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Genetic diversity in Indian cucumber based on microsatellite and morphological markers

Sudhakar Pandey [a,*], Waquar Akhter Ansari [b], Vinay Kumar Mishra [a], Asheesh Kumar Singh [a], Major Singh [a]

[a] Indian Institute of Vegetable Research, Post Box-01, P.O.-Jakhini (Shahnshahpur), Varanasi 221305, Uttar Pradesh, India
[b] Department of Botany, Banaras Hindu University, Varanasi 221005, Uttar Pradesh, India

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ABSTRACT

Genetic variation among 44 cucumber accessions was assessed using morphological and SSR markers. High genetic variability was observed for days to 50% female flowering (37–46 days from sowing), number of fruits per plant (1.4–6.0), individual fruit weight (0.04–0.552 kg) and root length (14.25–32.8 cm). The pair-wise Jaccard similarity coefficient ranged between 0.25 and 0.85 indicating that the accessions represent genetically diverse populations. The allelic diversity of polymorphic markers ranged from 0.001 to 0.9396 with an average of 0.31 based on polymorphic information content. The clustering pattern of SSR markers was not in consonance with the groupings based on quantitative traits. The accession of Indian state i.e.; Madhya Pradesh and Uttar Pradesh were diverged from the accessions of other parts of India. The study provides information for future exploration and collection of cucumber germplasm in India and utilization of diverse germplasm for developing cultivars/hybrids for specific traits.

1. Introduction

Cucumber (*Cucumis sativus* L. $2n = 2x = 14$) is one of the most important vegetable crops and belongs to family Cucurbitaceae (Jeffery, 1980). Global production of cucumber was 57.55 million tons in 2010, of which ~26% (15.17 million tons) was produced in India (FAOstat, 2012 at http://faostat.fao.org/). The productivity of cucumber in India is 6.34 mt/ha as compared to the average world productivity of 30.23 mt/ha. Cucumber is indigenous to India (Sebastian et al., 2010) and varies in terms of morphological characters such as growth habit, fruit size and colour (Staub et al., 1997). As a result of continued selection, a large number of landraces and forms with restricted local distribution have been accumulated in different growing areas. Although there is substantial variation in the morphology of cucumbers, little is known about the genetic diversity of this species in India. Assessment of genetic diversity based on phenotypes has limitations, since most of the morphological characters are greatly influenced by environmental factors and developmental stage of the plant.

Among the PCR based molecular markers, SSR markers are neutral and in general have high level of transferability, therefore, such markers are significantly valuable. Different types of molecular markers, viz.; random amplified polymorphic DNAs (Horejsi and Staub, 1999), amplified fragment length polymorphisms (Li et al., 2004), inter-simple sequence repeats (Wang et al., 2007), simple sequence repeats (Danin Poleg et al., 2001) and expressed sequence tag-derived SSRs (Hu et al., 2010) have been used for the assessment of genetic diversity in cucumber. There are a few

* Corresponding author. Tel.: +91 (0)542 2635247; fax: +91 (0)5443 229007.
E-mail address: sudhakariivr@yahoo.com (S. Pandey).

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reports of assessment of genetic diversity of cucumber in India using ISSR (Parvathaneni et al., 2011) and RAPD and ISSR markers (Manohar et al., 2012).

In this study, 70 SSR markers evenly distributed across the cucumber genetic map (Ren et al., 2009) coupled with 10 morphological traits were used to analyze genetic relationships among 44 cucumber germplasm/cultivars collected from different regions of India.

2. Materials and methods

2.1. Plant materials and DNA extraction

In this study, a total of 44 cucumber accessions (33 from India and 11 exotic collections) were used (Table 1). These genotypes are maintained at Division of Crop Improvement, Indian Institute of Vegetable Research (I.I.V.R.), Varanasi, India. The genomic DNA of all accessions was extracted from unexpanded young leaves by CTAB method (Doyle and Doyle, 1987) with minor modifications.

Table 1
Details of cucumber accessions used in the present study.

S. No	Germplasm name	Country	Source (place of collection)	Agro-climatic zone[a,b] in India
1	BAM-HR-115	India	Maharashtra	VII
2	BAM-HR-135	India	Karnataka	VIII
3	BAM-HR-134	Holland	Holland	–
4	BAM-HR-136	India	Jharkhand	IV
5	BAM-HR-114	India	Tamilnadu	VIII
6	BAM-HR-129	India	Tamilnadu	VIII
7	BAM-HR-127	India	Kerala	VIII
8	BAM-HR-120	India	Maharashtra	VII
9	BAM-HR-117	India	Bihar	IV
10	BAM-HR-116	India	Chhattisgarh	V
11	BAM-HR-132	India	Uttar Pradesh	IV
12	BAM-HR-133	India	Odisha	V
13	BAM-HR-119	Bulgaria	Bulgaria	–
14	BAM-HR-501	India	Karnataka	VIII
15	BAM-HR-122	USA	USA	–
16	BAM-HR-137	India	Karnataka	VIII
17	BAM-HR-103	India	Uttar Pradesh	IV
18	BAM-HR-121	India	Jharkhand	IV
19	BAM-HR-128	India	Maharashtra	VII
20	BAM-HR-101	India	Jharkhand	IV
21	BAM-HR-504	India	Madhya Pradesh	VII
22	BAM-HR-130	India	Madhya Pradesh	VII
23	BAM-HR-131	India	Jharkhand	IV
24	BAM-HR-123	India	Himachal Pradesh	I
25	BAM-HR-108	USA	New York	–
26	BAM-HR-105	India	Kerala	VIII
27	BAM-HR-118	Japan	Japan	–
28	BAM-HR-125	Srilanka	Srilanka	–
29	BAM-HR-139	India	Rajasthan	VI
30	BAM-HR-104	India	Karnataka	VIII
31	BAM-HR-106	Canada	Canada	–
32	BAM-HR-502	India	Tamilnadu	VIII
33	BAM-HR-112	Bulgaria	Bulgaria	–
34	BAM-HR-102	USA	USA	–
35	BAM-HR-111	India	Jharkhand	IV
36	BAM-HR-126	Bulgaria	Bulgaria	–
37	BAM-HR-107	India	Jharkhand	IV
38	BAM-HR-110	India	Maharashtra	VII
39	BAM-HR-109	India	Jharkhand	IV
40	BAM-HR-113	India	Jharkhand	IV
41	BAM-HR-124	India	Odisha	V
42	BAM-HR-503	India	Andra Pradesh	V
43	BAM-HR-140	India	Karnataka	VIII
44	BAM-HR-138	Srilanka	Srilanka	–

[a] Singh et al. (2009).

[b] States under each zone and geographical region mentioned in parenthesis: Zone I – Jammu & Kashmir (J & K), Himachal Pradesh and Uttaranchal (Humid Western Himalayan Region), Zone IV – Punjab, U.P., Jharkhand and Bihar (Sub-Humid Sutlej Ganga Alluvial Plain), Zone V – Chattisgarh, Orissa and Andhra Pradesh (Sub-Humid to Humid Eastern and South Eastern Uplands), Zone VI – Rajasthan, Gujarat, Haryana and Delhi (Arid Western Plain), Zone VII – Madhya Pradesh and Maharashtra (Semi-Arid Lava Plateau and Central High Lands), Zone VIII – Karnataka, Tamil Nadu and Kerala (Humid to Semi-Arid Western Ghats and Karnataka Plateau).