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Research Paper

Development of pink-coloured yard long bean through the conventional breeding method

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Abstract

Yardlong bean is a very common delicious legume vegetable grown in Bangladesh both for domestic consumption and in the exporting of vegetable items to foreign supermarkets. Since it can be grown in this country almost throughout the year this popular vegetable has enormous importance within the country and in the upstream markets as well. A pink-coloured yardlong bean variety '*Shova*' has been developed in BRAC Agricultural Research & Development Centre through hybridization between the exotic variety and local yardlong bean varieties. This pink-coloured yardlong bean variety is almost a year-round variety and its yield in the actual growing season has been recorded as 10-11 Mt/ha. Its anthocyanin-rich pink-coloured tender fruits are 45-46 cm long and individual pod wt. is around 34-35 gm. In a trial between '*Shova'* and '*Ruposhi*' good uniformity in pod size and shape was observed in '*Shova*' and this yardlong variety was found to be more tolerant to major disease and insect attacks than '*Ruposhi*'. Unlike green-type yardlong bean varieties, its plot looks beautiful at the fruiting stage due to its huge no. of long attractive pink-coloured fruits. Besides its own market segment, owing to the decorative pod colour, usually it increases the sales volume of traditional type green fruited yardlong beans when these pink-coloured fruits are inserted into the bunch of green fruited beans. Its thicker fleshy fruits are non-fibrous and have good taste.

Keywords: Pink-coloured yardlong bean, *Vigna unguiculata,* round-the-year variety, '*Shova'*

Yardlong bean (*Vigna unguiculata* [L.] Walp. ssp. *sesquipedalis* Verdc.) is an important leguminous crop of tropical countries and it is a very common vegetable cultivated by the farmers of South Asian and Far East countries including Bangladesh for its protein-rich fleshy and crispy fruits (Haque *et al*. 2012b, Kumar *et al*. 2017). At present in Bangladesh yardlong bean is being cultivated on 5864.99 hectares of land with an annual production of 21,348 metric tons at the national average of yardlong bean production of 3.64 Mt/ha (Haque *et al*. 2012b) for their home consumption and exporting vegetables (Islam *et al*. 2007, Khan *et al*. 2015). Farmers of Bangladesh used to cultivate different types of landraces or local varieties of green fruited yardlong beans a few decades ago and those varieties were not only low yielding, those were almost seasonal type and also susceptible to diseases. Fruits of these local varieties were relatively shorter, fibrous and less meaty and these varieties were usually cultivated in the homestead areas. With the rapid advancement of commercial agriculture in Bangladesh now a good no. of commercial growers is cultivating improved varieties of yardlong bean which are the long-fruited type with meaty pulp, virus tolerant and relatively higher-yielding as well. Plants of these improved varieties are usually grown through the support of longer erected sticks arranged in an "A" like fashion to produce a better yield. Since the yardlong bean is a warm season crop (Haque *et al*. 2012a) in Bangladesh most of the farmers usually cultivate the yardlong bean as a Kharif crop although the availability of few local varieties of yardlong bean is not uncommon for the early part of the winter i.e. in the off-season. Yardlong bean is a nutritious vegetable (Ano and Ubochi 2008, Khan *et al*. 2015) and pink coloured yardlong bean has more health benefits as these varieties are rich sources of anthocyanin (Kuswanto *et al*. 2013, Biswas 2018). Basically, yardlong bean is a short duration profitable crop (Islam *et al*. 2007) and its vigorous plants

can survive easily in the poor quality soil of marginal type lands as well. And yet unlike other vegetable crops, it can withstand excessive soil moisture and in extreme cases, it can tolerate shorter water logging conditions caused by the heavy rain in the monsoon season and making it possible to be one of the few vegetable crops to be grown in this dull season of vegetable cultivation. Being a short duration crop (65-75 Days) its fitting in the crop rotation is rather easy and growing it in the existing cropping pattern it not only diversifies the cropping system yard long bean cultivation but also enriches the soil as it has the soil amelioration properties. Moreover, yardlong bean cultivation is also easy and it does not require heavy investment like other trellis-growing vegetables (such as cucurbits) in a number of cases, this vine crop can be grown utilizing rooftop, medium-type shrub-like trees and even over fences of the kitchen gardens (Haque and Ahmed 2010). The recent introduction of semi indeterminate all season type yardlong bean variety which can be grown without staking has already minimized the production cost of yardlong bean cultivation and has given the opportunity to the growers of intercropping other crops along with this vegetable in the same plot and make its cultivation more profitable. Despite these positive features yard long bean has failed to become a most popular vegetable crop in Bangladeshi growers due to the unavailability of good yardlong bean varieties and a supply of high-quality seeds. With the growing demand for yardlong beans as a vegetable item in the market, it is imperative to develop an improved type yard long bean to cater for the need for good variety among vegetable growers. Therefore, a breeding programme was initiated at BRAC Agricultural Research Centre (BARDC) considering the immense importance of yard long bean in Bangladesh agriculture where vegetable cultivation is gaining momentum these days as vegetable cultivation is more profitable than cereal crops. Yard long bean being a self-pollinated short duration crop and can be grown in 2 to 3 seasons in a year it is relatively easier to develop a new variety within a very short period. Keeping all these views in mind a purple-red yardlong bean variety '*Shova*' has been developed in BARDC through hybridization between the exotic and local yardlong bean varieties.

With a view to developing a high-yielding nutritious anthocyanin-rich pink-coloured yardlong bean, several germplasms of both green and light green fruited yardlong bean were evaluated at BRAC Agricultural Research and Development Centre during the year 2001-2002. During the evaluation trial, an exotic accession having exceptionally long but broad whitish green meaty fruits was selected for hybridization with the popular green fruited variety '*Kegornatki*' to improve the quality of the tender fruits of the expected newly developed pink-coloured variety. As a result, a new green fruited high yielding promising line with fruits having fleshy pulp was developed. Now, this improved type green fruited high yielding promising line was crossed with a locally grown pink-fruited type variety to incorporate the pink colour (i.e. anthocyanin) in the green genetic background of the newly developed promising line. Finally, a high yielding pink coloured advance line was developed through a series of careful selections from the progenies derived from the cross. This high yielding pink fruited variety has been released for commercial cultivation after finishing preliminary, advanced and multilocational trials (PYT, AYT & MLT).

Main characteristics of the newly developed yardlong bean '*Shova*' are (Figs. 1 & 2):

1. High yielding improved variety.
2. Prolific bearing and the fruits are pink coloured.
3. Higher seedling vigour and stronger well branched vines with broad deep green leaves.
4. Presence of light pink coloured tinge in the junction of nodes and petioles.
5. Early season type variety having good uniformity in pod size and shape.
6. Longer fleshy solid type fruits are delicious due to their meaty pod pulp.
7. Pod length is around 45.00- 46.00 cm. and the average pod wt. is 34- 35 gm while its pod diameter is around 7- 8 mm.
8. Virus tolerant line and can be grown almost throughout the year.
9. Due to the lower no. of seeds in the fruits, the fleshy part is greater in its fruits than in fruits of normal yardlong bean variety.
10. Tolerant to major diseases like leaf blight disease and also tolerant to leaf miner infestations.
11. It has the ability to grow in lands having high soil moisture.
12. Its tender fruits can be harvested for a longer period (10-11 times) and its pod yield/ha is around 10-11 metric tons.

For field evaluation trial of BRAC developed pink fruited yardlong bean variety, '*Shova*' was grown recently in two well-known yardlong bean growing districts Rajshahi & Jashore in the *Kharif-2* season with

locally grown pink fruited variety '*Ruposhi*'. The experiment was laid out in a randomized complete block design with three replications. Fresh seeds were planted in 10.50 m^2 plots maintaining a distance of 100 cm between rows and plant-to-plant distance was maintained at 30 cm. Two healthy seeds were placed per hole and after the emergence of seedlings, only one plant per hole was kept for evaluation. In each plot, there were 35 plants and necessary cultural management practices were followed to ensure better growth and development for each plant. Field evaluation results are presented in Table 1. Compared to the check variety, BRAC developed variety '*Shova*' exhibited better plant vigour and it flowered earlier than the check variety '*Ruposhi*' (Fig. 1 & Table 1). Naturally, picking of marketable size pods started much earlier than the locally grown variety (10 days earlier). The excellent pod-bearing nature of '*Shova*' was much better than the variety '*Ruposhi*' which has been reflected by the fresh pod yield per hectare of the two respective varieties (Table 1). Almost 16.27% higher yield was recorded in '*Shova*' compared to locally grown variety. Although the pod colour of the two pink-fruited varieties was the same there were marked differences between the two varieties with respect to pod length and pod wt. On average 39.28 % increased length and 24.76% higher pod wt. were recorded in '*Shova*' than that of '*Ruposhi*'. Growing '*Shova*' in two locations (Jashore and Rajshahi), significant variations in first flowering date, first picking date, days to final harvesting, pod length/pod and pod wt./pod were observed while variations in pod diameter/pod and pod yield/ha were found to be non-significant (Table 1). But in '*Ruposhi*' significant variations were recorded in all these traits growing it in the same locations. It can be mentioned here that the site-specific performance of a crop is chiefly dependent on environmental (temperature, rainfall, humidity, sunshine hours etc.) and edaphic conditions. Therefore, observed considerable variations in the yield-related traits in both varieties were mostly due to growing them in two different locations. However, in a yardlong bean variety trial experiment growing in a single location, Sundar *et al*. (2022) reported that both the environmental conditions as well as the genotype had a significant effect on the yield of yardlong beans. The newly released variety '*Shova*' was also found to be tolerant to major diseases like leaf blight and the plants were found to be tolerant to leaf miners which are very much common to green podded varieties. Kuswanto *et al*. (2013) also isolated some purple-fruited anthocyanin-rich yardlong bean lines from segregating populations which were tolerant to pests, diseases and water stress conditions as well. They believed that due to the thicker skin of fruits of the purple fruited variety these were not liked by the pests. Moreover, the crop duration of '*Shova*' was found to be relatively shorter than the local variety which enabled the grower to grow the next crop much earlier than the '*Ruposhi*' grown plot. Furthermore, as customer's preference for '*Shova*' was found to be better due to its fruit lustre, tenderness and cooking quality than '*Ruposhi*' (Fig.2). And it can be mentioned here that based on the superior performance as well as better market demand BRAC Seed & Agro Enterprise division has initially set a target of 50 kg commercial seed production of this newly developed variety for the current year (2018-19).

Fig. 1. Luxuriant growth of '*Shova*' in a farmer's plot.

Fig. 2. '*Shova*' with other types of yardlong bean.

Table 1. Performance of BRAC developed pink-coloured yardlong bean in two vegetable growing districts during the *Kharif-2* season of 2018.

Location	Variety name	Soil type	Seeding date	Days to			Pod length (cm)	Pod dia-meter (mm)	Pod wt./pod(gm)	Pod yield/ha (Mt)	Farmer's comment
				1st flower-ing	1st pick-ing	Final harvest-ing					
Jashore	*Shova*	Clay loam	12.08.18	32.00	48.00	92.00	38.00	7.00	32.71	10.20	Compared to check variety its yield is higher and its fruits are less fibrous & tasty.
Rajshahi		Sandy loam	02.08.18	25.00	42.00	63.00	40.00	7.00	35.00	11.52	It is a good early season type variety & its fresh fruits have a very good demand in the market.
Mean	-	-	-	28.50*	45.00*	77.50*	39.00*	7.00	33.85*	10.86	-
t-value	-	-	-	17.25	16.02	70.80	7.22	0.00	10.33	1.43	-
Jashore	*Ruposhi*	Clay loam	12.08.18	43.00	55.00	108.00	28.00	6.50	27.13	9.34	Lower pod bearing variety and the fruits are fibrous & shorter. Yield is also poor.
Rajshahi		Sandy loam	02.08.18	40.00	52.00	102.00	30.00	6.70	29.25	10.56	Fruits are relatively shorter & yield is poor.
Mean		-	-	41.5*	53.5*	105*	29.00*	6.60*	28.19*	9.95*	-
t-value		-	-	5.14	7.65	7.15	5.20	5.71	4.06	2.84	-

In Bangladesh, mostly green fruited type yardlong beans are cultivated and unsurprisingly due to their abundance in the market, customers had little choice but to purchase other types of yardlong beans. But with the availability of pink-coloured yardlong bean varieties vegetable customers are now purchasing both types of yardlong beans and in the kitchen and in the market it has been observed that when these pink-coloured yardlong beans are inserted into the bunch of green fruits; the selling rate of green fruited yard long beans increases significantly. Moreover, the taste of cooked foods from mixed type yard long beans is better than the single type yardlong beans and also mixed coloured yardlong beans ensure the supply of more nutrients in our body than the one particular type of yardlong bean.

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