Amla, Amlika, Dhotri, Emblica and Usuri (Nayaka, 2006). Aonla, indigenous to tropical South-east Asia, particularly central and southern India, is under cultivation since ancient times (Firminger, 1947). The genus *Phyllanthus comprises* of about 350 or even 500 species. The fruits of aonla are very extensively utilized by processing industry. It is an essential ingredient of Chyawanprash, a popular ayurvedic medicine. Other products are preserves, pickles, candy, jelly, jam and squash. Fruits can also be dried and powdered to be used subsequently in the preparation of oils, hair dyes and hair oils. In traditional medicine it is considered a health and vitality restorer (Ravindran *et al*, 2007). It has aroused good deal of interest among the scientific workers because it is one of the richest natural sources of vitamin C (Ascorbic acid). The fruits are major constituents of Chyavanprash and Trifla. Other uses of fruits are in pickle, marmalade, jam and sauce preparation (Shrivastava, 1990). It is a valuable medicinal plant used by herbalists (Oudhia and Tripathi, 2002). Bangladesh is an agro-based country and its development is inherently linked with the development of agriculture. Out of 14.39 million hectares of land only 1.2 million hectares were used for horticultural crops which is about 7% of the total cropped area (BBS, 2010). In Bangladesh, temperature ranges from 5ºC to 28ºC in winter and from 22ºC to 40ºC in the summer in Bangladesh with the variation in rainfall from 1430 mm in the North and North-west to 4,338 mm in the East and South-east (Rahim and Rahman, 2012). Besides, Bangladesh is situated between 20.50-26.50 N latitude and the soil are mostly loamy, porous and well aerated. The Northern region of Bangladesh is highly vulnerable to sandy soil. Local people informed that most of the vegetation including fruit plants was affected by sandy soil. In that case, BAU Germplasm Centre developed some potential fruits varieties which have made suitable for greater adoption in different northern regions of Bangladesh where sandy soil areas are rapidly increasing through climate change effect (Rahim and Rahman, 2012). Adaptability of a species and its suitability to a site is indicated by its frequency and growth. The proper area selection is very essential for getting good yield and quality of fruits varieties of Bangladesh. So, the present study was to determine the performance of BAU–GPC released Amloki–1 at different part of Northern Region with a view to select the suitable area for obtaining the better growth and higher production of Amloki.

Materials and Methods

The present study was conducted at different locations of Northern region and BAU–GPC (released region) area of Bangladesh during the period from July 2009 to June 2013. The single factor experiment was consisted 4 treatments of locations where three upazillas of Northern part of Bangladesh namely Palashbari, Gaibandha, Gaibandha Sadar and Pirgonj, Rangpur of AEZ–2 and BAU–GPC, Mymenisngh of AEZ–9. BAU Amloki–1 was used as planting materials which was released by BAU–GPC, Mymensingh–2202, Bangladesh. The performance study of BAU Amloki was continuing where the various data regarding morphology, yield and yield attributing were recorded at 2010, 2011 and 2012. The whole experimental area was divided into three plots whereas each block contains each replication. Similar design was also applied for each studied areas (treatments). Thus there were 12 (treatments 4 × replication 3) unit plots altogether in the experiment. A distance of 4 m was for both plant to plant and line to line where replication to replication (block to block) distance was 5 m. Two-three (2-3) years sampling of BAU Amloki–1 were planted at September 2009 (Plate 1). Irrigation was given after fruit set and thereafter at a fortnight interval. Fertilizers @ 10-15 kg FYM, 750 g urea, 400 g TSP, 250 g MP, 250 g gypsum and 15 g zinc sulphate were applied per plant in two split. Weeding was done at an integral of fifteen days up to fruit set and it was continued at an integral of seven days from fruit set to harvest. Caterpillar is the major insects during the experiment which was controlled by the injection of Endosulfan at the ratio of 2 ml in 1 litres of water. Spraying of Mancozeb in the proportion of 3 gm per litre of water twice first in early September and second 15 days

after first application controls the spread of rust in each year of experiment. Fruit are harvested when yellow color develops in the furrow between the ridges and the ridges are green. The data were recorded on plant height, leaves/plant, branches/plant, canopy volume (m^3), days to 100% flowering, days to fruit setting, total fruits/plant, harvested fruits/plant, fresh fruits/plant and yield/plant (kg). The experiment was laid out in single factors with three replications while statistical analysis of the data were done by RCBD method and means were adjudged by LAS at both 1 and 5% level of probability.

Plate 1. Photograph showing the sampling plant of BAU Amloki–1 at 45 days after planting

Results and Discussion

A data on various characteristics of morphology, yield and yield attributing are presented in Tables 1 to 2 in this chapter and their performance study regarding studied locations was given under the following headings.

Plant height: Plant height of BAU Amloki–1 influenced significantly due to locations at all the data recording stages except 2010 where the tallest plant (2.67 and 3.43 m) was exhibited by Palashbari, Gaibandha in 2011 and 2012, respectively followed by Gaibandha Sadar at 2011 (2.50 m) and BAU–GPC in 2012 (3.19 m). Plant height at 2010 was statistically identical among the locations. Similarly, Pirgonj, Rangpur noted the shortest plant (1.93, 2.36 and 3.09 m) at those stages, respectively (Table 1).

Table 1. Main effect of different locations on morpho–physiological characters of BAU Amloki at 2010, 2011 and 2012

Location	Plant height (m) at different DAP			Number of leaves/plant at different DAP			Number of branches/plant at different DAP			Canopy volume (m^3) at different DAP		
	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
BAU-GPC	1.95	2.44	3.19	751.33	1052.28	1298.57	10.67	18.38	20.68	1.81	2.17	3.19
Palashbari of Gaibandha	1.99	2.67	3.43	803.25	1242.20	1491.83	11.48	20.79	23.16	1.90	2.45	3.56
Gaibandha sadar	1.96	2.50	3.26	773.75	1110.17	1359.80	10.96	18.67	21.04	1.84	2.27	3.38
Pirgonj of Rangpur	1.93	2.36	3.09	740.67	973.67	1218.86	10.00	16.31	18.62	1.73	2.10	3.16
$LSD_{0.05}$	-	0.109	0.06	6.31	8.687	10.78	0.14	0.126	0.24	0.06	0.126	0.09
$LSD_{0.01}$	-	0.166	0.10	9.55	13.154	16.32	0.21	0.191	0.36	0.10	0.191	0.14
Level of significance	NS	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Number of leaves/plant: Leaf number $plant^{-1}$ had also significant due to locations at different year of the experiment (Table 1). From the Table 1, it was found that the maximum leaves/plant (803.25, 1242.20 and 1491.83) was found from the location Palashbari, Gaibandha followed by Gaibandha Sadar (773.75, 1110.17 and 1359.80) in 2010, 2011 and 2012, respectively. The minimum number of leaves/plant (740.67, 973.67 and 1218.86) was found under Pirgonj, Rangpur in 2010, 2011 and 2012, respectively which was followed by BAU–GPC.

Number of branches/plant: Branch production under different agro–ecological region had highly significant at all the data recording stage where the maximum branches/plant (11.48, 20.79 and 23.16) was recorded by Palashbari, Gaibandha and Pirgonj, Rangpur showed the minimum branches $plant^{-1}$ (10.00, 16.31 and 18.62) in 2010, 2011 and 2012, respectively.

Canopy volume: Canopy volume also affected significantly due to locations at different data recording stages of 2010, 2011 and 2012 (Table 1). Amogn the locations, canopy volume had higher (1.90, 2.45 and 3.56 m^3) under Palashbari, Gaibandha followed by Gaibandha Sadar (1.84, 2.27 and 3.38 m^3) in 2010, 2011 and 2012, respectively. Similarly, Pingonj, Rangpur, obtained the lower canopy volume (1.73, 2.10 and 3.16 m^3) followed by BAU–GPC in 2010, 2011 and 2012, respectively.

Days to flowering: A significant variation was found due to the locations in respect of days to 100% flowering of BAU Amloki–1 at both flowering season in each year of the study (Table 2). The requiring days to 100% flowering had longest under Palashbari Gaibandha in 2010 (30.26 days), Pirgonj, Rangpur in 2011 (28.38 days) and Gaibandha Sadar in 2012 (27.69 days) at first season while Palashbari, Gaibandha had longest in 2010 and 2011 (29.23 and 27.39 days, respectively) and Pirgonj, Rangpur in 2012 (27.80 days) at second season. Likewise, BAU–GPC needed the shortest time at first (25.67, 22.87 and 24.50 days) and second (23.33, 22.50 and 21.67 days) season in 2010, 2011 and 2012, respectively.

Days to fruit setting: Both observing data on days to fruit setting in each year had significant due to the locations where the requiring days for fruit setting varied from 28.81 to 33.63 days in 2010, 25.33 to 30.44 days in 2011 and 25.44 to 30.75 in 2012 at first while 29.26 to 34.56 days in 2010, 23.48 to 28.77 days in 2011 and 23.76 to 28.87 days in 2012 at second fruit setting (Table 2). Among the locations, Palashbari, Gaibandha obtained the shortest and Pirgonj, Rangpur showed the longest time for fruit setting at both stages in each year. The requiring days for fruit setting had shortest under Palashbari, Gaibandha in case of the climatic factors and soil nutrient were more favourable for early initiation of fruit as well as less time were required for fruit setting.

Number of fruits/plant: Number of fruits plant^{-1} data were also obtained two times in each year where analysis of variance data regarding to fruits plant^{-1} had significant due to location among the whole data recording period of the study (Table 2). From the Table 2, it was found that the fruits/plant varied from 9.58 to 21.48, 25.18 to 48.33 and 39.41 to 70.73 during the first harvest and 5.85 to 16.42, 17.88 to 37.67 and 26.10 to 52.62 were the second harvest in 2010, 2011 and 2012, respectively. Among the studied locations, the maximum fruits/plant was noticed under Palashbari, Gaibandha in 2010 and Gaibandha Sadar in 2011 and 2012 while it was the minimum under Pirgonj, Rangpur in 2010, 2011 and 2012 whereas it was followed by BAU–GPC.

Number of harvested fruits/plant: Harvested fruits plant^{-1} was calculated on the basis of the summation of both harvests in each year where harvested fruits/plant had significant due to studied locations (Table 2 and Plate 2). Among the locations, Palashbari, Gaibandha recorded the maximum number of harvested fruits plant^{-1} (17.67) in 2010 while it was maximum (94.18 and 123.08) under Gaibandha Sadar, in 2011 and 2012. On the other hand, the minimum number of harvested fruits plant^{-1} (5.67, 41.06 and 57.95) was exhibited under Pirgonj, Rangpur in 2010, 2011 and 2012, respectively.

Table 2. Main effect of different locations on various yield and yield contributing characters of BAU Amloki at harvest during 2010-2012

Location	Days to 100% flowering		Date to fruit setting		No. of fruit/plant		No. of harvested fruits/plant	No. of fresh fruits/plant	Yield/ plant (kg)
	1st	2nd	1st	2nd	1st	2nd			
					2010				
BAU-GPC	25.67	23.33	31.07	32.49	12.50	10.26	9.67	9.00	0.19
Palashbari of Gaibandha	30.26	29.23	28.81	29.26	21.48	16.42	17.67	16.67	0.36
Gaibandha sadar	27.69	25.37	29.90	30.19	18.96	13.22	13.33	12.33	0.27
Pirgonj of Rangpur	26.47	27.33	33.63	34.56	9.58	5.85	5.67	5.00	0.11
$LSD_{0.05}$	0.14	0.30	2.11	1.08	0.76	0.59	0.25	0.29	0.06
$LSD_{0.01}$	0.21	0.46	3.19	1.63	1.15	0.89	0.38	0.44	0.10
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
					2011				
BAU-GPC	22.87	22.50	28.22	25.49	28.69	20.33	45.15	43.15	0.91
Palashbari of Gaibandha	28.33	27.39	25.33	23.48	48.33	37.67	81.40	75.11	1.63
Gaibandha sadar	26.70	24.70	27.99	24.12	57.31	41.28	94.18	89.29	1.99
Pirgonj of Rangpur	28.38	26.80	30.44	28.77	25.18	17.88	41.06	33.42	0.77
$LSD_{0.05}$	0.20	0.56	0.260	0.190	0.485	0.845	0.485	0.619	0.141
$LSD_{0.01}$	0.30	0.85	0.394	0.287	0.735	1.280	0.735	0.937	0.214
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
					2012				
BAU-GPC	24.50	21.67	27.97	25.96	44.13	29.77	65.54	61.39	1.29
Palashbari of Gaibandha	26.10	25.37	25.44	23.76	70.73	52.62	110.88	104.30	2.56
Gaibandha sadar	27.69	22.75	27.24	23.98	76.89	59.64	123.08	112.13	2.23
Pirgonj of Rangpur	27.30	27.80	30.75	28.87	39.41	26.10	57.95	51.57	1.08
$LSD_{0.05}$	0.52	0.17	0.26	0.19	0.49	0.85	3.66	3.66	0.09
$LSD_{0.01}$	0.79	0.25	0.39	0.29	0.73	1.28	5.55	5.55	0.14
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Number of fresh fruits/plant: Fresh fruits means without infested fruits. The fresh fruits/plant had highly significant among the studied location in each of the data recording year (Table 2 and Plate 2). Among the locations, fresh fruits/plant varied from 5.00 to 16.67, 33.42 to 89.29 and 51.57 to 112.13 in 2010, 2011 and 2012, respectively where significantly the maximum fresh fruits/plant was taken under Palashbari, Gaibandha in 2010 and Gaibandha Sadar in 2011 and 2012 and the minimum in Pirgonj, Rangpur in 2010, 2011 and 2012.

Fruit yield: Fruit yield of BAU Amloki–1 had significant among the studied locations where Palashbari, Gaibandha registered the higher yield (0.36 kg plant^{-1}) followed by Gaibandha Sadar (0.27 kg plant^{-1}) in 2010 (Table 2). Among other locations, Gaibandha Sadar recorded the higher fruit yield (1.99 and 2.63 kg plant^{-1}) followed by Palashbari, Gaibandha (1.63 and 2.23 kg plant^{-1}) in 2011

and 2012, respectively. On the other hand, Prigonj, Rangpur took the lowest yield (0.11, 0.77 and 1.08 kg plant^{-1}) in 2010, 2011 and 2012, respective (Plate 2).

Plate 2. Photograph showing the mature fruits during harvest in 2012

From the above investigation, it was found that BAU–GPC released BAU Amloki–1 was most productive under Gaibandha Sadar than other studied regions which might be due to the climatic condition, physical and chemical properties of the soil, soil pH and other condition of that region were more favourable for the cultivation of BAU Amloki–1 which was helpful for maximizing the yield of Amloki.

Discussion

The present study showed that Palashbari, Gaibandha region significantly perform better than that of other study locations regarding growth development and yield maximizing of BAU Amloki–1 due to the higher adaptability of BAU Amloki with the climatic and soil condition of Palashbari. This variation was also found due to the climatic condition and soils characteristics of that region were more favourable for the cultivation of BAU Amloki–1. Significant variation among the morphological and yield contributing characters regarding different region were registered in this study which are consonance with that of Chandrawanshi *et al*. (2013) who found that moisture and temperature stress of Jabalpur showed variation on plant phonological parameters of *Phyllanthus amarus*. The performance of different commercial varieties of aonla was also assessed by Shukla Arun *et al*. (2010) under hot arid condition. Seven varieties of aonla have been also evaluated by Dhanumjaya and Subramanyam (2009) for scarce rainfall zone under rain fed at HRS, Anantapur for 3 years in red sandy loam which are poor, shallow, rocky soils where highest plant height and branches were recorded in NA-10 Kanchan at scarce rainfall zone for their higher adaptability. Krishnamoorthy (2009) also found that among the three arid zone fruit crops viz., aonla, pomegranate and annona; the aonla crop recorded higher yield over other two crops under sodic soil.

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