Collection of Chilli Genetic Resources from different Geographical Regions of West Bengal, India

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Abstract

West Bengal, India is immensely rich in plant biodiversity. The present study was undertaken for an exploration and collection mission for wild, semi-wild, and domesticated populations of Chilli germplasm collection was carried out from 2009 to 2012, a total eighty-eight accessions in 17 district of WB on the basis of their shape, size and color along with pungency which are always the selected characteristics feature of chilli. This collection was expanding the number of accessions of wild chilli that are publicly available for research in plant improvement, characterization, evaluation and for subsequent use in an inquiry into the domestication. The diversity could mainly be attributed to diverse agro climatic conditions in WB. The intraregional diversity could be as a valuable source as interregional diversity for chilli improvement. With the establishment of *Seed Genebank* we stored natural orthodox seeds in low temperature (4-6^{0}C) and low humidity condition.

1. Introduction

Chilli (*Capsicum* spp.) is one of the world's major vegetables and spice crops (Zewdie et al., 2004) as well as it is used in food industries for flavoring and coloring, and is valued as medicine and ornamentals (Mongkolporn, 2011). Chilli is ranked among the world's one of the most important vegetables. Csillery (2006) indicates that the first competent description of *Capsicum* was given in *Hungarian Herbal* by Dioszegi and Fazekas (1807), who used the nomenclature of Linnaeus to describe *C. annuum* and *C. sinense* (later *C. chinense*; the Chinese pepper). Chilli belongs to the family *Solanaceae* and includes 31 known species (Moscone et al., 2007). It is thought to originate from South America and has spread throughout the world, including the tropics, subtropics and temperate regions (Pickersgill, 1997). Among the 31 species included in the *Capsicum* genus, only five - *C. annuum, C. baccatum C. chinense, C. frutescens,* and *C. pubescens* - have been domesticated and cultivated (Heiser and Pickersgill 1969; IBPGR 1983). Chilli is widely cultivated from July to December in northern state of India (Choudhary and Samadia, 2004). Genetic variability and characteristic associations were previously studied by various workers, especially for *Capsicum annuum* as it is the most ecofriendly (economically as well as ecologically) species in the Indian subcontinent (Choudhary and Samadia 2004; Sreelathakumary and Rajamony 2004). The Indian germplasm is mainly represented by two species, *C. annuum* and *C. frutescens* with a number of varieties (Thul et al., 2009).

In India, it is cultivated in an area of about 9.15 lakh ha (Kallaupurackal and Ravindran, 2004) and exports only 2.75 to 7.50% of its total production. In West Bengal, it is an important cash crop, cultivated in an area of about 65,930 ha with a production of about 643,677 tones and contributes 6% in terms of Indian chilli production (Datta and Jana, 2011). Chilli is grown under diverse ecosystems. Farmers of WB have been growing chilli in highly diverse agro-climatic situations from Hilly and Terai soils of Himalayan foot hills in the North, Red lateritic and gravelly soils in the West, coastal saline soils in the South to rich alluvial soils in the Central region. Therefore, many genetically diverse chilli varieties are grown in different agro-climatic area of WB and no other state in the country has such diversity in chilli ecosystem.

Most chilli cultivars currently grown here are open pollinated. Some local chilli landraces are still grown on many small

farms due to consumer demand. For decades, these have been cultivated in different environments with same season has been also reported by Lohithaswa et al., 2000 and under different growing condition by Mini and Vahab (2000). In general, they are genetically diverse and well adapted to the locations where they have been developed (Votava et al., 2005). Although chilli plants are considered autogamous (Allard, 1960), high rates of cross-pollination (7-90%) have been recorded in several studies, and cross-pollination events could change the genetic identity of these landraces. Further, given the importance of commercial chilli production in WB, many growers have turned away from the traditional cultivars towards new, higher yielding cultivars that produce fruit suitable for processing. Certainly, hybrid varieties are used for greenhouse production.

However, morphological characterization is the first step in the description and classification of germplasm (Smith and Smith, 1989). The main aim of this study was to analyze the morphological and agronomic traits of WB chilli accessions collected from different parts of the state in order to assess their genetic diversity. It is hoped that this collection can be the foundation of further research efforts into the ecology of wild *Capsicum* and into the relationship between wild populations and the domesticated chilli peppers.

2. Material and Methods

2.1. Exploration, collection and documentation

At present, many wild cultivars of chilli was collected from different parts of West Bengal, India. During the period from 2009 to 2012, a total of eighty eight accessions has been assembled in 17 district and collection missions which included the trips made by the individual research workers under the Plant Biotechnology Laboratory, Department of Botany, Ramakrishna Mission Vivekananda Centenary College, Rahara, Kolkata, WB (700 118), India. as given in Table 1.

Collection trips were timed to coincide with fruiting periods of the plants. Collection trips started in September and terminated in mid of January. Using a personal vehicle would drive to the areas identified and search for local informants who could aid in the localization of plants in the area. Species ID were made GPS coordinates of each plant were recorded along with altitude (in meters above sea level) and the geo-political location of the presumed wild specimens (town, municipality, state), and all the ripe fruits collected from a single plant were given a unique ID. Ripe fruits were placed directly into manila envelopes, where exposure to the arid environments would ensure dried fruits in 3-5 days. Chilli populations were sampled from hilly region to coastal saline soils and also in human disturbed habitats. Plants that were found growing in minimally disturbed habitat were considered to be *wild*, whereas plants collected from areas that were disturbed and managed by humans, yet not intentionally planted, were considered *semi-wild*. In some other occasions well ripened fruit and seeds of different varieties are also collected from different local vegetable market as well as nurseries. Finally, the collected seeds of the different verities of chilli were conserved as *Seed Gene bank* we stored natural orthodox seeds in low temperature (4^0C) and low humidity condition.

3. Results and Discussion

A total of 88 varieties were sampled from hillsides, fields, creek beds and home gardens and markets. The wild chilli collection was found in a number of habitats and locales from 21°62' N to 27° 06' N, 85° 05' E to 89° 66' E (Table 1). We will review in closer detail each of the regions where collections were obtained.

The gradient between wild, semi-wild, and domesticated is quite fine and collectors in the field are challenged to identify the different varieties of chilli (Kraig et al., 2012). *Capsicum* species exhibit a wide variety of shapes, colors and sizes (Walsh and Hoot, 2001) on the basis of this maximum type of chilli was collected from different well-known vegetable market of Kolkata as an individual district, namely Baithakkhana market, Sealdah market and Dhakuria Market. Southern part of the WB including, Kolkata, North 24-Parganas, South 24-Parganas, West Medinipur, East Medinipur, Howrah, Hoogly and Nadia a total 54 type of chilli was found, maximum of them are collected from field as well as local market. In Middle part of the WB total 19 type of chilli was collected from different parts of Burdawn, Bankura, Birbhum, Purulia and Murshidabad district. Lastly the Northern part of WB, from four different district, Darjeeling, Coochbehar, North Dinajpur and Malda a total 15 type of chilli was sampled. In Figure 1 shows the photograph of some different types of red and green chilli.

Fruit size and pungency are always among the preferred characteristics in the surveys of chilli use in WB. The most of the chilli farmers grow local cultivars both in winter (*rabi*) and rainy (*kharif*) season because it has been known as part of human diet since the beginning of civilization (MacNeish, 1964). Out of eighty eight type of chilli some of them like Bullet lanka, Tejwasini lanka, Acchar lanka, Ghee lanka etc. have also found in different district with same local name due to its high commercial value. Though these varieties were grown in different climatic region and as well as different soil condition, slightly changes in their size and shape were observed. In general, larger and heavier fruits have low pungency and are used for cooking, in this case scented salad chilli are famous (Barbosa et al., 2010). Consumers' choice in relation to large fruits lies much more on fruit consistency and morphological dimensions that on pungency (Olarewaju and Aliyu, 1994). As compared to the three different region of

Table 1: List of Collected varieties of Chilli.

Sl. No.	Local Name	Location	District	Longitude	Latitude
1	*Kacche Gosani* Chilli	Ghum	Darjeeling	88°13'E	27°00'N
2	S-7	Kalimpong	Darjeeling	88°47'E	27°06'N
3	*Dholuya* Chilli	Kalimpong	Darjeeling	88° 47' E	27°06'N
4	*Bullet lanka*-6	Mathabhanga	Coochbehar	89° 21' E	26°34'N
5	Bullet Hybrid Lanka	Mathabhanga	Coochbehar	89°21'E	26°34'N
6	S-8	Tufanganj	Coochbehar	89°66'E	26°31'N
7	*Laal Lanka*	Tufanganj	Coochbehar	89°66'E	26°31'N
8	*Dhani Lanka*-5	Tufanganj	Coochbehar	89°66'E	26°31'N
9	*Dhani Lanka*-1	Kaliaganj	North Dinajpur	88°32'E	25°63'N
10	*Acchar Lanka*-3	Kaliaganj	North Dinajpur	88°32'E	25°63'N
11	*Kull Lanka*	Islampur	North Dinajpur	88°18'E	26°26'N
12	White *Bullet Lanka*	Islampur	North Dinajpur	88°18'E	26°26'N
13	S-9	Kaliachak	Malda	88°01'E	24°86'N
14	S-10	Kaliachak	Malda	88°01'E	24°86'N
15	*Bullet Lanka*-5	Kaliachak	Malda	88°01' E	24°86'N
16	IR8-3	Berhampore	Murshidabad	88°26'E	24°09'N
17	*Bullet Lanka*- 9	Berhampore	Murshidabad	88°26'E	24°09'N
18	*Chibri Lanka*	Berhampore	Murshidabad	88°26'E	24°09'N
19	*Beldanga Lanka*-1	Beldanga	Murshidabad	88°25'E	23°93'N
20	*Beldanga Lanka*-2	Beldanga	Murshidabad	88°25'E	23°93'N
21	*Janjhi Lanka*	Bolpur	Birbhum	87°68'E	23°68'N
22	*Buno Lanka*	Bolpur	Birbhum	87°68'E	23°68'N
23	*Bullet Lanka*-1	Rampurhat	Birbhum	87°78'E	24°17'N
24	IR8 -1	Rampurhat	Birbhum	87°78'E	24°17'N
25	*Tob Lanka*	Aranghata	Nadia	88°61'E	23°24'N
26	*Bullet Lanka*-3	Aranghata	Nadia	88°61'E	23°24'N
27	*Ghee Lanka*-3	Chakdaha	Nadia	88°51'E	23°08'N
28	*Kalo Lanka*-1	Chakdaha	Nadia	88°51'E	23°08'N
29	Yellow long *lanka*	Kalyani	Nadia	88°44'E	22°97'N
30	S- 6	Ranaghat	Nadia	88°57' E	23°17'N
31	*Sobuj Lanka*	Ranaghat	Nadia	88°57'E	23°17'N
32	*Dudhe Lanka*	Taherpur	Nadia	88°54'E	23°27'N
33	S-4	Burdwan	Burdwan	87°86'E	23°23'N
34	*Bombay Lanka*	Burdwan	Burdwan	87°86'E	23°23'N
35	*Bullet Lanka* 10	Durgapur	Burdwan	87°32'E	23°49'N
36	S-5	Galsi	Burdwan	87°69'E	23°66'N
37	S-11	Akui	Bankura	87°63'E	23°14'N
38	*Bullet Lanka*-7	Akui	Bankura	87°63'E	23°14'N
39	*Surya* Supreme *Lanka*	Bishnupur	Bankura	87°32'E	23°07'N
40	S-13	Bagmundi	Purulia	85°05'E	23°19'N
41	S-12	Bagmundi	Purulia	85°05'E	23°19'N
42	*Dhani*-4	Jhalda	Purulia	85°97'E	23°36'N
43	Sweet Banana Lanka-1	ChandannagarHaat	Hooghly	88°39'E	22°89'N
44	*Purano Bangla Lanka*	ChandannagarHaat	Hooghly	88°39'E	22°89'N
45	IR8-2	ChandannagarHaat	Hooghly	88°39'E	22°89'N

Continue

46	*Karbhanga Lanka*	Goghat	Hooghly	87°70'E	22°88'N
47	*Bullet Lanka*-5	Bandel	Hooghly	88°37'E	22°92'N
48	*Jhanti Lanka*	Tajpur	Howrah	88°00'E	22°57'N
49	*Surya Mukhi Lanka*	Tajpur	Howrah	88°00' E	22°57'N
50	*Dhani Lanka*-3	Tajpur	Howrah	88°00'E	22°57'N
51	*Tejwasini Lanka*-1	Amta	Howrah	88°00'E	22°57'N
52	*Thubi Lanka*	Amta	Howrah	88°00'E	22°57'N
53	*Pusha Jwala Lanka*	Amta	Howrah	88°00'E	22°57'N
54	*Jhanti Lanka*	Shyampur	Howrah	88°03'E	22°29'N
55	*Lethe Lanka*	Bagnan	Howrah	87°96'E	22°46'N
56	*Kasu Lanka*	Aminpur	Howrah	88°26'E	22°59'N
57	*Acchar Lanka*-1	Baithakkhana	Kolkata	88°36'E	22°57'N
58	*Soru Lanka*	Baithakkhana	Kolkata	88°36'E	22°57'N
59	*Jhal Lanka*	Baithakkhana	Kolkata	88°36'E	22°57'N
60	*Chapati Lanka*	Baithakkhana	Kolkata	88°36'E	22°57'N
61	Capsicum Salad(Red)	Baithakkhana	Kolkata	88°36'E	22°57'N
62	Sweet Banana *Lanka*-2	Dhakuria Market	Kolkata	88°36'E	22°51'N
63	*Acchar Lanka*-4	Dhakuria Market	Kolkata	88°36'E	22°51'N
64	*Ghee Lanka*-2	Dhakuria Market	Kolkata	88°36'E	22°51'N
65	*Acchar Lanka*-5	Sealdah Market	Kolkata	88°37'E	22°56'N
66	*Tejwasini Lanka*-2	Sealdah Market	Kolkata	88°37'E	22°56'N
67	*Bullet Lanka*-11	Sealdah Market	Kolkata	88°37'E	22°56'N
68	*Kalo Lanka*-2	Sealdah Market	Kolkata	88°37'E	22°56'N
69	*Haringhata Lanka*	Digha	West Medinipur	87°52'E	21°62'N
70	*Kolkati Lanka*	Digha	West Medinipur	87°52'E	21°62'N
71	*Deshi Lanka*	Digha	West Medinipur	87°52'E	21°62'N
72	*Rupsa Lanka*	Datan	West Medinipur	87°26'E	21°91'N
73	*Saipaa Lanka*	Datan	West Medinipur	87°26'E	21°91'N
74	*Bullet Lanka*-4	Haldia	East Medinipur	88°10'E	22°06'N
75	*Khanra Lanka*	Tamluk	East Medinipur	87°91'E	21°27'N
76	*Birnagar Puta*	Chowberia	N. 24 Parganas	88°67'E	22°97'N
77	*Dhani Lanka*-2	Chowberia	N. 24 Parganas	88°67'E	22°97'N
78	*Chotna Lanka*	Chowberia	N. 24 Parganas	88°67'E	22°97'N
79	*Bullet*-8	Barrackpore	N. 24 Parganas	88°38'E	22°76'N
80	S-1	Barrackpore	N. 24 Parganas	88°38'E	22°76'N
81	*Ghee Lanka*-1	Khardah	N. 24 Parganas	88°37'E	22°72'N
82	*Chop Lanka*	Khardah	N. 24 Parganas	88°37'E	22°72'N
83	S-2	Rahara	N. 24 Parganas	88°38'E	22°72'N
84	S-3	Titagarh	N. 24 Parganas	88°37'E	22°73'N
85	*Acchar Lanka*-2	Titagarh	N. 24 Parganas	88°37'E	22°73'N
86	*Volvo Lanka*	Diamond Harbour	S. 24 Parganas	88°18'E	22°19'N
87	*Krishnachura Lanka*	Diamond Harbour	S. 24 Parganas	88°18'E	22°19'N
88	*Bullet Lanka*-2	Diamond Harbour	S. 24 Parganas	88°18'E	22°19'N

WB, maximum varieties of chilli was collected from southern part rather than middle and northern part because most of the experiment regarding performance of the different genotypes of chilli was carried out in the southern parts of the WB due to its soil and agro climatic condition.

The accessions sampled in these collection trips constitute the most extensive collection of Bengal wild and cultivated chilli in existence. Collection and maintenance of the genetic diversity

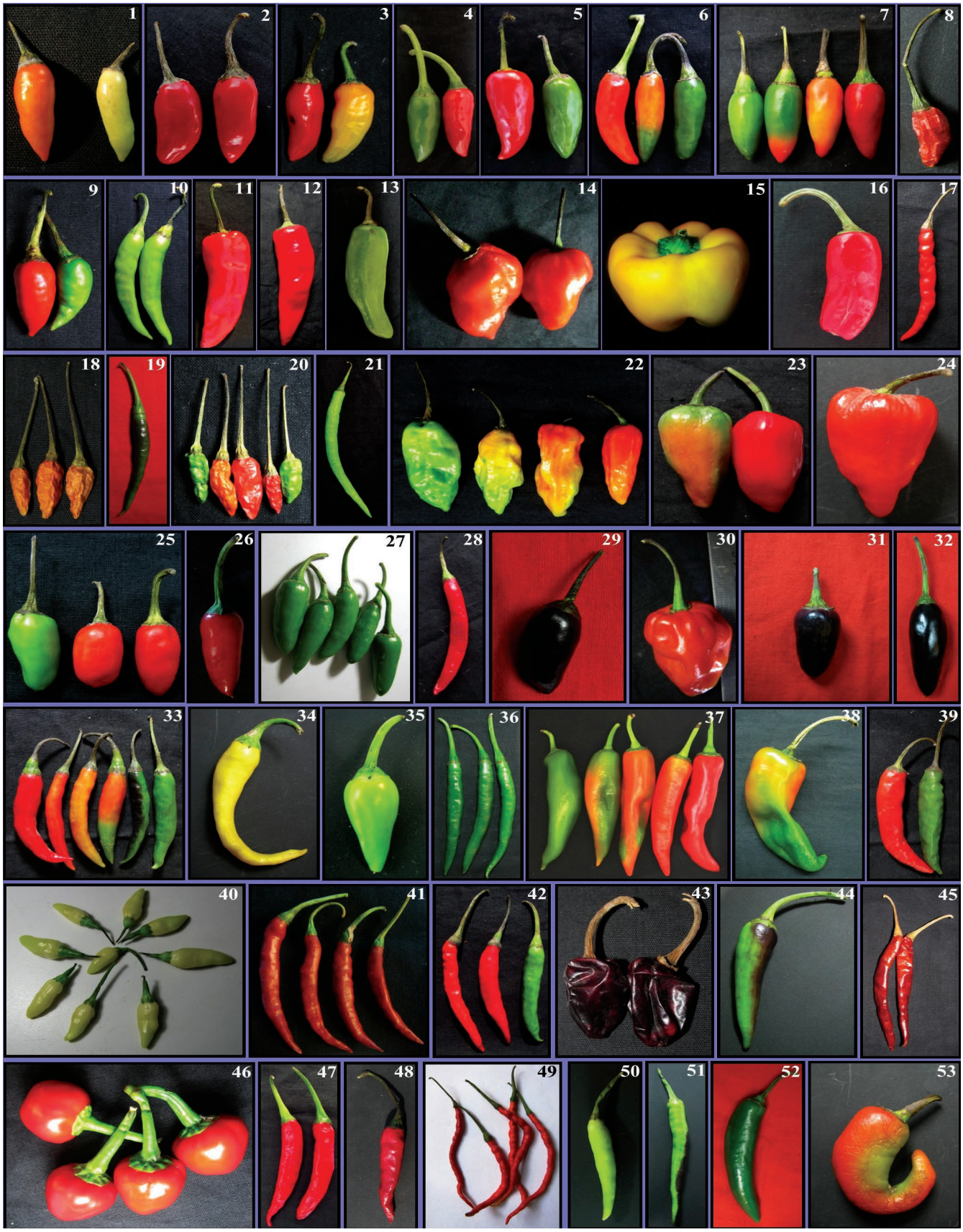

Figure 1: Local Chilli varieties of West Bengal (Name of the above chillies is mentioned in the next page)

1. *Akashbani Lanka*; 2. *Bullet Lanka*-1; 3. *Bullet Lanka*-6; 4. *Bullet Lanka*-7; 5. *Bullet Lanka*-8; 6. *Bullet Lanka*-9; 7. *Bullet Lanka*-10; 8. *Dhani Lanka*; 9. *Deshi Lanka*; 10. *Haringhata Lanka*; 11. *Acchar Lanka*-1; 12. *Acchar Lanka*-2; 13. *Acchar Lanka*-3; 14. S-1; 15. S-2; 16. S-3; 17. S-4; 18. S-5; 19. S-6; 20. S-7; 21. S-8; 22. *Ghee Lanka*-1; 23. *Ghee Lanka*-2; 24. *Ghee Lanka*-3; 25. *Beldanga Lanka*-1; 26. *Akash Lanka*; 27. S-9; 28. *Buno Lanka*; 29.S-10; 30. *Bombay Lanka*; 31. *Krishnachura Lanka*; 32. *Kalo Lanka*-1; 33. *Chibri Lanka*; 34. Yellow Long *Lanka*; 35. *Volvo Lanka*; 36. *Tejaswani Lanka*; 37. Sweet Banana *Lanka*; 38. *Chop Lanka*; 39. IR8-1; 40. *Dudhe Lanka*; 41. *Jhanjhi Lanka*; 42. *Jhanti Lanka*; 43. *Karvanga Lanka*; 44. *Kasu Lanka*; 45. *Kolkati Lanka*; 46. *Kull Lanka*; 47. *Laal Lanka*; 48. *Lethe Lanka*; 49. S-11; 50. *Rupsa Lanka*; 51. *Saaipa Lanka*; 52. *Tob Lanka*; 53. S-12

in chilli are important to avoid the genetic erosion (Karima et al., 2012). This collection is especially deep in the coverage of chilli from southern region of WB. However, there remain a few areas of interest that should be visited in future collections, namely areas in Northern part of WB that were not collected-Jalpaiguri and South Dinajpur district. If well maintained and renewed, this collection will allow for many future studies on the morphologic characterization, genetic differentiation and the documentation of a gene bank are essential to maintain an active basis for the genetic variability in breeding programs in *Capsicum* (Viana et al., 2006; Arriel et al., 2007; Lannes et al., 2007) as well as ethnobotanical studies.

4. Conclusion

We highlight comprehensive efforts that are underway for rational germplasm collection, and preliminary agro-morpholgical characterization mainly shape and size of eighty-eight chilli cultivar from WB, India. Some of the highly demanded varieties like *Bullet lanka*, *Tejwasini lanka*, *Acchar lanka*, *Ghee lanka* etc. were cultivated in many district of WB. Soil and agro climatic conditions play an important role in production of chilli. Due to highly fertile soil in southern part, the variation in shape and size of the fruits were higher compared to the rest of WB.

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