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Study on performance of aonla cultivars in laterite soil of West Bengal

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ABSTRACT

To find out suitable cultivar of aonla (*Emblica officinalis* Gaertn) *in laterite zone of West Bengal, a study was made on seven released varieties viz., Anand 1, BSR1, Chakaiya, Kanchan, Krishna, NA 10 and Neelum for six consecutive years adopting randomized block design. The soil was laterite and acidic in nature. Significant variation in yield and physico-chemical characteriscts of fruits of different cultivars was observed. The cultivar Neelum gave peak production of 80 kg plant^{-1} at 9 year of age with an average of 56.0 kg tree^{-1} followed by Kanchan which produced maximum yield of 60 kg tree^{-1} at 9 year of age with an average of 27.7 kg tree^{-1}. These two cultivars were found to resistance and tolerant respectively against the stem borer pest. The highest fruit weight (35g) with maximum in size (4.5 × 5.0 cm) was observed in Neelum while highest pulp content was noted from Kanchan (95.0%). The TSS content was maximum in Anand 1 and BSR 1 (14.2 – 14.3%) and minimum in Krishna (11.0%). The ascorbic acid content was highest in Krishna (475 mg 100^{-1} g) followed by Neelum (460 mg100^{-1}g). Considering overall performance and presence of self-incompatibility phenomenon in aonla, the cultivars Neelum and Kanchan (10:1 :: Neelum : Kanchan) can be recommended for commercial cultivations in orchards under red and laterite zone of West Bengal.*

***Keywords*:** Aonla, foliar NPK, fruit quality and yield

Aonla, Indian goose berry (*Emblica officinalis* Gaertn) is one of the most nutritious fruits, which could be grown in marginal and waste lands successfully by proper technological intervention. Due to use of aonla in ayurvedic and unani medicine's industry as raw material, demand of fresh fruits is increasing worldwide. Besides medicines industry, it has also high demand in small and large scale food industry for preparation of health-based preserved products like candy, jam, squash, pickle, thokku and RTS (Parvathi and Anbu, 1997); Jain *et al.* (2007). Now-a-days, cultivation of aonla is gaining popularity due to its high market demand, less management cost coupled with wide adaptability in diverse agro-climatic condition.

Among the various factors for high production of quality fruits, cultivar is considered to be the prime ones, as this single factor controlled more than 60% of yield and quality attributing characters. Again, expression of characters of a genotype, which are controlled by genes, depends on environmental factors. For this reason, varietal specification of crop in a particular agro-climatic condition is the foremost task for commercialization of that crop in a locality or zone. In the western part of West Bengal where the soil is red and laterite which covers 5 districts and accounting about 1.5 lakh hectares is considered to be suitable for growing aonla (Ghosh *et al*. 2009). With the view to find out suitable cultivars (s) of aonla in the above mentioned zone of West Bengal, a long term investigation was, therefore, made as no such attempt was made earlier.

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MATERIALS AND METHODS

The investigation was carried out in a private orchard, Jhargram, Paschim Medinipur, West Bengal during 2007 to 2012. The site is in dry and sub-humid agro-climatic region. The experimental site was located at 22.5^0N latitude and 87^0E longitude with an altitude of 78.8 meters above mean sea level. The annual rainfall of the region ranges between 1200-1500 mm, of which about 80% is received from 2nd week of June to end of September. May is the hottest month (42^0C) and December is the coolest (8^0C). Grafted plants of seven aonla cultivars *viz.*, Anand – 1, BSR-1, Chakaiya, Kanchan (NA 4), Krishna (NA 5), NA-10 and Neelum (NA 7), planted at 5×5m spacing during July, 2003, were selected for the study following Randomized Block Design having four replications with two plants in each. The soil of the orchard was laterite having pH 5.7. The plants were fertilized with 40kg FYM, 300g N, 100g P_20_5 and 200g K_2O plant^{-1} year^{-1} (Tarai and Ghosh, 2005). The observations were recorded on fruit yield, physico-chemical characteristics of fruits, incidence of stem borer and foliar N, P and K status of the cultivars. Ten mature fruits from each tree were taken randomly for recording observations on physico-chemical parameters. The TSS was recorded with the help of hand refractometer while acidity and ascorbic acid content were estimated following standard techniques (A.O.A.C., 1990). For foliar analysis of N, P and K, the leaves were collected during July from the middle portion of three-month old indeterminate shoots (Awasthi *et al.*, 1993). Leaf N was determined using micro-kjeldahl method, P by vandomolybdophosphoric acid method and K by flame photometer.

RESULTS AND DISCUSSION

The perusal of the data presented in Table-1 indicated that the cultivars expressed their yield potentially at different magnitude in the present agro-climatic situation. All the cultivars, taken for the study reported to have good yield potentiality (Singh *et al*., 1994; Bhavani Sanker *et al.*, 1999) but at the present situation, the yield performance of many cultivars was poor. The highest average yield (56.0 kg plant^{-1}) was recorded from Neelum followed by Kanchan (27.7kg plant^{-1}) and lowest yield was in Anand-1 and BSR-1 (0.2 to 1.0 kg plant^{-1}). It was interesting to note that all the cultivars under study, showed their higher yield potentiality at the age of 5th year and cent-percent at the age of 9th year of orchard life. It was also observed that the aonla has tendency to alternate bearing to some extent like a tide with high yield in one year followed by low yield in next year. The peak yield of 80kg plant^{-1}was recorded from Neelum followed by 60 kg plant^{-1} in Kanchan at the plant age of 9th year. The yield of these two cultivars was noted satisfactory when we compared with their performance at their original place (Faizabad, U.P.), where it was reported as 62kg and 74kg fruits plant^{-1} in Neelum and Kanchan respectively at the plant age of 8 year (Singh *et al*. 1994). Poor yield performance of BSR-1 may be due to prevailing climatic condition of area of study (dry and sub-humid climate) as this cultivar prefers humid tropical climate (Kumar *et al.*, 2011).

Table 1: Yield performance of aonla cultivars.

Cultivars	Fruit yield (kg plant^{-1}) at the age of							Foliar status (%)		
	4th year	5th year	6th year	7th year	8th year	9th year	Mean	N	P	K
Anand 1	0	0	0	0.8	0	0.6	0.2	1.4	61	0.7
BSR 1	0	0	0	2.5	0	3.5	1.0	1.4	61	0.7
Chakaiya	5	20	2	4.0	5	30.0	11.0	1.8	63	0.8
Kanchan	20	52	4	12.0	18	60.0	27.7	1.9	64	0.9
Krishna	1	28	2	9.0	1	30.0	11.8	1.6	63	0.8
NA-10	2	18	1	5.0	15	20.0	10.2	1.6	63	0.8
Neelum	38	73	25	72.0	48	80.0	56.0	2.2	67	0.9
LSD (0.05)	**4.2**	**6.8**	**3.1**	**5.6**	**4.7**	**7.3.0**	**4.8**	**0.2**	**NS**	**NS**

Leaf nutrient content of aonla cultivars showed significant difference for and N and non-significant for P and K (Table 1). Highest foliar N value was recorded from Neelum (2.2%) followed by Kanchan (1.9 %).The result indicated that foliar N value could be considered as one of the indicators for judging suitability of a variety in laterite soil. However, Balamohan *et al.*, 2002) noted non-significance difference of N and P vales and significant in K values in leaves of different aonla cultivars grown in sodic soils.

Regarding fruit weight, it was maximum in Neelum (35g) followed by Krishna (31g) and minimum in BSR-1 (12g). The same trend was also found in case of fruit size (Table 2). Increase in fruit weight in Neelum and Krishna may be due to more activeness of monocarp cells which enlarge during fruit development (Balasubramanyan and Bangarusamy, 1998). Pulp content in aonla is considered as one of the important parameter for preparation many recipes (by-products). Highest pulp content was recorded from Kanchan (95.0%) followed by Chakaiya (94.8%), Krishna (94.7%) and Neelum (94.2%) and lowest in BSR-1 (91.5%) (Table 2) Singh *et al*. (1994) reported that pulp content in Krishna and Kanchan was 93% under Faizabad condition (U.P.) while Mehta *et al.*, (2002) recorded 95.1% in Chakaiya; 93.5% in Krishna and Kanchan under Hisar (Haryana) condition. From the above comparison, it could be conferred that the cultivars grown at Jhargram, have the better pulp content as compared to growing them at Faizabad or Hisar condition. Number seeds per fruit varied from 4.9 in Krishna to 6.5 in Neelum (Table 2). The total soluble solid content in different cultivars of aonla has been present in table-2. It was maximum in Anand 1 (14.3%) followed by BSR-1 (14.2%) and lowest in Krishna (11.0%). Kumar *et al*., 2011) observed that TSS content in different aonla cultivars varied from 7.6% (Krishna) to 14.0% (BSR-1) grown and Coorg conditions (Karnataka). The acidity content in fruits of different cultivars (Table 1) was recorded at Maximum in BSR-1 (1.9%) and minimum in Anand 1 (1.1%). This is in conformity with the findings of Singh *et al*., (2004). The ascorbic acid content was maximum in Krishna (475mg 100^{-1} g) followed by Neelum (460mg 100^{-1} g)

and Kanchan (455mg 100^{-1} g) and minimum in BSR-1 (280mg 100^{-1} g) and Anand 1 (290mg 100^{-1} g). Kumar *et al*., (2011) recorded ascorbic acid content as minimum of 228.8mg 100^{-1} g in Kanchan and maximum of 448.8mg 100^{-1} g in BSR-1, grown under Coorg conditions. It was interesting to note that ascorbic acid content in different cultivars of aonla was higher under arid condition (Meghwal and Azam, 2004) as compared to the same cultivars grown in high rainfall areas (Kumar *et al*., 2011).

Table 2: Physico-chemical characteristics of aonla cultivars (Mean of 3 years)

Cultivars	Fruit weight (g)	Fruit length (cm)	Fruit breadth (cm)	Pulp content (%)	Number of seeds $fruit^{-1}$	TSS (^{0}B)	Acidity (%)	Ascorbic acid (mg 100^{-1} g pulp)	Incidence of stem borer
Anand 1	30.0	4.2	4.8	92.0	6.0	14.3	1.4	290	Susceptible
BSR 1	12.0	3.4	3.8	91.5	6.0	14.2	1.9	280	Susceptible
Chakaiya	25.0	4.3	4.7	94.8	5.9	13.4	1.5	540	Resistant
Kanchan	27.0	4.5	4.7	95.0	5.2	12.0	1.6	455	Tolerant
Krishna	31.0	4.2	4.9	94.7	4.9	11.0	1.3	475	Susceptible
NA-10	29.0	4.2	4.8	94.1	5.3	12.7	1.3	430	Susceptible
Neelum	35.0	4.5	5.0	94.2	6.5	11.2	1.4	460	Resistant
LSD (0.05)	**2.2**	**NS**	**0.2**	**0.8**	**NS**	**0.4**	**NS**	**12.5**	

Now-a-days, incidence of stem borer is considered as one of the major threats of aonla cultivation. The study revealed that the aonla cultivars showed different degree of resistance against the incidence of stem borer. Among the seven cultivars studied, Neelum and Chakaiya were found to show resistance against the incidence of stem borer as only 2 to 3 holes $tree^{-1}$ were observed, while more than 10 holes per tree noted in Anand 1, BSR 1, Krishna and NA 10 even adoption of proper prophylactic and curative measures in the orchard during the last five years. The trees which had more than 10 holes $tree^{-1}$ showed drying of more number of shoots especially at the top portion and resulted in reduction of fruit yield as observed in the case of Krishna and NA 10 (Table 1). The cv. Kanchan showed tolerance against the incidence of stem borer as only 4-5 holes per tree were noted. From the above discussion, it is clear that the parameter on 'stem borer incidence' is considered to be an essential observation, while varietal trial of aonla to be carried out in any area.

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