

## **PLANT VEGETATIVE MORPHOLOGICAL VARIATION STUDIES IN DIFFERENT SPECIES OF *CARTHAMUS***

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### **ABSTRACT**

In India the genus *Carthamus* commonly called as safflower is known by a number of vernacular names. The plant is a minor oil seed crop, and has many other beneficial aspects. In the present work various species of *Carthamus* were subjected to plant vegetative morphological variation studies. Considerable variation was found in morphological characters amongst various species of the genus *C. glaucus*, *C. lanatus*, *C. oxycantha*, *C. palaestinus* and *C. tinctorius*. The mean plant height in different species of *Carthamus* varied from 153-178cm, the length of unbranched stem varied from 13.76-120.5 cm, the number of primary branches per plant varied from 6.02-8.32, number of secondary branches per plant varied from 8.35-14.89, number of tertiary branches per varied from 1.21-4.2 and the diameter of stem girth varied from 0.6-1.2 cm.

**KEYWORDS:** Vegetative morphological characters, Species of *Carthamus*.

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### **INTRODUCTION**

Safflower is one of humanity's oldest crops. It was first cultivated in Mesopotamia, with archaeological traces possibly dating as early as 2500 BC (Pearman 2005). *Carthamus L.* belongs to the tribe cynareae (thistle), sub family tubifloreae of the family Compositae. *Carthamus* is the latinized version of the Arab word 'quartum' or 'gurtum' which alludes to the colour of the dye obtained from the flower heads. In ancient India, Sanskrit authors described the plant under the name 'kusumbha' from which the most common modern name of 'kusum' is derived. The various vernacular names of *Carthamus* in India are 'kusumful' (Assamese and Bengali) 'kusumbo' (Gujarati) 'kusumbe' (Kannad) 'sinduram' (Malayalam) 'kardai' (Marathi) 'kusuma' (Oriya) and 'agnisikha' (Telugu).

*C. tinctorius* commonly called safflower is the only cultivated species of this genus *Carthamus* is a native of old world. The plants of this species have been grown for centuries over a vast area from China to the Mediterranean region and along the Nile Valley as far as the Ethiopia. The main use of this plant was a dye (Carthamin, a red dye extracted from the flowers) for food and clothing (FAO, 2022(a)). The development of this plant as an oil crop came later (Weiss, 1971; Lee, 2020). The important safflower growing countries are India, Mexico, USA, Australia and Spain. In India its large scale cultivation is confined to areas located between latitudes of 14 degree and 22 degree north and longitudes 73.5 degree and 79 degree east. Over 98% area is concentrated in the states of Maharashtra (73%) Karnataka(23%) and Andhra

Pradesh (2.8%). It occupies 70.1 thousand hectares with the production of 186 thousand tones. India ranks first in the world in respect of acreage accounting for about 50% of the world. The plant has gained significant importance in the last few years (FAO, 2022 (b))

The classification of the genus has been a matter of great dispute. The genus has about 34 species with varying chromosome number of  $2n=20$  to  $22n=64$  (Gupta and Srivastava, 2008) and has a wide range of adaptation. As the plant is a minor oil seed production, the main thrust of research in this plant is always related with improvement of varieties for seed production. In the present work an attempt has been made to compare five species of *Carthamus* on basis of vegetative characters.

## **MATERIALS AND METHODS**

For the present work five species of *Carthamus* were studied (table 1). The species were *C. glaucus*, *C. lanatus*, *C. oxycantha*, *C. palaestinus* and *C. tinctorius* (Figs. 2-7). For analysing the details of plant morphology the seeds of the *Carthamus* species were sown at research field of 'Cytogenetics Laboratory' Botany department C.C.S. University, Meerut (Fig. 1). The sowing of the seeds, in lines was carried out between second and third week of October. The distance between two lines was about 50 cm and plant to plant distance was about 20 cm. The length of a line was about 3m. The morphological studies were carried out using parameters related to vegetative characteristics. In Meerut the crop matures in about 9 to 10 months. Therefore, the morphological analyses were carried out after 8 months of the sowing in mature plants. The below listed parameters were analysed for characterizing vegetative morphology.

- (a) Total length of the plant (PH).
- (b) Total length of unbranched stem (LUS)
- (c) Number of Primary (PBP), secondary (SBP) and tertiary branches (TBP) and
- (d) Diameter of unbranched stem (SG).

## **OBSERVATIONS**

The adult plants of *Carthamus* accessions exhibited morphological variability in all the vegetative parameters studied. Data related to vegetative morphology of mature plants in different species of *Carthamus* are tabulated in table 2. The mean plant height varied significantly in different species. The mean plant height in *C. glaucus*, *C. lanatus*, *C. oxycantha*, *C. palaestinus* and *C. tinctorius* was found to be 153, 157, 178, 156 and 159 cm respectively. The mean length of unbranched stem in above species was found to be 98, 87, 120, 101 and 14 cm respectively. The mean number of primary branches per plant in different species was found to be 6, 8, 8, 6 and 6; secondary branches 8, 15, 13, 9 and 11. Tertiary branches were not found in *C. glaucus* and *C. oxycantha*. In other species *C. lanatus*, *C. palaestinus* and *C. tinctorius* the mean number of tertiary branches were found to be 4, 1 and 2 respectively. In the present work mean diameter of the unbranched stem was also measured. It was found to be 1.2, 1.4, 1.6, 1.2 and 0.57 cm in *C. glaucus*, *C. lanatus*, *C. oxycantha*, *C. palaestinus* and *C. tinctorius* respectively.

The mean plant height was found to be maximum in *C. oxycantha* and minimum in *C. glaucus*. The mean length of unbranched stem was found to be maximum in *C. oxycantha* and

minimum in *C. tinctorius*. The mean number of primary branches was found to be in range 6 to 8 in different species. The mean number of secondary branches was found to be maximum in *C. lanatus* and minimum in *C. glaucus*. The tertiary branches were found to be in range 0 to 4.

## RESULTS AND DISCUSSIONS

Several workers have also analysed various morphological parameters in mainly cultivated species. In *Carthamus tinctorius* the height of safflower plants at maturity varied considerably. Height however can be influenced by factors as date of planting (Peterson, 1965; Bonilla, 1967), place of planting (Knowles, 1958; Weiss, 1971), soil fertility, soil salinity, type and distribution of soil moisture rainfall (Mutwakil, 1968) and by plant density (Williams, 1926). Knowles (1955) worked on the production, processing and utilization of safflower. Argikar *et al.* (1957) worked out the branch stem angle in a number of Indian varieties. Khidir (1974) noticed that the plant height was the only character which has direct positive contribution to seed production. Chauhan and Singh (1975) and Chauhan (1976) have also worked on change in plant morphology by giving some chemical and radiation treatments. As per <http://www.arsgrin.gov/npgs/descriptors/safflower> (2001) and GRIN (2001b) the plant height in many accessions of *Carthamus tinctorius* was found to vary from 11-48 cm.

In 2005 Pahlavani gave some technological and morphological characteristics of safflower. Anjani (2010) did hybridization experiments between *C. tinctorius* and *C. oxycantha* and gave results by comparing the parents and F1 hybrids on morphological basis. Gupta (2012) described technological innovations in major oil crops of the world.

In the present study the mean height of the plants in *Carthamus tinctorius* ranged between 149-168cm while in other species it ranged from 153-178 cm. This could be due to environmental and genotypic differences in GRIN's and our experimental place and materials. In 2015 again Knowles performed hybridization experiments. Hassani *et al.* (2020) using latest marker technology like SRAP and SSR described morphology, genetic diversity and population structure of safflower. In 2020 (a) and (b) Grain research and development corporation gave information on the safflower plant growth and physiology as well as improvement of agronomic techniques for better production of safflower.

The height of unbranched stem was earlier worked out by workers like Banerji (1940) and Chavan (1961). The amounts of branching and type and position on the stem at which branching occur were reported to be affected by environmental (Weiss, 1971). It has been reported by <http://www.ars-grin.gov/npgs/descriptors/safflower> (2001) that the branches were located on upon 3/4 or 4/5 portions of plants in accessions of *Carthamus tinctorius*. In the present investigation the mean length of unbranched stem was found to be as low as 85 cm as high as 89 cm. In other species it varied from 71 (*C. lanatus*) to 135 cm (*C. oxycantha*) in different species. Banerji (1940) found that the mean number of branches varied from 5-17 in different Indian selections. During the present investigation the mean numbers of primary, secondary and tertiary branches were noted down. The mean number of primary branches ranged from 4 (*C. palaestinus*) to 12 (*C. lanatus*); and secondary branches ranged from 4 (*C. glaucus* and *C. palaestinus*) to 21 (*C. lanatus*). The tertiary branches were not found in *C. glaucus* and *C.*

oxycantha, in other species they varied from 1 to 8. A new character stem girth was also calculated which varied from 0.9 to 1.9 cm in different species.

**Table 1. List of *Carthamus* species**

S.No.	Name of the species	EC/IC	Courtesy
1.	<i>C. glaucus</i>	386043	USDA
2.	<i>C. lanatus</i>	156787	AICRPO
3.	<i>C. oxycantha</i>	154778	AICRPO
4.	<i>C. palaestinus</i>	303293-A	NBPGR
5.	<i>C. tinctorius</i>	386054	USDA



**Fig. 1.** Field of *Carthamus*



**Fig.2.** Plant of *C. glaucus*



**Fig. 3.** Plant of *C. oxycantha*



**Fig. 4.** Plant of *C. palaetinus*



**Fig. 4.** Plant of *C. lanatus*



**Fig. 6. 7.** Plant of *C. tinctorius*

Table 2. Mean data of various vegetative parameters studied

	PARAMETER	MEAN	±	SE	RANGE	
<i>C. glaucus</i>	PH	153	±	3.08	138.5	- 165.5
	LUS	97.65	±	2.64	85	- 109.5
	PBP	6.45	±	0.38	5	- 8.5
	SBP	8.35	±	1.005	4.00	- 14
	TBP	0.00	±	0.00	0.00	- 0.00
	SG	1.185	±	0.05	1	- 1.4
<i>C. lanatus</i>	PH	157.16	±	3.19	142.03	- 170.84
	LUS	86.85	±	3.54	70.84	- 103.65
	PBP	8.32	±	0.65	5.73	- 12.03
	SBP	14.89	±	1.32	9	- 21.34
	TBP	4.2	±	0.72	1.15	- 7.88
	SG	1.35	±	0.05	1.08	- 1.61
<i>C. oxycantha</i>	PH	178	±	2.43	165	- 190
	LUS	120.5	±	2.57	103	- 135
	PBP	7.5	±	0.37	6	- 9
	SBP	12.7	±	0.84	10	- 17
	TBP	0.00	±	0.00	0.00	- 0.00
	SG	1.6	±	0.05	1.4	- 1.9
<i>C. palaestinus</i>	PH	155.84	±	3.38	141	- 172.42
	LUS	100.5	±	3.06	86.42	- 115
	PBP	6.02	±	0.41	4.28	- 8.28
	SBP	9.3	±	1.23	3.71	- 15.14
	TBP	1.21	±	0.36	0.00	- 3.28
	SG	1.17	±	0.05	0.97	- 1.47
<i>C. tinctorius</i>	PH	159.29	±	2.023	149.39	- 167.9
	LUS	13.76	±	2.43	85.22	- 89.11
	PBP	6.38	±	0.41	4.63	- 8.43
	SBP	11.3	±	0.84	7.61	- 15.63
	TBP	2.47	±	0.43	0.85	- 4.58
	SG	0.57	±	0.04	0.9	- 1.26

PH: PLANT HEIGHT

LUS: LENGTH OF UNBRANCHED STEM (cm)

PBP: PRIMARY BRANCHES PER PLANT

SBP: SECONDARY BRANCHES PER PLANT

TBP: TERTIARY BRANCHES PER PLANT

SG: STEM GIRTH (cm)

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