

Original Research Article

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Agro-morphological and Palynological studies in Cucumber (*Cucumis sativus* L.) accessions from Northeast India

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ABSTRACT

Fourteen cucumber accessions collected from different Northeast states of India were analysed for variations by means of agro-morphological traits and palynological characteristics. Phenotypic variations in fruit length (19.20 cm – 28.33 cm, fruit width 5.0 cm – 7.3 cm), number of locules (3 – 4/fruit), seed length (0.8 cm – 1.2 cm), seed width (0.3 cm – 0.43 cm) and weight of 100 seeds (1.0 gm – 3.4 gm/ accessions) were observed. Variations were also observed in pollen characteristics among the accessions. Size of pollen varies from 40.00 (41.33) 44.00 µm x 46.00 (47.56) 48.70 µm to 48.00 (48.30) 48.60 µm x 52.00 (52.86) 53.40 µm. Variations in P/E ratio, pore diameter and interpore distance was also observed among the accessions. Cucumber genotypes with superior agro-morphological traits were observed to have bigger pollen size, larger pore diameter and interpore distance, indicating a positive correlation between the two. Present study provides useful information which can assist in efficient utilization and improvement of cucumber germplasm.

Keywords

Agro-
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Pollen grains

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Introduction

Cucumber (*Cucumis sativus* L.; $2n = 2x = 14$), is an important vegetable crop that is widely cultivated worldwide. This in part is due to their wide adaptability under varying climatic conditions (Pandey *et al.*, 2018). Cucumber is ranked fourth among the most valuable crop in the world (FAO, 2016). Owing to its status as an important agricultural crop, the cucumber

genome sequence has also been completed almost a decade ago (Huanget *al.*, 2009). India is the primary centre of diversity and China is considered as its secondary centre of diversity (Staub *et al.*, 1997). *C. sativus* var. *hardwickii* the wild progenitor of the cultivated *C. sativus* is also found in the Indian Himalaya (Royle, 1839). According to Food and Drug Administration, (2016), India is the second largest producer of cucumber next to China.

Besides, cucumber is also important as a model system in sex determination studies and plant vascular biology (Huanget al., 2009).

Several studies have been undertaken to evaluate the diversity of the Indian cucumber germplasm. These studies are in general agreement that Indian cucumber germplasm have considerable variability in terms of morpho-physiological and agro-morphological characters (Pandey *et al.*, 2013, 2018; Ranjan *et al.*, 2019). For e.g., variability was observed in morpho-physiological characters like days to 50% female flowering, number of fruits/plant, average fruit weight, vine length, relative water content, electrolyte leakage, photosynthetic efficiency and chlorophyll concentration index in 40 Indian cucumber genotypes by Pandey *et al.* (2018). Similar observation was reported in agro-morphological characters in orange-fleshed cucumber germplasm from Northeast India by Ranjan *et al.* (2019). Staub *et al.* (1997) compared the isozyme profile of 192 Indian cucumber accession which were collected before 1972 and during 1992 from different states of India and reported that significant variations existed between the two collections. They further concluded that genetic diversity was greater in commercial, open-pollinated accessions examined as compared to local land races. On the contrary, studies using microsatellite markers (EST-SSR, ISSR) and chloroplast markers (*rbcL* and *matK*) revealed that genetic diversity of Indian cucumber at the molecular level is comparatively low (Pandey *et al.*, 2013, 2018; Punetha *et al.*, 2017). This narrow genetic base has been an impediment in the development of new cultivars by cross-breeding (Pandey *et al.*, 2018).

Based on these premises, the present study has been undertaken to assess – 1) variation in agro-morphological traits and pollen morphology in the cucumber accessions from

different Northeast states of India and, 2) if observed variations are linked to traits both qualitative and quantitative.

Materials and Methods

In the present study, a total of 14 cucumber accessions collected from different states of Northeast India and maintained at ICAR-NBPGR was used (Table 1). They were grown at the experimental garden of ICAR-NBPGR Regional Station Shillong during the month of April – July, 2019. Agro-morphological characters such as fruit size (fruit length and fruit diameter), number of locules, seed length, seed width and weight of hundred seeds were recorded in 3 replicates per *Cucumis* accession. PUSA Uday a released variety of cucumber was used as a check variety in the present study.

For scanning electron microscopic studies, the methodology of Rajbhandary *et al.* (2012) was followed. Samples were mounted on 12 mm Agar Scientific adhesive carbon tabs and placed on aluminium stubs. The pollen on the stubs was then sputter coated using gold in argon SC7620 at one run of 2 mins. Carl Zeiss EVO-18 MA Scanning Electron Microscope was used to examine the prepared specimens at a working distance of 8 mm. Microphotographs of the pollen grains were taken in different views and saved using attached computer system. SEM analyses was carried out at Botanical Survey of India, Eastern Regional Centre, Shillong.

Results and Discussion

Agro-morphological traits of the studied cucumber accessions

Variations were observed in the agro-morphological traits among the 14 cucumber accessions (Table 1; Fig 1& Fig. 2). The genotype IC-595510 had the maximum fruit

length (28.33 cm) while IC-613466 had the minimum fruit length (19.20 cm). The recorded fruit length of IC-595510 represented a 21.4 percent increase over the check variety Pusa Uday. It was however observed that fruit length had no direct bearing on fruit width as maximum width of fruit was observed in the genotype IC-595514 (7.30 cm) while minimum fruit width was recorded in the genotype Shillong-52 (5.0 cm). The number of locules per fruit recorded in majority of the accessions was 3 while 4 locules was observed in three accessions collected from Mizoram, Tripura and Meghalaya viz. IC-613461, IC-595514 and Shillong-51. Characteristics of seeds were also assessed among the accessions (Fig. 2). Genotype IC-613458 & IC-613460 had the maximum recorded seed length (1.20 cm; 33.3 % increase in length over check variety) while Shillong-52 had the minimum seed length (0.80 cm). Seed width ranges from 0.3 cm in Shillong-52, IC-613462, IC-613461, IC-618083 to 0.43 cm in IC-613458 (43.3 % increase in width over check variety). Quantitative attributes of seeds were also studied by recording the weight of 100 seeds per accession. Maximum seed weight per accession was recorded for genotype IC-595510 (3.8 gm) which is 137.5 percent increase in weight over the check variety while minimum seed weight was recorded for Shillong-52 (1 gm).

Pollen grain description and variability

Pollen grains in monads, suboblate, oblate spheroidal, P/E 0.85 (0.90) 0.96, outline in polar view subtriangular, outline in equatorial view elliptical; trizonoporate, pores circular, 8.60 (10.03) 11.60 μm in diameter, distinct annulus present surrounding the pores; colpus absent. Sculpturing reticulate (Table 2; Fig.3). Among the cucumber accessions studied, the size of pollen varies from 40.00 (41.33) 44.00 μm x 46.00 (47.56) 48.70 μm (IC-618083) to 48.00 (48.30) 48.60 μm x 52.00 (52.86) 53.40

μm (IC-595517). Highest P/E ratio was recorded in IC-613458 (0.97 (0.96) 0.95) and lowest was recorded in IC-613467 (0.84 (0.87) 0.90). Variations in pore diameter and interpore distance was also observed among the accessions. Highest pore diameter was recorded in IC-595517 & IC-595510 (11.00 (11.66) 12.00 μm), lowest in IC-613461 [7.50 (7.83) 8.00 μm] and highest interpore distance was observed in IC-618083 & IC-613461 [44.00 (44.66) 45.00 μm] and lowest in IC-613457 [32.00 (33.00) 35.00 μm].

Cucumber is susceptible to damage by various insect and diseases such as cucumber beetles, aphids, pickleworms, bacterial wilt, mosaic leaf spot, anthracnose, scab and downy mildew (Sharma *et al.*, 2016). Understanding existing genetic variations within collections is therefore, very important for efficient genetic resources utilization and improvement of crops. In the present study, agro-morphological traits and pollen morphology were used to assess the genetic variations in the cucumber accessions collected from different states of NE India. Phenotypic variations in fruit length, fruit width, number of locules, seed length, seed width and weight of 100 seeds were observed. Variations were also observed in pollen size, pore diameter and interpore distance among the cucumber accessions.

The present study, also revealed positive correlation between agro-morphological traits and pollen characteristics. Genotypes having superior agro-morphological traits were also observed to have bigger pollen size, larger pore diameter and interpore distance. The observed variations in agro-morphological traits and the indicated positive correlation between agro-morphological traits and pollen characteristics in the accessions in this study can assist geneticists and breeders in utilization and improvement of cucumber germplasm.

Table.1 State of collection and agro-morphological characters of fruits and seeds of *Cucumis sativus* L.

Sl. No.	Accession no.	State	Fruit length (cm)	Fruit width (cm)	No of locules/ fruit	Seed length (cm)	Seed width (cm)	Weight of 100 seeds/accession (gm)
1	IC-613457	Mizoram	24.00	7.16	3	1.16	0.40	2.50
2	IC-613458	Mizoram	25.50	6.16	3	1.20	0.43	3.40
3	IC-613460	Mizoram	21.00	6.46	3	1.20	0.36	3.20
4	IC-613461	Mizoram	26.33	6.73	3	0.90	0.30	2.00
5	IC-613462	Mizoram	23.33	6.60	3	0.90	0.30	1.10
6	IC-613466	Mizoram	19.20	5.60	3	1.00	0.40	2.10
7	IC-613467	Mizoram	20.33	6.16	3	1.00	0.40	2.00
8	IC-595508-A	Tripura	25.33	6.73	3	1.00	0.40	1.20
9	IC-618083	Tripura	20.00	6.16	3	0.90	0.30	1.50
10	IC-595510	Tripura	28.33	6.23	3	1.16	0.40	3.80
11	IC-595514	Tripura	22.33	7.30	4	1.00	0.40	3.20
12	IC-595517	Tripura	22.33	6.40	3	1.00	0.40	3.30
13	Shillong-51	Meghalaya	20.00	6.00	4	1.06	0.40	2.70
14	Shillong-52	Meghalaya	21.33	5.00	3	0.80	0.30	1.00
15	PUSA Uday		23.33	9.73	3	0.90	0.30	1.60
MEAN			22.84	6.56	3.13	1.01	0.36	2.31
MAX			28.33	9.73	4.00	1.20	0.43	3.80
MIN			19.20	5.00	3.00	0.80	0.30	1.00
SD			2.66	1.05	0.35	0.12	0.05	0.92
CV %			11.66	15.94	11.22	12.18	13.69	40.09

Table.2 Morphological characteristics of pollen of *Cucumis sativus* L

Sl. No.	Accession no.	Size of pollen (µm)		P/E ratio	Pore diameter (µm)	Interporal distance (µm)
		Polar axis	Equatorial diameter			
1	IC-613457	46.60 (47.26) 48.10	49.50 (49.80) 50.20	0.94 (0.95) 0.96	8.50 (9.40) 10.20	32.00 (33.00) 35.00
2	IC-613458	44.70 (46.30) 48.30	46.00 (48.20) 50.80	0.97 (0.96) 0.95	8.00 (8.66) 9.00	38.00 (39.33) 40.00
3	IC-613460	44.00 (46.24) 47.70	49.20 (49.73) 50.00	0.89 (0.93) 0.94	9.00 (9.66) 10.00	42.00 (42.33) 43.00
4	IC-613461	47.00 (47.66) 49.00	52.00 (52.16) 52.50	0.90 (0.91) 0.93	7.50 (7.83) 8.00	44.00 (44.66) 45.00
5	IC-613462	44.40 (45.53) 46.20	47.50 (47.83) 48.00	0.93 (0.95) 0.96	9.00 (10.00) 11.00	34.00 (34.66) 35.00
6	IC-613466	45.00 (46.00) 47.00	53.00 (54.33) 56.00	0.85 (0.85) 0.84	10.00 (10.66) 11.00	39.60 (39.86) 40.00
7	IC-613467	43.30 (45.33) 46.70	51.00 (51.66) 53.00	0.84 (0.87) 0.90	10.00 (10.66) 11.00	38.00 (39.50) 40.00
8	IC-595508-A	47.00 (47.33) 48.00	52.00 (52.66) 53.40	0.90 (0.89) 0.89	10.00 (10.66) 11.00	37.00 (37.33) 38.00
9	IC-618083	40.00 (41.33) 44.00	46.00 (47.56) 48.70	0.86 (0.86) 0.90	9.00 (9.33) 10.00	44.00 (44.66) 45.00
10	IC-595510	44.00 (44.80) 46.30	47.00 (48.03) 48.90	0.93 (0.93) 0.94	11.00 (11.66) 12.00	38.00 (39.33) 40.00
11	IC-595514	45.00 (45.76) 46.20	52.90 (53.43) 54.40	0.85 (0.85) 0.84	9.00 (9.33) 10.00	37.00 (37.66) 38.00
12	IC-595517	48.00 (48.30) 48.60	52.00 (52.86) 53.40	0.92 (0.91) 0.91	11.00 (11.66) 12.00	38.00 (38.66) 40.00
13	Shillong-51	43.00 (43.66) 44.00	47.00 (47.40) 47.80	0.91 (0.92) 0.92	9.00 (9.66) 10.00	35.00 (35.33) 36.00
14	Shillong-52	41.80 (44.46) 46.60	46.00 (47.66) 49.00	0.90 (0.93) 0.95	10.00 (10.33) 11.00	40.00 (40.33) 41.00
15	PUSA Uday	44.00 (45.00) 46.00	48.00 (49.00) 50.00	0.91 (0.91) 0.92	10.00 (10.66) 11.00	39.00 (39.16) 39.50
MEAN		45.55	49.86	0.90	10.03	38.64
MAX		48.30	54.30	0.96	11.60	44.60
MIN		41.30	47.40	0.85	8.60	33.00
SD		1.67	2.42	0.04	0.99	2.92
CV %		3.68	4.86	4.12	9.86	7.56

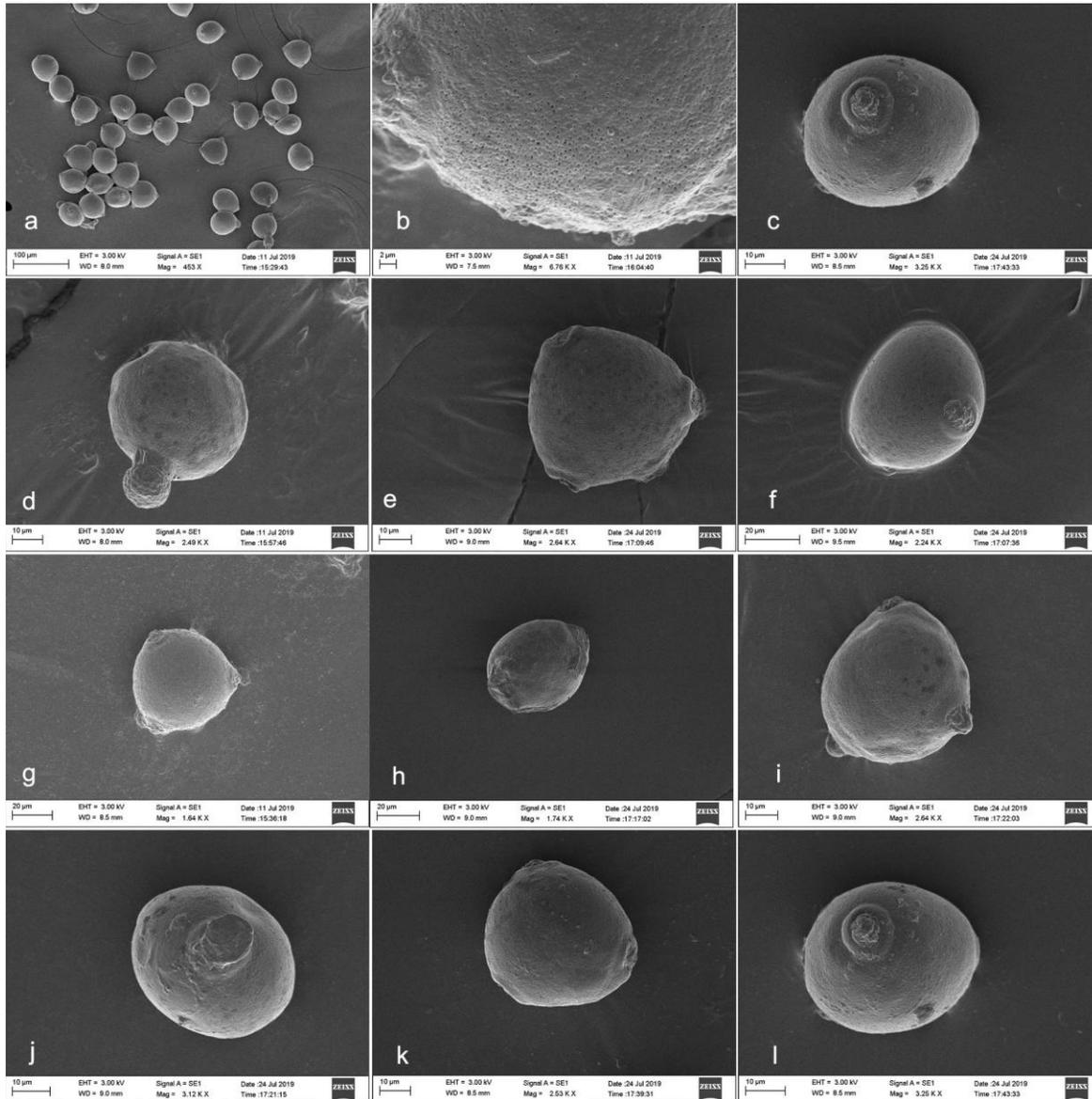
Fig.1 Fruit morphology and cross section of fruit showing number of locules of different accessions.a – b) IC-3613467, c-d) IC-595510, e-f) IC-395514, g -h) IC-613461, k – l) 618083



Fig. 2: Seed morphology of different accessions. a) IC-613457, b) IC-613458, c) IC-613460, d) IC-613461, e) IC-613462, f) IC-595510, g) IC-618083, h) IC-595508-A, i) IC-595517, j) Shillong-52, k) Shillong – 51, l) PUSA Uday, m) IC-613466, n) IC-613467, o) IC-595514



Fig. 3: Pollen morphology under SEM. a) Pollen in monads, b) View showing reticulate sculpturing, c) Pore with distinct annulus, d) Germinating pollen, e) IC-613466 – polar view with pores, f) IC-613466 – equatorial view with pores, g) IC-613461 - polar view with pores, h) IC-613461– equatorial view with pores, i) IC-618083 - polar view with pores, j) IC-618083– equatorial view with pores, k) PUSA Uday – polar view with pores and, l) equatorial view showing pores with annulus.



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