Asian Plant Research Journal

7(2): 23-29, 2021; Article no.APRJ.65016
ISSN: 2581-9992

Evaluation of Different Chaba (*Piper chaba*) Germplasm for Growth and Yield Performances

Md. Riazul Islam[1], Md. Nazmul Hasan Mehedi[2*], Rumman Ara[3], Abu Jafor Mohammad Obaidullah[1], Md. Moniruzzaman[4] and Nahida Aktar[5]

[1]Regional Spices Research Centre, Bangladesh Agricultural Research Institute (BARI), Magura-7600, Bangladesh.
[2]Horticulture Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh -2202, Bangladesh.
[3]Regional Spices Research Centre, BARI, Gazipur-1701, India.
[4]Regional Spices Research Centre, BARI, Magura-7600, Bangladesh.
[5]Department of Islamic History and Culture, Islamic University, Kushtia, Bangladesh.

Authors' contributions

This work was carried out in collaboration among all authors. Author MRI designed the study, performed the research work and wrote the protocol and wrote the first draft of the manuscript. Authors MNHM finalized the manuscript according to journal. Author NA managed the analyses of the study. Authors RA and AJMO managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/APRJ/2021/v7i230151
Editor(s):
(1) Dr. Langa Tembo, University of Zambia, Zambia.
Reviewers:
(1) Alina M, Politehnica University of Bucharest, Romania.
(2) Pradeep K, Govt Ayurveda Medical College, India.
Complete Peer review History: http://www.sdiarticle4.com/review-history/65016

Original Research Article

Received 27 November 2020
Accepted 28 January 2021
Published 24 February 2021

ABSTRACT

Genetic diversity is the base for survival of plants in nature and for crop improvement. Diversity in plant genetic resources provides opportunity for plant breeders to develop new and improved cultivars with desirable characteristics. Therefore, an experiment was employed to determine the genetic variability and evaluate the growth performing parameters of different Chaba germplasm at the research field of Regional Spices Research Centre, Bangladesh Agricultural Research Institute, Magura during kharif 1 season in 2018-19 following completely randomized design with three replications. Six germplasm namely PCmag-001, PCmag-002, PCmag-003, PCmag-004, PCmag-005 and PCmag-006 were collected from khulna region of Bangladesh and transplanted adjunct to

**Corresponding author: E-mail: nazmul02348@gmail.com;*

different tree species mainly mango. Among the six germplasm heighest plant height (450 cm), number of branch (35), number of leaves (350), internodes length (16 cm) and vine diameter (2.5 cm) after one year of planting was recorded from PCmag-001 germplasm followed by PCmag-002 while the lowest plant height (450 cm), number of branch (35), number of leaves (350), internodes length (16 cm) and vine diameter (2.5 cm) were found from the germplasm PCmag-005. Through the observation of one year field trail in terms of growing characteristics the germplasm PCmag-001 and PCmag-002 can be chosen for future breeding material to release a commercial variety in southern part of Bangladesh.

Keywords: Growth; evaluation; germplasm; Piper chaba.

1. INTRODUCTION

Chaba (*Piper chaba* Hunter) is a herbaceous plant, commonly known as "King of Bitters," in the family Piperaceae. Piperaceae has about 350 species [1]. It grows abundantly in southeastern Asia. i.e., India, Sri Lanka, Pakistan, Java, Malaysia, and Indonesia, while it cultivated extensively in India, China, and Thailand [2]. It is a creeper type flowering vine that spreads on the ground under Piperaceae family. It may also grow around large trees. It is used as spices in meat, fish and mutton curry and other famous dishes. Chaba is called Chui Jhal or Choi Jhal in the Khulna-Jashore region of Bangladesh, Tripura (India) and West Bengal (India). People in Bangladesh's south-western districts like Khulna, Jessore, Bagerhat, Satkhira & Narail cut down the stem, roots, peel the skin and chop it into small pieces and cook them with meat and fish, especially with mutton. The spicy pungent flavor of Choi Jhal is a year-round additive spice. In Indian states of West Bengal and Tripura people use this spice similarly with exception to some people in southern Bengal who prepare a complete dish with the Chaba as the base ingredient, it is very spicy. It is a relatively expensive spice in Bangladesh, and the roots are usually more expensive than the stems because of their stronger aroma.

In Bangladesh and India, this plant has many more medicinal values in a wide variety of diseases including asthma, bronchitis, piles, colic pain, dyspepsia and gastralgia [3,4]. Studies have shown that chemicals (pipernonaline, guineensine etc) isolated from the Chaba plant have potential anti-inflammatory, antibacterial, antifungal and analgesic activities. The primary bioactive component of the chaba is a Piperine [5,6]. Piperine has also been shown to have certain serious toxicities such as antifertility [7], respiratory paralysis, hemorrhagic necrosis, urinary bladder and adrenal glands [8]. In Ayurvedic medicine, there are 26 different remedies containing Piper chaba used to treat liver disorders. Administration of Piper chaba Hunter prevented hexachlorocyclohexane induced increase in the activities of glutamyl transpeptidase. glutathione-S-transferase and lipid peroxidation in mouse liver, an indication of potential antioxidant and hepatoprotective effects of Piper chaba Hunter [9]. Potential of chaba as an antioxidant to preserve endothelial function resulting in maintenance of the balance of nitric oxidefendothelin [10]. The arterial narrowing caused by injury to the inner lining of the blood vessel and by high cholesterol in the diet was also found to be decreased by Piper Chaba [11]. Leaves and bark are used for diabetes, malaria and jaundice. The arial part of this plant has also exhibited anti-diarrhoeal, anti-hypertensive, carminative, diuretic, stimulant, expectorant, and smooth muscle relaxant properties [12]. The bark is used for making an external application for pain and chest. Stem is used to reduce post-delivery pain in mothers and also fruitful in rheumatic pains [13]. Chaba fruits were reportedly used as pungent, aromatic, stimulant, anthelmintic, expectorant and carminative [14]. Phytochemical evaluation of P.chaba fruits revealed the presence of various classes of compounds such as lignans, amides, long-chain ester, terpenoids, steroids, pyrones, chalcones and flavonoids [15]. Extracts of chaba stem have also been found to exhibit anti-diarrhoeal and diuretic activities [16]. The fruits are applied as a gastro-protective, anti-flatulent, appetizing property, and also possesses cholesterol lowering properties [17]. The urging for more drug candidates from this kind of natural sources is continuously increasing day by day.

In the scenario of increasing demand and lack of recommended varieties, there is immediate need to develop high-yielding varieties in accordance to usage of this plant. In Bangladesh, It is widely known and used throughout the south-western region but these spices are not well known in other parts of the country. Because of its

increasing demand, our efforts to collect the indigenous germplasm from the native lands and evaluate them on the basis of morphological traits. The crop improvement in any crop will require a thorough understanding of physiology of the crop along with its genetics and agronomic requirements. Hence, the present study was undertaken to investigate the growth performances of some collected germplasm and identify a potential one(s).

1.1 Botanical Description of *Piper chaba*

The plant Piper chaba is an herbaceous plant. It is a creeper that spreads on the ground or way take support of other trees. The leaves are simple, oval-shaped and about 3 to 5 inches long opposite and decussate; stipules are lacking. The older leaves are demtate dark in colour and shaped. The flowers are monoecious, zygomorphic and usually are associated with conspicuous, often brightly colored bracts and blossom during the monsoon. The calyx is usually deeply 4-5 lobed or sometimes is highly reduced with more numerous minute teeth. The corolla is sympetalous, usually 5-merous, mostly, zygomorphic and commonly 2 lipped. The androecium usually consists of 4 didynamous stamens or only 2 stamens adnate to the corolla tube or epigynous zone, alternate with the lobes. The gynoecium consists of a single compound pistil of 2 carpels, a single style and a superior ovary with 2 locules, each with usually 2-10 axial ovules in one or two collateral vertical tiers. An annular nectar disk is usually found around the base of the ovary. The fruit looks similar to other varieties of long pepper, with an elongated shape that can grow up to 3 inches long. The fruit is red when ripe, which turns dark brown or black when dry. The seed stalk or funiculus of each seed is modified into a hook shaped jaculator or retinaculum that functions in flinging out the seeds during dehiscence.

2. MATERIALS AND METHODS

The study was carried out at the research field of Regional Spices Research Centre, Magura during 2018-19 to evaluate the performance of different Chaba germplasm and to select the promising one(s) for releasing a variety. The experimental site represents agro-ecological zone (AEZ)-11 recognized as to high Ganges river floodplain. The land was medium high and the soil was clay loam in texture. Germplasm was collected from five upazila under four districts. Vine and sapling was collected during April to July 2018 and transplanted near different tree species to support for the creeping. Fertilizer and manures were applied according to fertilizer recommendation guide. One light irrigation was given just after transplanting to ensure optimum soil moisture for normal growth and development. The crop was managed by recommended package of intercultural practices. The Observations on different morphological and yield attributing characters viz., % germination, days to germination (d), plant height (cm), number of tiller/plant, number of leaves/plant, leaf length (cm), root length (cm), 1st emergence of spike (days), days to 50% flowering, number of spikes/plant, length of spike (cm), number of seeds/spike, 1000 seeds weight (g), weight of seeds/ plant (g) and seed yield (kg/ha) were recorded from five randomly selected plants from each replications. Collected data were statistically analyzed using MSTAT-C computer package program. Difference between treatments was assessed by Duncan's Multiple Range Test at 5% level of significance [18].

Table 1. Source of collection of different Chaba germplasm

Chaba germplasm	Source of collection
PCmag001	Chuknagar, Khulna
PCmag002	Batiaghata, Khulna
PCmag003	Dumoria, Khulna
PCmag004	Fakirhat, Bagerhat
PCmag005	Tala, Satkhira
PCmag006	Monirampur, Jashore

2.1 Collection and Analysis of Soil Nutrients

Soil sample was also collected from the exact location from where the germplasm was collected.The soil sample was air dried, ground and sieved. Then the soil sample was ready for analysis. Soil properties were analyzed by using the following methods (Table 2). All soil chemical properties were analyzed in the Regional Laboratory, Soil Resource and Development Institute (SRDI), Batiaghata, Khulna.

3. RESULTS AND DISCUSSION

The mean performance of six Chaba germplasm for all the morphological and yield attributing characters are presented in Tables 4, 5 and Fig. 1 which showed significant variation among the germplasm.

3.1 Soil Nutrient Status

Table 3 showed that nutrients status of different soil that were collected from different Chaba growing area. It was found that average pH was 6.6 to 7.6, electrical conductivity was 2.2 to 6 dS/m, organic matter was 1.1 to 3.5 percent, available potassium was 0.29 to 0.87 meq/100g soil, available phosphorus was 0.07 to 0.16 µg/g soil, available sulfur was 13.47 to 207.70 µg/g soil and available zinc was 0.63 to 2.33 µg/g soil.

Morphological data was collected from one year aged plant. Some morphological variations were found among the six germplasm. Leaf shape was ovate in all the germplasm but leaf color varied from green to greenish yellow. Among the six germplasm PCmag-001, PCmag-002, PCmag-004, PCmag-006 were found climbing type and PCmag-003 and PCmag-005 were bushy type. Germplasm PCmag-003 and PCmag-005 were profusely branched and PCmag-001, PCmag-002 PCmag-004 and PCmag-006 were tendrils or twinning type branching behavior. Vine color of germplasm PCmag-003 and PCmag-005 were light green color while germplasm PCmag-001, PCmag-002 PCmag-004 and PCmag-006 were deep green color.

Table 2. Soil properties and methods used for analyzing soil samples

Properties	Methods of analyses
Soil pH	Glass electrode method
Organic matter content	Wet oxidation method
Total Nitrogen	Micro-Kjeldahl method
Available Phosphorus	Bray and Kurtz method
Available Potassium	Atomic absorption spectrophotometer
Available Sulfur	Turbidity method
Available Zinc	Dithiozone method

Table 3. Soil nutrients status of different chaba cultivation area

Location	Soil properties							
	pH	EC (dS/m)	OM (%)	K(meq/ 100g soil)	Total N (%)	P(µg/ g soil)	S(µg/ g soil)	Zn (µg/ g soil)
Chuknagar, Khulna	7.3	2.46	2.79	0.9	0.16	51.11	207.7	2.33
Batiaghata, Khulna	7.1	3.22	2.34	0.87	0.15	44.41	120.43	2.17
Dumoria, Khulna	7.6	4.3	2.1	0.75	0.11	24.86	87.56	1.76
Fakirhat, Bagerhat	6.5	5.4	3.5	0.8	0.12	60.52	102	1.58
Tala, Satkhira	7	6	1.1	0.53	0.07	14.75	13.47	0.63
Monirampur, Jashore	7.6	2.2	1.44	0.29	0.09	15.71	16.02	0.85

PC mag001 **PC mag002** **PC mag003**

PC mag004 **PC mag005** **PC mag006**

Plate 1. Photographs of different chaba germplasm*yield*

Table 4. Morphological characteristics of chaba germplasm

Name of the germplasm	Leaf shape	Leaf color	Growing pattern	Branching pattern	Vine color
PCmag-001	Ovate	Green	Climbing type	Tendrils or twining	Deep green
PCmag-002	Ovate	Green	Climbing type	Tendrils or twining	Deep green
PCmag-003	Ovate	Greenish yellow	Bushy type	Profusely branched	Light green
PCmag-004	Ovate	Green	Climbing type	Tendrils or twining	Deep green
PCmag-005	Ovate	Greenish yellow	Bushy type	Profusely branched	Light green
PCmag-006	Ovate	Green	Climbing type	Tendrils or twining	Deep green

Table 5. Growth characteristics of chaba germplasm after one year of planting

Name of the germplasm	Plant height(cm)	Number of branch(nos.)	Number of leaves (nos.)	Leaf length(cm)	Leaf breadth(cm)	Length of internode(cm)	Vine growth /month	Vine diameter(cm)
PC mag001	450	35	350	21	14	16	30	6.0
PC mag002	410	24	250	20	13	15	25	5.0
PC mag003	210	19	190	16	10	11	25	5.5
PC mag004	320	20	200	18	12	13	28	5.0
PC mag005	200	18	180	15	10	10	24	5.5
PC mag006	230	23	225	17	12	14	25	5.0
Mean	303.3	23.1	232.5	17.8	11.8	13.1	26.1	5.3
SD	107.6	6.2	62.9	2.3	1.6	2.3	2.3	0.4

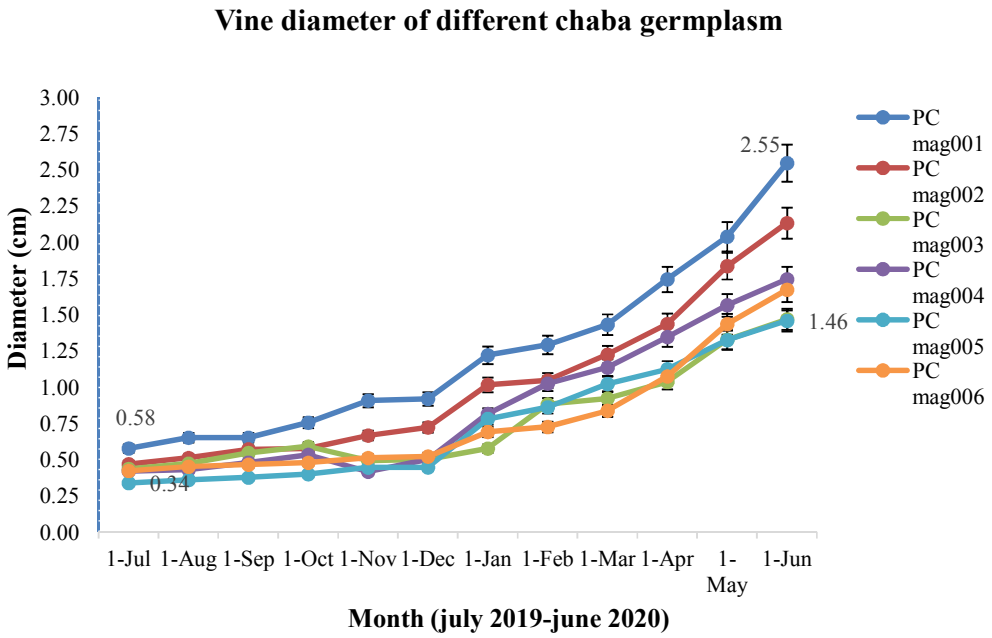

Fig. 1. Vine diameter of different chaba germplasm during July 2018 to June 2019

Growth data was collected from six germplasm after one year of planting. Average mean data showed some variation among the six germplasm. The highest plant height (450 cm), number of branch (35), number of leaves (350), leaf length (21 cm), leaf breadth (14 cm), length of internode (16 cm), vine growth (30) and vine diameter (6 cm) were found from PCmag-001 followed by PCmag-002. The lowest plant height (200 cm), number of branch (18), number of leaves (180), leaf length (15 cm), leaf breadth (10 cm), length of internode (10 cm), vine growth (24) and vine diameter (5 cm) were recorded from the germplasm PCmag-005 followed by PCmag-003.

3.2 Yield

Vine is the mostly edible part of Chaba plant in our country. The more the diameter of vine increased its taste as well as market value also increased. Fig. 1 showed the growth curve of different Chaba germplasm over time. Maximum diameter of vine (2.55 cm) was found from PCmag-001 in june 2020 where it was only 0.58 cm in july 2019. The minimum diameter of vine (1.34 cm) was found from PCmag-005 in june 2020 where it was only 0.34 in july 2019. The growth of diameter increased rapidly after five month of transplanting.

4. CONCLUSION

However, overall analysis of all the germplasm in terms of morphological and yield attributing parameters clearly reveals that the germplasm PCmag-001 and PCmag-002 were found to be the best in one year field trial. Thus, PCmag-001 and PCmag-002 germplasm can be taken for the further investigation for commercial Chaba cultivation. In conclusion, genetic markers will be providing better information on genetic relatedness among the different *Piper chaba* germplasm and this knowledge of genetic variation would provide an important contribution for improvement of Chaba germplasm.

ACKNOWLEDGEMENT

The authors provide immense gratitude to Bangladesh Agricultural Research Institute (BARI), Gazipur, Bangladesh for financial aid along with all other helping hands to complete this research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ward JL, Hassis C, Lewis J, Beale MH. Phytochemistry. 2003;62:949-957.
2. Deepa M, Padmaja CK. Preliminary phytochemical analysis and thin layer chromatography of the extracts of Excoecaria agallocha L. International Journal of Pharmaceutical Sciences and Research. 2014;5(10):4535.
3. Chopra RN. Indigenous Drugs of India (U.N. and Son's Private Ltd., India, 1958); 1958.
4. Krishnan MKS. The useful plants of India (Publication and Information Directorate, CSIR, New Delhi, India, 1986); 1986.
5. Basak A, Cooper S, Roberge AG, Banik UK, Chretien M, Seidah NG. Inhibition of pro-protein convertases-1, -7, and furin by diterpines of *Piper chaba* and their succinoyl esters. Biocheim. J. 1999;338:107-113.
6. Iruretagoyena MI, Tobar JA, González PA, Sepúlveda SE, Figueroa CA, Burgos RA, Kalergis AM. Andrographolide interferes with T cell activation and reduces experimental autoimmune encephalo myelitis in the mouse. Journal of Pharmacology and Experimental Therapeutics. 2005; 312(1):366-372.
7. Daware MB, Mujumdar AM, Ghaskadbi S. Reproductive toxicity of piperine in Swiss albino mice, Planta Med. 2000;66:231-236.
8. Piyachaturawat P, Glinsukon T, Toskulkao C. Acute and subacute toxicity of piperine in mice, rats and hamsters, Toxicology Letters.1983;16:351-359.
9. Cui L, Qiu F, Wang N, Yao X. Four new andrographolide metabolites in human urine. Chemical and pharmaceutical bulletin. 2004;52(6):772-775.
10. Babish JG, Howell T, Pacioretty L. U.S. Patent No. 6,629,835. Washington, DC: U.S. Patent and Trademark Office; 2003.
11. Cheung HY, Cheuna SH, Li J, Cheung CS, Lai WP, Fon WF, Leung FM. Piperine isolated from Piper chaba induces cell cycle arrest and mitochondrialmediated apoptosis in human leukemic HL-60 cells. Planter Med. 2005;71:1106-1111.
12. Ghani A. Medicinal Plants of Bangladesh, Asiatic Society of Bangladesh, Dhaka, 2nd ed; 2003;267-268.
13. Yusuf M, Chowdhury JU, Wahab MA, Begum J. Medicinal plants of Bangladesh, BCSIR, Dhaka, Bangladesh. 1994;193.
14. Kirtikar KR, Basu BD. Indian Medicinal Plants, International Book Distributors, 3rd ed. 1987;2130-2131.
15. Scott IM, Jensen HR, Philogène BJ, Arnason JT. A review of Piper spp. (Piperaceae) phytochemistry, insecticidal activity and mode of action. Phytochemistry Reviews. 2008;7(1):65.
16. Rahman TU, Shilpi M, Ahmed JA, Hossain CF. Preliminary pharmacological studies on *Piper chaba* stem bark. Journal of ethnopharmacology. 2005;99(2):203-209.
17. Lumb PJ, Slavin BM. Determination of serum cholesterol concentration in the presence of ascorbate, J Clin Patho. 1993;46:283-284.
18. Gomez KA, Gomez AA. Statistical procedures for agricultural research (2 ed.). John wiley and sons, New York. 1984;680.

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/65016