Original Research Article

Comparative assessment of farmer's brinjal variety in different agro-climatic conditions

Abstract

In order to evaluate the performance and suitability of the long brinjal variety *'Niranjan Bhata'* developed by an innovative farmer of Chhattisgarh in different agro-climatic conditions of the country, the comparative field experiment conducted under Gandhinagar, Gujarat condition was accommodated in a randomized complete block design comprising five replications of four treatments, i.e. *Niranjan Bhata*, *Pusa Shamla* as National Check (NC) and two Local Check (LC) during *Kharif* 2016. The plant height of *Niranjan Bhata* (115.50 cm) was recorded at par with LC-1 (118.33 cm). However, the maximum fruit length (45.80 cm) was recorded in Niranjan Bhata (45.80 cm). The significant highest fruit yield was produced by Niranjan Bhata (314 q/ha).

Farmer participatory on-farm trials (FPOFTs) in five states were also carried out in five states (Chhattisgarh, Gujarat, Odisha, Kerala, and Manipur) between 2017-18 and 2020-21 at 68 locations (loc.) during the *Kharif* season. The test variety *'Niranjan Bhata'* reported superior performance in Chhattisgarh with the highest plant height (161.17 cm), fruit length (59.67 cm), and marketable fruit yield (9.81 kg/plant). Similarly, the variety outperformed in Gujarat and Maharashtra states and showed percent increase in plant height (9.39%, 16.40%), fruit length (55.10%,

49.00%) and fruit yield (34.81%, 35.45%) over checks respectively. As per the growers' feedback, the variety was found to be high-yielding. The long fruits containing lesser seeds and soft pulp having a lower infestation of insect pests and diseases with good market preference too. Thus the evaluation of variety with the farmers' participation was found most suitable approach which assured the varietal preference and its suitability for large-scale dissemination.

Keywords: Brinjal, Eggplant, *Solanum melongena***,** Niranjan Bhata, farmer participatory on-farm trials, long fruit

Introduction:

Brinjal (*Solanum melongena* L) is the most important solanaceous crop cultivated in subtropical and tropical areas. Globally, India is the second largest producer after China contributing 24.5% with 12.6 Million tonnes in global production [1]. A range of wild species of Eggplant (*Solanum melongena*) is found abundantly in the country, considered to be a rich source of genetic diversity for breeding programs, particularly for the characteristics associated with climate change adaptability [2]. The indigenous genotypes and local landraces of brinjal were superior in yielding to other economic traits and resistance to pests and diseases, which are considered the most desirable traits for crop improvement programs [3, 4]. The replacement of traditional, regionally adapted crop varieties with high-yielding and hybrid varieties threatens global agro-biodiversity, resulting in collective losses of the crop, variety, and allele diversity [5]. Despite this fact, wild relatives of crops are highly under-represented in the worldwide eggplant genetic resource conservation system.

Farmers require improved eggplant varieties for sustainable production and adaptability against the various challenges due to climate change [6, 7].

Although such studies so far, very less substantial work has been undertaken to promote potential traditional landraces and farmers' developed brinjal varieties at farmers' fields. As a result, in light of the importance of such studies, comparative performance evaluation trials at Gandhinagar, Gujarat and farmer-participatory on-farm trials to evaluate the performance of a long-fruited farmer's brinjal variety *'Niranjan Bhata'* with ascertaining farmers' assessment of the variety for desirable traits in different agro-climatic zones of the country were undertaken. The test variety was developed through the mass selection method based on fruit length with other characteristics i.e. lesser number of seeds, prickles on the stem, and calyx with resistance to major insect pests and diseases by an innovative farmer of Dhamtari district of Chhattisgarh from a traditional cultivar conserved by his forefathers for the last 70 years [8]. The innovator for his significant contribution to the crop improvement of brinjal has been conferred with an award by then Hon'ble President of India Shri Pranab Mukherjee at Rashtrapati Bhavan, New Delhi during the Festival of Innovation-2017 organized by National Innovation Foundation-India. The application for registration of the variety under PPV&FR, Act 2001 has also been filed (REG/2017/1797) at Protection of Plant Varieties and Farmers' Rights Authority, New Delhi.

Material and Method

The field trial was conducted at NIF's research farm, Gandhinagar district of Gujarat, situated at 23.223˚N latitude and 72.650˚E longitude conditions for the

performance evaluation of farmer's brinjal variety *'Niranjan Bhata'* in comparison with a national check (NC) and two local checks (LC) during *Kharif* 2016. The trial was accommodated in a randomized complete block design comprising four treatments and five replications. The local checks were procured from the agri-input shop from Gandhinagar after interaction with the progressive farmers of the region, while a national check (*Pusa Shyamla*) was collected from Seed Division, ICAR-Indian Institute of Agricultural Research, New Delhi. The cultivation practices of the brinjal as recommended for a particular area for a good crop stand were adopted. In order to evaluate the performance and ascertain farmers' assessment of the variety on its claimed traits viz. fruit length with plant height, and fruit yield per plant in different agro-climatic conditions, the farmer-participatory on-farm trials (FPOFTs) were also undertaken by the NIF team from the headquarter, Gandhinagar (Gujarat), NIF-Cell, Guwahati (Assam) for North East Region and NIF-cell, Bhubneswar (Odisha) at 68 locations covering five states Chhattisgarh, Gujarat, Odisha, Kerala and Manipur during Kharif 2016-17 and 2017-18. Similarly, comparative FPOFTs were also conducted at ten locations in each Gujarat and Maharashtra states during *Kharif* 2020-21. Under the supervision of NIF's experts, the seeds of the test variety *(Niranjan Bhata)* are only being produced and maintained by the innovator. NIF provided seeds of the variety to selected potential brinjal growers and acquainted them with its cultivation practices. The observations were recorded from ten randomly selected plants and/or plant parts and subjected to statistical analysis using standard protocols. This FPOFTs study can be used to facilitate multi-location on-farm trials by involving more farmers to generate reliable data on its uniformity and stability for further crop improvement programs. Such trials will also help us to

devise appropriate strategies for its dissemination in suitable agro-climatic conditions on a large scale.

Result and Discussion

The comparative study conducted at NIF research farm, Gujarat during *Kharif* 2016 revealed that the *Niranjan Bhata* variety reported a higher plant height of 115.50 cm, found statistically at par with LC-1 recorded with a maximum plant height of 118.33 cm among all test varieties. However, the fruit length of *Niranjan Bhata* variety (45.80 cm) was recorded as significantly superior. In the same way, the significantly highest marketable fruit yield was recorded in *Niranjan Bhata* with 314 q/ha (Table 1).

Table 1: Performance evaluation of *Niranjan Bhata* in comparison to checks under the Gandhinagar condition.

Brinjal varieties	Plant height (cm)	Length of fruit (cm)	Fruit Yield (q/ha)
Niranjan Bhat	115.50	45.80	314.00
Pusa Shyamla	86.60	19.30	269.80
Local check-1	118.33	22.50	226.20
Local check-2	75.23	17.20	225.60
SEm ±	1.27	0.71	2.55
CD (p=0.05)	3.91	2.19	7.85
CV%	2.87	6.07	2.20

Note: The data presented are the mean of five replications and recorded from 10 plants/plant parts

The higher fruit yield of *Niranjan Bhata*, brinjal variety might be attributed also by higher plant height and more fruit length. The fruit yield has a significant and positive correlation with plant height [9, 10], completely support the present result obtained. A similar significant and positive association of plant height and fruit length with fruit yield was also revealed in some studies [11,12] which is also consistent with the present result obtained. In the study of Bhushan *et al*. 2020 [13],

the highest fruits yield (per plant & per hectare) was obtained in *Pusa Shyamla*, indicating the higher yield of farmer's variety and partially supporting the present findings.

Farmer-Participatory On-Farm Trials: The data generated and analyzed from the research trial revealed that the brinjal variety, *Niranjan Bhata* fulfilled multiple requirements, including agronomic performance and quality production during the trials. Therefore, in view of the above, it was envisaged to evaluate the variety at farmers' fields to check its performance and suitability in various locations across India. Thus, the data recorded and analyzed from the farmer-participatory on-farm trials conducted during *Kharif* 2016-17 and 2017-18 at a total of 68 locations (Loc.) covering five states, e.g. Manipur (Loc 4), Chhattisgarh (Loc 48), Gujarat (Loc 08), Kerala (Loc 3) and Odisha (Loc 5) is depicted in Table 2 and Appendix I. NIF provided seeds of the test variety to selected farmers who voluntarily agreed to participate in the study and the farmers adopted cultivation practices of the respective region, including plant protection measures. The researchers posted in different locations by NIF collected the observations and farmers' feedback from the trials. The data presented showed that the Niranjan Bhata, brinjal variety outperformed in Chhattisgarh with the highest plant height (161.17 cm), fruit length (59.67 cm), and yield (9.81 kg/plant). Similarly, Chhattisgarh recorded highest fruit length (59.67 cm) and followed by Odisha, Manipur, Kerala, Gujarat, and Maharashtra. On the same way, the maximum fruit yield was recorded in Chhattisgarh (9.81 kg/plant) followed by Maharashtra (6.46 kg/plant), Gujarat (5.83 kg/plant), Odisha (5.10 kg/plant), Manipur (4.00 kg/plant), and Kerala (2.50

kg/plant). In unavailability of long-fruited local check at test locations, the trait-specific observations for the farmer's variety were recorded and presented.

Table 2: Performance of *Niranjan Bhata* brinjal variety under farmer-participatory on-farm trials (FPOFTs) conducted in five states in the *Kharif* season between 2016-17 and 2017-18.

States	Plant height (cm)	Fruit length (cm)	Yield per plant (kg)
Manipur (Loc 4)	108.75	53.00	4.00
Chattisgarh (Loc 48)	161.17	59.67	9.81
Gujarat (Loc 08)	97.17	41.83	5.83
Kerala (Loc 3)	109.67	38.00	2.50
Odisha (Loc 5)	107.80	54.00	5.10
Mean	116.91	49.30	5.45
SD	25.25	9.04	2.74
SEm ±	11.29	4.04	1.23

Note: The data presented were the mean of data recorded from 10 plants/plant parts from respective locations

Photographs:

i. Comparative study of Niranjan Bhata conducted during Kharif 2016-17 under Gandhinagar (GJ) condition.

Photo 1. View of the fruit length & pulp appearance of Niranjan Bhata at experimental field

ii. Farmer-Participatory On-Farm Trials in different agro-climates

Photo 2. FPOFTs in Gujarat 2016-17 and

Photo3. FPOFTs in Chattishgharh-2017-18

Photo 4. FPOFTs in Manipur

Photo 5. FPOFTs in Kerala 2016-17

Photo 6. FPOFTs in Odisha

Table 3: Comparative assessment of *Niranjan Bhata* brinjal variety under farmers' participatory on-farm trials (FPOFTs) conducted at ten locations in each Gujarat and Maharashtra state during *Kharif* 2020-2021.

States	Plant height (cm)			Fruit length (cm)			Yield per plant (kg)		
	Niranjan Bhatan	Local Check	PIOC	Niranjan Bhatan	Local Check	PIOC	Niranjan Bhatan	Local Check	PIOC
Gujarat	99.12	89.81	9.39	35.30	15.85	55.10	5.85	3.82	34.81
Maharashtra	103.47	86.5	16.40	37.06	18.9	49.00	6.46	4.17	35.45
Mean	101.30	88.16		36.18	17.38		6.16	3.99	
SD	3.08	2.34		1.24	2.16		0.43	0.25	
SEm ±	2.18	1.66		0.88	1.53		0.30	0.18	

Note: The data presented were the mean of data recorded from 10 plants/plant parts from respective locations where Loc.: Location; PIOC: Percent Increase Over Control

iii. Farmer-Participatory On-Farm Trials in Gujarat and Maharashtra

Photo 7. FPOFTs in Gujarat -

Photo 8. FPOFTs in Maharashtra 2020-21

Where in the comparative results of FPOFTs in Gujarat and Maharashtra showed the superiority of *Niranjan Bhata* over local checks. It was recorded 9.39%, 55.10%, and 34.81% higher plant height, fruit length, and fruit yield, respectively as compared to local check in Gujarat, and a similar trend was also observed in Maharashtra with 16.40%, 49.00%, and 35.45% increase in plant height, fruit length

and fruit yield in Maharashtra (Table 3). These results revealed that the Niranjan Bhata variety is most suitable for *river basins Agro-eco region and Hot Moist/Dry Sub-humid Transitional ESR region* of Chhattisgarh, which gave a better result in the *hot arid/ semi-arid eco-region* including plains of Maharashtra and Gujarat states. It was also found suitable for the *hot moist sub-humid eco sub-region* of Odisha. However, it performed lower in the *North-Eastern Hills Warm Perhumid Eco-sub regions* of Manipur. It may not perform better in the *hot subhumid - humid to perhumid eco-subregion* of Kerala (ICAR-Agro-Ecological Sub Region).

The performance of variety at farmers' fields mainly depends upon the various agro-climatic conditions of the respective area. Therefore, the variation in plant height, fruit length, and fruit yield might be influenced by the weather and growing environment in respective states at different locations. The study of Rajasekar *et al.* 2013 [14] reveals the significant effect of temperature and relative humidity on the number of branches, plant height, inter-nodal length with average fruit weight, and yield per plant, which is in confirmation of the present findings. A similar finding of the significant role of temperature and relative humidity in biometric and yield parameters such as plant height, number of leaves, leaf area index, fruit length, girth, and weight, including soil fertility improvement which favours growth and productivity of the crop, was revealed by Shikha *et al.* 2020 [15] which partially supports variation in yield found in the present findings.

As per the feedback recorded from growers, the farmer's brinjal variety, Niranjan Bhata found a high yielder and bears more fruits per plant. The longer fruits contained lesser seeds with soft pulp and were found to be most suitable for the '*sabzi*' and "Sambhar" preparation due to their good taste. The consumer preference

for the brinjal fruits is based on shape, size, colour and flavour, including ripeness with less seeded fruit pulp [16]. The fruits of this variety also fetch a higher market price due to long fruit preferences. The beneficiaries of Maharashtra, Odisha, and Chhattisgarh have been able to enhance their income due to attractive fruit appearance, higher yield, and long fruit size. Local landraces and traditional cultivars still contribute one-third of the cultivation of brinjal crops in India, which might be due to locale specification performance, and consumer-friendly attributes of the cultivars [17] found consistent with present findings. Indigenous vegetable cultivars provide nutritional and financial security for small farmers and women. The result is inconsistent with the findings of Singh *et al*. 2020 [18].

The present study gives a choice to the farmers that they can adopt the improved farmers' developed crop varieties, which are better adapted to wider climatic conditions. A similar finding was revealed by Kaushik *et al.* 2016[2] for wild species of eggplant, which was found in concordance with the present findings.

As per the phenotypic observation of the farmers' field and noticed by the growers of this variety that *Niranjan Bhata* possesses long fruits having spines on shoot and calyx was reported to lower the incidence of pests and diseases. The similar morphological characteristics prevented the insect from egg-laying on shoot and fruits, as reported by Gautam *et al*. 2019 [19] and the Local long fruited cultivars *Pusa Purple Long* - 74, including *Navkiran* were observed with the low shoot and fruit infestation by Mathur *et al*. 2012 [20] which is in line with the present study.

Hence, it is a thrust to work on Host Plant Resistance and the identification of markers for this brinjal variety, Niranjan Bhata. It shall also be a prominent variety

for developing high-yielding, pests-resistant varieties. The local landraces and farmers' plant varieties are a rich source of genetic material for the trait-specific development of varieties for researchers. They would facilitate the improvement of local genotypes with greater adaptability to local conditions with the capability of performing better with higher yield [21].

Conclusion:

Superiority in desirable traits fruit length and yield of the farmers developed brinjal variety - Niranjan Bhata in comparison to Pusa Shyamla and local checks makes it potential variety for wider dissemination. The Farmer-Participatory On-Farm Trials (FPOFTs) also concluded the variety as most preferred for different agro-climatic conditions i.e. Chhattisgarh, Maharashtra, Gujarat, and Odisha. It also outperformed during comparative Farmer-Participatory On-Farm Trials (FPOFTs) conducted at the tribal and hilly regions of Gujarat and Maharashtra. It made is a more reliable and promising planting material for such resource-poor farmers for additional income generation from small land holdings. As per the growers' feedback, the variety had minimum pest occurrence where lesser seeds with soft pulp made it more preferred for cooking purpose. The performance recorded with such preferred characteristics can increase the varietal adoption among small landholders and make it a potential landrace for crop improvement programs too.

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Appendix I. Site and agro-climatic descriptions of the various locations for the performance evaluation trials of farmer's brinjal variety 'Niranjan Bhata'.

State	Districts covered	Agro-Climatic Region (ICAR-Agro Ecological Sub Region)	Agro Climatic Zone (NARP)
Manipur	Thoubal	Zone II: Eastern Himalayan Region (17.2 North-Eastern Hills (Purvachal), Warm Perhumid Eco-sub region)	Sub-Tropical Zone (NEH-4)
Chhattisgarh	Dhamtari	Zone-VII: Eastern plateau and hills (11.0 Chhattisgarh/Mahanadi Basin Agro-eco region)	Chhattisgarh plain zone
	Durg	Zone VII: Eastern plateau and hills region (11.0 Moderately To Gently Sloping Chattisgarh Mahanadi Basin, Hot Moist/Dry Sub-humid Transitional ESR With Deep Loamy To Clayey Red And Yellow Soils)	Chhattisgarh plain zone (MP-1)
Gujarat	Junagadh	Zone XIII: Gujarat Plains & Hills Region (5.1 Arid western Plains)	South Saurashtra Zone (GJ.7)
	Kheda	Zone XIII: Gujarat plains and hill region (5.2 Central Highlands (Malwa), Gujarat Plain And Kathiawar Peninsula, Semi-Arid Eco-Region)	Middle Gujarat Agro Climatic zone(GJ-3), North Gujarat Zone GJ-4
	Gandhinagar *	Zone XII: Gujarat Plains and Hills Region *(4.2 Northern Plain (And Central Highlands) Including Aravallis, Hot Semi-Arid Eco-Region)*	North Gujarat Zone (GJ-4)
	Bharuch	Zone XIII: Gujarat plains and hills region (5.2 Central (Malva) Highlands, Gujarat Plains and Kathiawar, Peninsula Ecoregion)	South Gujarat Zone (GJ-2)
	Narmada	Zone XIII: Gujarat Plains and hills region (*5.2 Central highlands, Malwa, Gujarat Plain*)	South Gujarat Zone (GJ-2)

Kerala	Kozhikode	Zone XII: West Coast Plains and Ghat Region (*19.3 Konkan, Karnataka and Kerala Coastal plain, hot humid to perhumid eco-subregion*)	Northern Zone (KE-1)
	Idukki	Zone XII: Western Plain and Ghat Region (*19.2 Western Ghats And Coastal Plain, Hot-Humid Region*)	High altitude zone (KE-4)
	Thrissur	Zone XII: West Coast Plains and Ghat Region (*19.2 Konkan, Karnataka and Kerala Coastal plain, hot humid to perhumid eco-subregion (19.3) Central and south Sahyadris, hot moist, subhumid to humid eco-subregion*)	Central Zone (KE 3)
Odisha	Kalahandi	Zone VII: Eastern plateau and hill region (*12.1 Gujrat Hills, Dandakaranya and Eastern Ghats hot moist sub-humid eco sub-region*)	Western undulating zone (OR-8)
Maharashtra	Nandurbar	Zone IX: Western Plateau & hills region (*6.1 Deccan Plateau, hot semi-arid ecoregion*)	Western Maharashtra Plain Zone (MH-6)

Source: Agriculture Contingency Plan. Ministry of Agriculture & Farmers Welfare, Department of Agriculture & Farmers Welfare. *Govt. of India*. 2022. [22, 23]; * SAP & SIDP 2017-18 to 2019-20 Gujarat, Dept. Agri., Farmers Welfare and Co-operation Govt. of Gujarat, Gandhinagar.