



## Cytomorpho variation in *Chenopodium album* L. from northern India

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### Abstract

The analysis of 10 populations of *Chenopodium album* L. showed ploidy level tetraploid ( $2n=36$ ) and hexaploid ( $2n=54$ ). The analysed population showed two cytotypes. Detailed morphological and cytological studies has been done and comparisons have been done. Meiosis behavior was normal with respect to equal segregation of chromosomes. The average plant height varies between 28cm to 56cm. There was noticeable variation in the leaf parameters as well. Leaves are petiolate and petiole size varied between  $0.68\pm 0.13$ cm to  $3.34\pm 0.53$ cm. The average size of lamina varied between  $1.72\pm 0.16\times 1.26\pm 0.42$ cm to  $3.78\pm 0.60\times 1.42\pm 0.10$ cm. The inflorescence size was quite variable ranging from  $1.12\pm 0.25$ cm to  $1.90\pm 0.37$ cm.

**Keywords:** *Chenopodium album* L., meiosis, plant height, leaf parameter.

### Introduction

Botanically this folklore plant belongs to genus *Chenopodium* (family Chenopodiaceae) which comprising of 250 species<sup>1</sup> found throughout the world, some species being naturalized in the tropics. The genus contains herbaceous perennials, colonizing annuals, heteromorphic and semi cultivated forms<sup>2,3</sup>. The generic name *Chenopodium* is derived from Greek words *chen*: a goose and *pous*: a foot, referring to shape of the leaves also called Lamb's Quarters. The species was introduced in to American continent from Europe<sup>4,5</sup>.

*Chenopodium album* L. has bushy appearance, tapering towards apex. The stem is erect, much branched, green or purple-red. Leaves are alternate, lobed or toothed. Leaf blade ovate to lanceolate as long as petiole. Leaves are waxy coated, unwet table with whitish coat underside. Flowers are of bisexual type and are borne in lateral and terminal spikes. The cytological work on *Chenopodium* was initiated in the earlier parts of last century. First ever, chromosome count for *C. album* L. appeared in 1917<sup>6</sup>. He worked out  $2n=18$  chromosome number of this species. First observation of the existence of diploid ( $2n=18$ ) and tetraploid ( $2n=36$ ) cytotypes in the species was done by<sup>7</sup>. He reported the hexaploid cytotype ( $2n=54$ ) for the species<sup>8</sup>. He reported all the three cytotypes  $2x$ ,  $4x$  and  $6x$  from different populations of *C. album* in India<sup>9</sup>.

The finely powdered leaves are used as a dusting powder about the external genitalia in children<sup>10-16</sup>.

### Materials and methods

Natural populations of *Chenopodium album* L., growing in different locations in various districts of Punjab were collected for investigation. The information regarding the altitude, latitude and longitude of various localities from where

*Chenopodium album* L. populations were collected is given in Table-1. The parameters selected for present study was cytological and morphological analysis.

**Cytological analysis:** For meiotic analysis young floral buds from the healthy plants were collected and were fixed in Carnoy' fixative for 24 hours. The materials were transferred to rectified spirit and kept at 4°C in refrigerator till use. The anthers were squashed in 1-2 drops of 2% Acetocarmine, prepared by dissolving 2gm of standard strain Carmine (BDH) in 100ml of 45% Acetic acid.

A number of prepared slides were examined for meiotic analysis and chromosome counts. The incidence of various types of meiotic abnormalities like late disjunction, laggards, bridges at Anaphase-1 or Telophase-1 etc., were scored from various slides at random. Detailed observations were made on PMCs at tetrad stage to study the microsporogenesis. Pollen fertility was estimated by squashing the mature anthers from different flowers in 1:1 Glycerol-acetocarmine at 60°C for 5 minutes and examined after 24 hours. Well filled pollen grains with stained nuclei were scored as fertile, while shriveled and unstained cytoplasm were counted as sterile. Photomicrographs of chromosome counts, sporads and Pollen grains were made from freshly prepared/temporary slides using Nikon 80i eclipse microscope.

**Morphological analysis:** *Chenopodium album* L. plants have been collected at random from as many as ten populations of the species found growing in wild in different districts of Punjab. Morphological analysis of plants was done using standard parameters like plant height, leaf length, leaf breadth, petiole length and inflorescence length.

Data regarding the morphological parameters of the plants are given in Table-2.

**Table-1:** Sampled populations of *Chenopodium album* L. with geographical location.

Population	Localities	Latitude	Longitude	Altitude
Amritsar	Wheat fields	31°20'N	76°24'E	252mt
Barnala	Sewage irrigated fields	30°23'N	75°31' E	226mt
Bathinda	NFL sewage disposal	30°11'N	75° 00'E	210mt
Hoshiarpur	Wheat fields	31°32'N	75°57'E	295mt
Jalandhar	Leather complex disposal	31°19'N	35°18'E	221mt
Ludhiana	Wheat fields	30°55'N	75°54'E	262mt
Mohali	Wheat fields	30°46'N	76°41'E	220mt
Mukatsar	Sewage disposal	30°30'N	74°43'E	184mt
Patiala	Punjabi University campus	30°20'N	76°24'E	252mt
Sangrur	Sewage disposal (Bhasaur)	30°12'N	75°53'E	231mt

**Table-2:** Comparison of size of various plant parts (cm) in various populations of *Chenopodium album* L.

Population	Plant Height (cm)	Inflorescence Size cm±S.D.	Leaf size (cm±S.D.)		
			Length	Breadth	Petiole
Amritsar	56	1.24±0.28	3.78±0.60	1.42±0.10	3.34±0.53
Barnala	63	1.68±0.32	1.72±0.27	1.28±0.25	0.68±0.13
Bathinda	28	1.42±0.34	2.00±0.20	0.96±0.55	1.10±0.37
Hoshiarpur	32	1.24±0.21	2.36±0.35	1.42±0.29	1.56±0.23
Jalandhar	56	1.54±0.17	1.82±0.43	1.20±0.42	0.96±0.15
Ludhiana	42	1.48±0.35	3.38±0.45	1.06±0.13	2.04±0.49
Mohali	43	1.12±0.25	4.20±0.51	1.66±0.28	2.88±0.39
Mukatsar	41.3	1.90±0.37	2.36±0.27	1.00±0.20	1.34±0.33
Patiala	42	1.34±0.29	4.02±0.13	1.48±0.26	2.74±0.42
Sangrur	30	1.64±0.18	1.72±0.16	1.26±0.42	0.92±0.14

## Results and discussion

Cytological investigation has been carried out on ten populations of *C. album* growing at different locations in Punjab. The data regarding the meiotic course, pollen fertility and pollen size are provided in Tables-3, 4, 5. Comparison of cytotypes is given in Table-6.

The morphological variation in the presently investigated species can be attributed to the variation in chromosome number

and ploidy level. The tetraploid plants are much branched and gives bushy appearance, ranging 30-63cm tall with smaller leaves but with bigger inflorescence than hexaploid species in which plants ranges between 28-56cm and on the average these plants were smaller in size than the tetraploids. The hexaploid plants possessed bigger leaves than the tetraploids. The gigas effect of polyploidy is quite evident in the micro as well macro characters. The hexaploid plants have broader and longer leaves and stomata, but have shorter size (height), inflorescence and pollen size than the tetraploid species (Table-10).

**Table-3:** Data on cytomixis and meiotic course in the different populations of *Chenopodium album* L.

Population	Chr. No. (n)	Cytomixis			Meiotic abnormalities (%)				
		% of PMC	PMC associated	Meiotic stages	Total PMC observed	Lag	Brid	Vag	Abberant PMC
Amritsar	27	3.82	2-3	Dia, M-I, T-II.	109	—	—	2.75	2.75
Barnala	18	—	—	—	114	—	1.75	—	1.75
Bathinda	18	3.30	2-3 units	Triad, tetrad	98	3.06	1.02	—	4.25
Hoshiarpur	27	3.49	3-4 units	Tetrad	132	2.72	—	—	2.72
Jalandhar	18	24.07	19-21	Dia, M-I, A-I, T-II.	—	—	—	—	—
Ludhiana	27	—	—	—	—	—	—	—	—
Mohali	27	4.65	2-3	T-II	78	1.28	—	—	1.28
Mukatsar	18	—	—	—	—	—	—	—	—
Patiala	27	3.44	2-3	T-II	87	—	—	3.44	3.44
Sangrur	18	3.22	2-3	T-II	75	1.33	—	—	1.33

Lag=Lagard, Vag=Vagarnt, Brid=Bridge.

**Table-4:** Data on microsporogenesis in different populations of *Chenopodium album* L.

Population	PMC observed (%)								
	Total	Diad		Triad		Tetrad		Polyad	Abnormal PMC
		N	Mn	N	Mn	N	Mn		
Amritsar	182	—	—	—	—	90.10	7.69	2.19	9.89
Barnala	192	—	—	3.12	—	92.18	4.68	—	7.81
Bathinda	213	—	—	1.40	—	94.83	2.81	0.93	5.16
Hoshiarpur	131	—	—	1.52	0.76	87.78	8.39	—	12.21
Jalandhar	226	4.86	1.76	3.53	0.88	84.51	2.65	1.76	15.48
Ludhiana	132	—	—	—	—	100	—	—	NIL
Mohali	114	—	—	—	—	93.85	6.14	—	6.14
Mukatsar	167	—	—	—	—	100	—	—	NIL
Patiala	208	—	—	1.92	—	95.19	2.88	—	4.80
Sangrur	217	—	—	2.76	1.84	91.70	3.84	—	8.29

N = Normal, Mn = Micronuclei.

**Table-5:** Data on chromosome number, ploidy level, pollen fertility and pollen size of *Chenopodium album* L.

Population	N	Ploidy level	Pollen fertility (%)	Pollen size (µm)
Amritsar	27	6X	96.14	17.58X17.10
Barnala	18	4X	98.76	17.70X17.10
Bathinda	18	4X	96.98	19.25X19.21
Hoshiarpur	27	6X	74.32	23.82X22.82
Jalandhar	18	4X	92.82	20.23X20.19
Ludhiana	27	6X	99.22	16.81X16.44
Mohali	27	6X	98.21	17.33X16.51
Mukatsar	18	4X	100	17.88X17.32
Patiala	27	6X	96.78	17.64X17.50
Sangrur	18	4X	98.31	17.91X17.74

**Table-6:** Comparison between different cytotypes of *Chenopodium. album* L.

Characters	Cytotypes	
	Tetraploid Range (mean)	Hexaploid Range (mean)
1.Plant height (cm)	30-63 (46.46)	32-56 (42.20)
2.Leaf size (cm)		
a.Lamina length	1.72-2.36 (1.92)	2.37-4.203.54)
b.Lamina breadth	0.96-1.28 (1.14)	1.06-1.661.40)
c.Petiole	0.68-1.34 (1.00)	1.56-3.34 (2.51)
3.Inflorescence	1.42-1.90 (1.63)	1.12-1.48 (1.28)
4.Stomatal characters		
a.Length (µm)	18.93-28.14 (22.19)	21.6-24.6 (23.16)
b.Breadth (µm)	12.24-17.99 (15.51)	15.69-17.44 (16.90)
c.Index	27.00-51.40 (41.48)	32-59 (51.28)
5.Pollen characters		
a.Size (µm)	16.81×16.44 to 17.64×17.50 (18.59×18.31)	17.70×17.10 to 23.28×22.82 (18.62×18.07)
b.Fertility (%)	92.82-100 (97.34)	74.32-99.22 (97.58)
6.Chromosome number	n=18	n=27
7.Habitat	Wasteland	Crop fields
8.Locality	Barnala, Bathinda, Jalandhar, Mukatsar, Sangrur	Amritsar, Hoshiarpur, Ludhiana, Mohali, Patiala

**Discussion:** Various morphological parameters like plant height, leaf and stomatal characteristics, inflorescence length were evaluated during the study against cytotypes. The following points were noted during the study.

The tetraploid plants are much branched and gives bushy appearance, ranging 30-63cm tall with smaller leaves but with bigger inflorescence than hexaploid species in which plants ranges between 28-56cm and on the average these plants were smaller in size than the tetraploids. The hexaploid plants possessed bigger leaves than the tetraploids. The gigas effect of polyploidy is quite evident in the micro as well macro characters. The hexaploid plants have larger stomata but have shorter inflorescence and pollen size than the tetraploid species. The tetraploid individuals with chromosome number  $n=18$  are common in the fields as well as waste places in districts Barnala, Bathinda, Jalandhar, Mukatsar and Sangrur. The hexaploid individuals with  $n=27$  are exceedingly common in wheat fields at Amritsar, Hoshiarpur, Ludhiana, Mohali and Sangrur.

## Conclusion

The deep observations has been done on the plants collected from wild and cultivated fields, from various regions of northern India. The species have been examined on population basis to look for intraspecific genetic diversity and to mark out the different morphotypes / cytotypes / cytomorphotypes. The results of the present studies covering taxonomical, cytological and morphological aspects have been evaluated in detail.

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