



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(10): 1443-1446
© 2023 TPI
www.thepharmajournal.com
Received: 02-08-2023
Accepted: 08-09-2023

Sudipta Sannigrahi
Department of Fruit Science,
Faculty of Horticulture
Bidhan Chandra Krishi
Viswavidyalaya, Mohanpur,
Nadia, West Bengal, India

Soustav Datta
Department of Fruit Science,
Faculty of Horticulture, Bidhan
Chandra Krishi Viswavidyalaya,
Mohanpur, Nadia, West Bengal,
India

Tanmoy Mondal
Department of Fruit Science,
Faculty of Horticulture, Bidhan
Chandra Krishi Viswavidyalaya,
Mohanpur, Nadia, West Bengal,
India

Susmita Dey
Department of Fruit Science,
Faculty of Horticulture, Bidhan
Chandra Krishi Viswavidyalaya,
Mohanpur, Nadia, West Bengal,
India

Sushanta Kumar Sarkar
Department of Fruit Science,
Faculty of Horticulture, Bidhan
Chandra Krishi Viswavidyalaya,
Mohanpur, Nadia, West Bengal,
India

Corresponding Author:
Susmita Dey
Department of Fruit Science,
Faculty of Horticulture, Bidhan
Chandra Krishi Viswavidyalaya,
Mohanpur, Nadia, West Bengal,
India

Study of establishment and growth of tissue cultured plants of pomegranate cv. Bhagwa in red and lateritic region of West Bengal

Sudipta Sannigrahi, Soustav Datta, Tanmoy Mondal, Susmita Dey and Sushanta Kumar Sarkar

Abstract

Pomegranate (*Punica granatum* L.) belonging to Punicaceae family, have wider adaptability and are grown worldwide in tropical as well as subtropical regions. Recently, the area under pomegranate cultivation in West Bengal is increasing to a large extent due to its drought hardy nature, wider adaptability, suitability to marginal lands and higher yield. With this background, a research work was carried out to study the establishment and growth of tissue cultured pomegranate plants cv. Bhagwa in red and lateritic region of West Bengal and laid out in a Randomized Block Design (RBD), having four treatments *i.e.* locations (Chhatna, Pathri, Bamunpathri & Damodarpur) with ten replications. Bimonthly increase in plant height, plant spread, stem girth, number of leaves/branch and number of suckers were highest at Damodarpur. This might be due to climatic factors and soil characteristics of the location. Internodal length at yearly interval was also maximum at Damodarpur. Finally, it can be concluded that successful cultivation of pomegranate at Damodarpur location may be disseminated to the farming community for increasing their income and better livelihood.

Keywords: Pomegranate, tissue cultured plants, plant physical characters, red & lateritic region

Introduction

Pomegranate (*Punica granatum* L.) is a woody perennial shrub and one of the most popular table fruits worldwide. It referred as 'super fruit' due to its reviving juice with nutritional, medicinal as well as anti-oxidant properties (Czeczor *et al.*, 2018 and Reddy, 2011) [6, 10]. Earlier pomegranate was considered as minor fruit crop in India but now-a-days it has occupied first position in area and production at global level (Chandra and Jadhav, 2008). It is an ancient fruit that originated in Afghanistan, Persia and Baluchistan (De Candolle, 1967) [7]. It is also believed to be a native of Iran, where it was first cultivated about 2000 BC ago (Chell *et al.*, 2023) [5]. Pomegranates are widely grown in many Mediterranean nations, including Spain, Morocco, Iran, Egypt, Afghanistan and Baluchistan. In India it is commercially cultivated in Maharashtra parts of Karnataka (Ghosh *et al.*, 2009) [8]. The total area under cultivation of pomegranate in India is 2.33 lakh ha and production is around 28.44 lakh tonnes (Anon, 2018) [3]. More than 25 varieties are grown in different parts of India and some important varieties are Bhagwa, Ganesh, G-137, Mridula, Dholka and Phule Arakta. Earlier Ganesh variety with big size fruits was preferred but presently soft seeded, red rind and aril coloured varieties with higher juice percent such as Bhagwa and Mridula are being preferred (Saroj and Kumar, 2019) [11]. Pomegranates are grown commercially in Maharashtra, some areas of Gujarat and sections of Karnataka in India, where the dry, hot climate results in the production of high-quality fruits. Due to its wide range of adaptation, better yield, drought resilience and salinity tolerance, pomegranate production is currently becoming more and more popular in arid as well as semi-arid regions of India (Reddy, 2011) [10]. Recently, the area under pomegranate cultivation in West Bengal is increasing to a large extent due to its drought hardy nature, wider adaptability and suitability to marginal lands (Anon, 2014) [1]. In West Bengal, Bankura and Purulia district may be suitable for cultivation of good quality pomegranate due to its unique geographical situation and environmental conditions such as low rainfall. An initiative has been taken by ICAR- NRC on Pomegranate in convergence with MGNREGA by supplying 3500 tissue cultured pomegranate saplings during 2015-16 for planting in four blocks *viz.*, Simlatal, Bankura-I, Ranibandh and Onda of Bankura districts.

Another 15,000 tissue cultured pomegranate saplings were supplied and planted during 2016-17 in different blocks of Bankura district *viz.*, Onda, Sonamukhi, Indpur, Chhatna and in three blocks of Purulia district *viz.*, Pucha, Kashipur and Balarampur. The report of these initiatives suggests that the establishment and growth of the plants in both the districts are very encouraging (Anon, 2016-17) [3]. With this background, a research work was carried out to study the establishment & growth of tissue cultured plants of pomegranate cv. Bhagwa in different locations *viz.*, Pathri, Bamunpathri, Chhatna and Damodarpur of Bankura district.

Materials and Methods

Geographically, the experimental fields were situated under red and lateritic agro-climatic zone of West Bengal. The experimental area was located at an altitude of 448 meters above MSL between 22°38' and 23°38'N latitude and 86°36' and 87°46'E longitude. The experiment was conducted on tissue cultured propagated Pomegranate plants cv. Bhagwa planted at 4.5 m × 4.5 m spacing at different locations of Bankura district of West Bengal during 2017-2019 and laid out in a Randomized Block Design (RBD), having four treatments *i.e.* locations (Chhatna, Pathri, Bamunpathri & Damodarpur) with ten replications. Plant height, plant spread in East-West (E-W) and North-South (N-S) directions as well as the internodal length were measured using measuring tape, the stem girth of the trees was measured by using a thread at 6 cm above ground level of the tree and finally the length of thread was measured through measuring tape. Statistical analysis was done through the method detailed by Panse and Sukhatme (1985) [9].

Results and Discussion

Soil characteristics analysis of different locations of Bankura district, West Bengal

The data concerning to soil pH, organic carbon (%) and bulk density (g cm^{-3}) has been presented in Table 1. The soil characteristics analysis of experimental soil showed that the soil of that locations in Bankura district are acidic. The maximum soil pH was observed at Damodarpur (5.75) followed by Pathri (5.62) and Chhatna (5.31) while, minimum was recorded at Bamunpathri (4.67). The maximum organic carbon percentage was observed at Chhatna (1.00%) followed by Bamunpathri (0.87%) and Damodarpur (0.67%) whereas, the minimum was recorded at Pathri (0.39%). Bulk density of soil was recorded maximum at Chhatna and Pathri (2.8 g cm^{-3}) which was followed by Bamunpathri (2.15 g cm^{-3}) while, was observed at Damodarpur (1.46 g cm^{-3}).

Table 1: Soil characteristics of different locations in Bankura district

Specification	Chhatna	Pathri	Bamunpathri	Damodarpur
Soil pH	5.31	5.62	4.67	5.75
Organic carbon (%)	1.00	0.39	0.87	0.67
Bulk density (g cm^{-3})	2.18	2.18	2.15	1.46

Plant characteristics of tissue cultured grown plants of Pomegranate cv. Bhagwa in different locations of Bankura district, West Bengal

The data regarding the increase in plant height over the previous observation at 60 days, 120 days, 180 days, 240 days, 300 days and 360 days after initiation of experiment during 1st year & 2nd year for all locations has been presented in Table 2. At the beginning of 1st year maximum plant height

(171.40 cm) was recorded at Bamunpathri followed by Damodarpur (156.10 cm) while the minimum was recorded at Pathri (29.15 cm). At the beginning of 2nd year maximum plant height was observed at Damodarpur (195.60 cm) and minimum was recorded at Pathri (106.40 cm). The observations after 360 days of previous observations showed significant variation at different locations. The maximum increase in plant height was recorded at Damodarpur (3.40 cm during 1st year & 4.00 cm during 2nd year) followed by Bamunpathri (3.20 cm & 3.30 cm respectively) in both years. The minimum increase in plant height was observed at Chhatna (2.40 cm & 2.20 cm respectively).

Maximum initial stem girth during 1st year was recorded at Bamunpathri (9.93 cm) followed by Damodarpur (9.05 cm) while the minimum (1.15 cm) was recorded at Pathri. During 2nd year maximum initial stem girth was observed at Damodarpur (14.22 cm) and minimum was observed at Pathri (2.99 cm). At 360 days after the previous observation the increase in stem girth differed significantly among all locations (Table 3). The maximum increase in stem girth was recorded at Damodarpur (0.61 cm during 1st year & 0.26 cm during 2nd year) followed by Bamunpathri location (0.41 cm & 0.18 cm respectively). The minimum increase was noticed at Chhatna (0.23 cm & 0.16 cm respectively).

The data concerning plant spread in East-West direction over the initial observation at 60 days, 120 days, 180 days, 240 days, 300 days and 360 days after initiation of experiment during 1st year & 2nd year for all locations has been presented in Table 4. During 1st year, maximum initial plant spread (185.30 cm) was recorded at Bamunpathri followed by Damodarpur (149.90 cm) while the minimum (40.70 cm) was recorded at Pathri.

During 2nd year maximum initial plant spread (187.90 cm) was observed at Damodarpur and minimum (113.60 cm) was recorded at Pathri. At 360 days after previous observation maximum increase in plant spread was recorded at Damodarpur (3.00 cm during 1st year & 3.60 cm during 2nd year) whereas the minimum was observed at Chhatna (1.70 cm & 2.00 cm respectively).

The data regarding increase in plant spread over the previous observation at North-South direction at 60 days, 120 days, 180 days, 240 days, 300 days and 360 days after initial observation during 1st year & 2nd year for experimental locations has been presented in Table-5. During 1st year maximum initial plant spread (197.80 cm) was recorded at Bamunpathri followed by Damodarpur (137.90 cm) while the minimum (42.40 cm) was recorded at Pathri location. During 2nd year maximum initial plant spread was observed at Damodarpur (180.20 cm) and minimum was recorded at Pathri (112.20 cm). At 360 days the maximum increase in plant spread (N-S) was recorded at Damodarpur (3.10 cm during 1st year & 3.90 cm during 2nd year) followed by Bamunpathri (2.80 cm & 2.90 cm respectively). The minimum increase in plant spread during the period was recorded at Chhatna (1.70 cm & 2.20 cm respectively).

At the beginning of 1st year maximum number of leaves/branch (565.39) was recorded at Damodarpur while the minimum number (27.57) was recorded at Pathri (Table-6). At the beginning of 2nd year maximum number of leaves were observed at Damodarpur (755.26) and minimum number (163.66) was observed at Chhatna. At 360 days the increase in number of leaves was significantly maximum at Damodarpur (124.50 during 1st year & 111.00 during 2nd year) which was

statistically at par with Bamunpathri (112.00 & 104.00 respectively). The minimum increase in number of leaves was observed at Chhatna (63.50 & 49.90 respectively).

The data regarding internodal length over the previous observation at 365 days and 730 days after initiation of experiment for all locations has been presented in Table-7. Maximum initial internodal length (3.57 cm) was recorded at Bamunpathri which was at par Damodarapur (3.47cm) while the minimum (2.88 cm) was recorded at Pathri. At the end of 1st year the intermodal length was recorded maximum at Bamunpathri (4.07cm) which was at par with Damodarapur (4.05 cm) while minimum was observed at Pathri (3.30 cm). At the end of 2nd year the maximum internodal length was observed at Bamunpathri (4.76cm) which was at par with Damodarapur (4.48 cm) while minimum was observed at Chhatna (3.92 cm).

At the beginning of 1st year maximum suckers was observed at Bamunpathri (40.70) followed by Damodarapur (33.30) while the minimum number (1.50) was recorded at Chhatna (Table 8). During 2nd year maximum number of suckers was

observed at Damodarapur (83.30) while minimum was observed at Pathri (6.90). At 360 days the maximum increase in number of suckers was recorded at Damodarapur (4.30 during 1st year & 3.00 during 2nd year) while minimum was recorded at Chhatna (2.50 & 1.70 respectively).

The observations on morphological characters of young pomegranate trees viz., increase in plant height, stem girth, plant spread in East-West and North-South directions, number of leaves/branch as well as number of suckers/plant at bimonthly intervals revealed that maximum increase in comparison to other experimental locations were recorded at Damodarapur location. This may be due to climatic factors and soil characteristics of Damodarapur experimental site. Soil at Damodarapur is comparatively less acidic and low in bulk density. The minimum increase in tree morphological characters at bimonthly interval was recorded at Chhatna location. The experimental site at Chhatna had low soil pH and higher bulk density, which may have resulted adverse effect on plant growth in comparison to other experimental locations.

Table 2: Increase in plant height (cm) of tissue cultured grown plants of Pomegranate cv. Bhagwa at bimonthly interval

Treatment	Initial plant height		60 days		120 days		180 days		240 days		300 days		360 days	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
Chhatna	68.30	160.80	3.10	2.90	3.25	2.10	3.90	2.35	4.20	2.30	2.80	2.30	2.40	2.20
Pathri	29.15	106.40	3.65	3.80	4.22	4.40	4.90	3.70	5.60	2.70	3.70	2.70	2.80	2.60
Bamunpathri	171.40	151.90	4.00	3.50	4.85	4.70	5.40	4.80	5.70	3.70	3.80	3.50	3.20	3.30
Damodarapur	156.10	195.60	4.90	4.70	5.50	5.80	6.00	5.90	6.60	4.50	4.00	4.70	3.40	4.00
C.D.at 5%	14.900	17.920	NS	NS	1.605	1.126	1.493	0.991	1.666	0.584	0.793	0.450	0.480	0.570
S.Em(±)	5.174	6.223	0.634	0.475	0.557	0.391	0.518	0.344	0.579	0.203	0.275	0.156	0.167	0.198

NS: Non-Significant

Table 3: Increase in stem girth (cm) of tissue cultured grown plants of Pomegranate cv. Bhagwa at bimonthly interval

Treatment	Initial stem girth		60 days		120 days		180 days		240 days		300 days		360 days	
	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
Chhatna	2.67	5.88	0.17	0.15	0.19	0.14	0.20	0.15	0.24	0.16	0.29	0.17	0.23	0.16
Pathri	1.15	2.99	0.19	0.13	0.23	0.15	0.27	0.16	0.34	0.18	0.50	0.19	0.37	0.17
Bamunpathri	9.93	5.70	0.35	0.19	0.41	0.19	0.49	0.19	0.48	0.23	0.58	0.24	0.41	0.18
Damodarapur	9.05	14.22	0.58	0.65	0.59	0.27	0.70	0.28	0.75	0.25	0.83	0.26	0.61	0.26
C.D.at 5%	0.964	1.700	0.163	NS	0.178	0.080	0.176	0.063	0.191	0.065	0.206	0.064	0.173	0.062
S.Em(±)	0.335	0.590	0.057	0.243	0.062	0.028	0.061	0.022	0.066	0.023	0.071	0.022	0.060	0.021

NS: Non-Significant

Table 4: Increase in plant spread in East-West direction (cm) of tissue cultured grown plants of Pomegranate cv. Bhagwa at bimonthly interval

Treatment	Initial plant spread		60 days		120 days		180 days		240 days		300 days		360 days	
	1st Year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
Chhatna	71.49	165.00	2.91	3.10	2.90	2.85	3.20	2.80	3.20	2.50	2.50	2.70	1.70	2.00
Pathri	40.70	113.60	3.50	3.20	3.40	3.00	3.70	3.10	3.50	3.00	3.30	3.10	2.60	2.60
Bamunpathri	185.30	122.80	4.40	3.30	3.90	3.95	4.00	3.60	3.70	3.70	3.70	3.70	2.80	3.30
Damodarapur	149.90	187.90	5.20	5.00	4.60	4.30	5.00	4.30	4.60	4.10	4.50	4.70	3.00	3.60
C.D.at 5%	17.682	18.396	0.893	0.967	0.539	0.940	1.285	0.845	NS	0.736	0.848	0.551	0.482	0.453
S.Em(±)	6.140	6.388	0.310	0.336	0.187	0.326	0.446	0.293	0.417	0.255	0.294	0.191	0.167	0.157

NS: Non-Significant

Table 5: Increase in plant spread in North-South direction (cm) of tissue cultured grown plants of Pomegranate cv. Bhagwa at bimonthly interval

Treatment	Initial plant spread		60 days		120 days		180 days		240 days		300 days		360 days	
	1st Year	2nd Year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
Chhatna	72.30	167.00	2.70	2.30	2.60	2.50	2.60	2.40	2.80	2.60	2.20	2.50	1.70	2.20
Pathri	42.40	112.20	2.60	2.80	2.90	2.70	2.80	2.90	3.00	2.90	2.70	2.80	2.50	2.70
Bamunpathri	197.80	127.10	3.40	3.50	3.30	3.30	3.50	3.50	3.50	3.60	3.60	3.40	2.80	2.90
Damodarapur	137.90	180.20	3.90	4.40	4.30	4.20	4.40	4.30	4.50	4.40	4.70	4.20	3.10	3.90
C.D.at 5%	18.886	19.247	0.675	0.689	0.635	0.684	0.787	0.605	0.812	0.570	0.485	0.805	0.790	0.635
SEm(±)	6.558	6.683	0.235	0.239	0.220	0.237	0.273	0.210	0.282	0.198	0.168	0.279	0.274	0.220

Table 6: Increase in number of leaves/ branch of tissue cultured grown plants of Pomegranate cv. Bhagwa at bimonthly interval

Treatment	Initial number of leaves		60 days		120 days		180 days		240 days		300 days		360 days	
	1st Year	2nd Year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year	1st year	2nd year
Chhatna	80.76	163.66	35.47	37.34	39.89	41.67	56.20	52.50	67.00	50.00	67.50	49.50	63.50	49.90
Pathri	27.57	205.19	16.53	22.70	65.94	60.50	67.50	60.50	84.30	52.10	88.00	50.30	87.50	50.50
Bamunpathri	555.00	516.00	104.79	97.24	122.50	99.40	127.30	110.40	126.70	109.00	128.80	101.00	112.00	104.00
Damodarpur	565.39	755.26	125.64	125.64	126.40	121.80	137.80	124.30	139.50	121.50	134.00	121.00	124.50	111.00
C.D.at 5%	123.974	117.367	21.439	24.601	15.458	16.034	23.925	13.365	21.506	10.471	26.965	13.615	21.968	10.890
S.Em(±)	43.049	40.755	7.444	8.543	5.368	5.568	8.308	4.641	7.468	3.636	9.363	4.728	7.628	3.781

Table 7: Increase in internodal length (cm) of tissue cultured grown plants of Pomegranate cv. Bhagwa at yearly interval

Treatment	Initial internodal length (cm)	1 st year	2 nd year
Chhatna		2.92	3.36
Pathri		2.88	3.30
Bamunpathri		3.57	4.07
Damodarpur		3.47	4.05
C.D.at 5%		0.375	0.355
S.Em(±)		0.130	0.111

Table 8: Increase in number of suckers/ plant of tissue cultured grown plants of Pomegranate cv. Bhagwa at bimonthly interval

Treatment	Initial no. of sucker		60 days		120 days		180 days		240 days		300 days		360 days	
	1 st year	2 nd year	1 st year	2 nd year	1 st year	2 nd year	1 st year	2 nd year	1 st year	2 nd year	1 st year	2 nd year	1 st year	2 nd year
Chhatna	1.50	17.10	1.80	3.30	2.00	3.10	1.90	2.80	2.30	3.00	2.60	2.30	2.50	1.70
Pathri	3.20	6.90	2.50	3.60	2.70	4.10	2.50	3.10	2.20	3.10	3.10	2.50	3.00	2.20
Bamunpathri	40.70	16.60	4.10	4.00	3.40	4.90	2.80	4.80	3.50	3.30	4.20	2.80	3.80	2.60
Damodarpur	33.30	83.30	6.90	7.60	5.60	7.40	5.60	7.40	4.60	4.40	4.60	4.40	4.30	3.00
C.D.at 5%	6.436	13.013	1.322	1.584	1.083	1.186	1.170	1.274	0.753	NS	1.044	1.142	NS	0.570
S.Em(±)	2.235	4.519	0.459	0.550	0.376	0.412	0.406	0.443	0.261	0.399	0.362	0.397	0.615	0.198

Conclusion

In the present experiment, observations revealed that soil pH of the experimental locations were acidic ranging from 4.67 to 5.75. The soil had low organic carbon ranging from 0.39% to 1.00%. Bulk density of the soil varied from 1.46 g cm⁻³ to 2.18 g cm⁻³. Bimonthly increase in plant height, stem girth, plant spread, number of leaves and number of suckers were highest at Damodarpur. This might be due to climatic factors and soil characteristics of the location. Internodal length at yearly interval was also maximum at Damodarpur. Subsequently, it can be concluded that the finding of this present experiment that is successful cultivation of pomegranate at Damodarpur location may be disseminated to the farming community for increasing their income and livelihood by pomegranate cultivation.

Reference

- Anonymous. Indian Horticulture Database, National Horticulture Board, Ministry of Agriculture & Farmers Welfare, Govt. of India. 2014;52:30-31.
- Anonymous. Annual Report. ICAR-NRC on Pomegranate, Solapur, Maharashtra, p. 66.
- Anonymous. Horticultural Statistics at a Glance. Govt. of India, 2016-2017; c2018. p. 183.
- Chandra R, Jadhav VT. Pomegranate (*Punica granatum* L.) biodiversity and conservation. Biodiversity and agriculture, Uttar Pradesh State Biodiversity Board; c2008. p. 63-64.
- Chell S, Roy S, Mohanta R, Mondal T, Layek S, Mandal KK. Effect of Nitrogen and Potassium on Pomegranate cv. Bhagwa under Red And Lateritic Zone of West Bengal. Journal of Survey in Fisheries Sciences. 2023;10(1S):6979-6983.
- Cziczor L, Bentkamp C, Damerow L, Blanke M. Non-invasive determination of the quality of pomegranate fruit. Postharvest Biology and Technology. 2018;136:74-79.
- De Candolle A. Origin of Cultivated Plants. Hafner Publishing Company, New York and London; c1967, 441.
- Ghosh SN, Bera B, Roy S, Kundu A. Effect of plant growth regulators in yield and fruit quality in pomegranate cv. Ruby. Journal of Horticultural Sciences. 2009;4(2):158-160.
- Panse VG, Sukhatme PV. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi; c1985. p. 145-152.
- Reddy YN. Certain new approaches to the production problems of Pomegranate. Acta Horticulturae. 2011;890:287-293.
- Saroj PL, Kumar R. Recent advances in pomegranate production in India-a review. Annals of Horticulture. 2019;12(1):1-10.