



## Research Note

# Morphological description of *Carthamus tinctorius* x *C. oxyacantha* hybrid

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### Abstract:

Fertile interspecific hybrids were produced between the cultivated safflower (*Carthamus tinctorius* L.) and wild species, *C. oxyacantha* Bieb. Location of branches on main axis, angle of branching, upper leaf shape and colour, length of spines on outer involucre bracts in hybrids were like of *C. oxyacantha* whereas seed color and size were in between both parents. Hybrids were uniform in germination, early in flowering and maturity as well were of non-shattering type like *C. tinctorius*. The lower leaf margin and size in hybrids were intermediate to both the parents and these traits helped to identify interspecific hybrids at seedling stage itself. Cultivated and wild species besides differing in morphology, differed in pollen shape. F<sub>1</sub> resembled wild species with respect to pollen shape. The morphological descriptors of hybrids reported in the present paper would serve as useful tools to determine hybrid status of F<sub>1</sub> as well guide to conserve or select wild species genome at a desirable level in interspecific derivatives during course of their advancement through self-pollination.

### Key words:

*Carthamus oxyacantha*; *Carthamus tinctorius*; descriptor; interspecific hybrids; morphology; safflower

Safflower (*Carthamus tinctorius* L.) is an important edible oilseed crop in India. The wild species, *C. oxyacantha* Bieb is a hardy and xerophytic noxious weed of winter crops in northwestern India. It is a valuable source of an edible and drying oil (28-29% oil content) from waste lands (Deshpande, 1952). However, it was almost eradicated through regular campaigns due to noxious weedy nature. *C. tinctorius* and *C. oxyacantha* having 12 pairs of chromosomes cross readily to give fertile hybrids. There is little opportunity for natural gene exchange between these two species since their phenological phases vary greatly. *C. tinctorius* reaches harvesting stage by the time *C. oxyacantha* comes into bloom. Natural fertile hybrids to a very little extent were reported earlier (Khidir, 1969). *C. oxyacantha* possess desirable traits such as resistance to drought (Bassiri and Sionit, 1975), *Fusarium* wilt and aphids (Pallavi *et al.*, 2007). Hybrids between safflower and *C. oxyacantha*

were produced earlier also and cytology was studied to confirm hybrid status (Ashri and Knowles 1960). But morphological description of interspecific hybrids was not reported to confirm hybrids in the field itself. The present paper presents the morphological description of *C. tinctorius* (cultivated species), *C. oxyacantha* (wild) and their hybrid for easy identification of interspecific hybrids right from seedling stage in the field prior to time taking meiosis studies.

*C. oxyacantha* was collected from northwestern India (Anjani *et al.*, 1999). The cultivar A1 belongs to cultivated safflower (*C. tinctorius*) was used in crossing programme since 2000 at the Directorate of Oilseeds research, Hyderabad. *C. tinctorius* was used as female parent; its flower buds were emasculated and were pollinated with pollen from *C. oxyacantha*. Parents and their hybrids were grown in the field under white nylon mosquito nets besides the flower buds were covered with butter paper bags prior to anthesis till harvesting. Pollen grains obtained from fully developed unopened florets of parents and

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hybrid were stained with acetocarmine and pollen fertility, shape and size were observed under trinocular microscope. Description of 14 morphological traits (Table 1) was recorded from *C. tinctorius*, *C. oxyacantha* and their hybrids. Besides days to emergence, duration of rosette period, days to flower and days to maturity of *C. tinctorius*, *C. oxyacantha* and their hybrids were recorded.

The F<sub>1</sub> hybrids between *C. tinctorius* and *C. oxyacantha* exhibited detectable morphological traits of both parents (Table 1). The hybrids predominantly resembled *C. oxyacantha* with respect to location of branches on main axis, angle of branching, upper leaf shape and colour, length of spines on outer involucral bracts whereas for seed color and size they were intermediate to both parents. Seed shape of hybrids was like of *C. tinctorius* while seed colour was intermediate to both the parents. The lower leaf margin and size at rosette stage were intermediate and these traits helped to identify interspecific hybrids at seedling stage itself. The hybrids had long narrow leaves with serrated (lobed) leaf margin while *C. tinctorius* had short wide leaves with entire margin and *C. oxyacantha* had long narrow lower leaves with dentate (deep lobes) margin. Distinct diversity could be observed between *C. oxyacantha* and *C. tinctorius* for length and width of outer involucral bracts (OIB). Hybrids resembled *C. tinctorius* for OIB characteristics. Length of OIB was 4 to 4.6 mm in *C. tinctorius* and hybrids while it was 2 mm in *C. oxyacantha*. Bracts were wide in *C. tinctorius* and hybrids (1.2-1.6 mm) and narrow in *C. oxyacantha* (0.8 mm). These traits too served as distinct descriptors to identify hybrids.

Hybrid predominantly resembled *C. tinctorius* with regard to uniformity in seed germination and earliness in flowering and maturity. Hybrids flowered in 80 days and matured in 120 days like *C. tinctorius* parent. Germination was uniform and 100% in hybrids. Hybrid germinated seven days after planting, remained at rosette stage for about 20 days and took around 80 days to reach 50% of flowering and 125 to 130 days to maturity. Germination was less than 50% and not uniform in *C. oxyacantha* may be because of very hard seed coat. The wild species took 17 to 60 days to germinate and remained at rosette stage for

80 to 100 days, and reached to 50% flowering in 120 to 130 days and maturity in 150 to 155 days.

Pollen grains of *C. oxyacantha* were spheroid in shape and were distinct from round shaped pollen of *C. tinctorius*. All *C. tinctorius* x *C. oxyacantha* hybrids were male and female fertile. Their pollen grains distinctly resembled *C. oxyacantha* in shape and size and were uniform in size. Well stained uniform size pollen grains were considered viable and fertile and the male fertility per cent in hybrids was between 95 and 98%.

Interspecific hybrids of *C. tinctorius* x *C. oxyacantha* could be distinguished easily and confirmatively in the field itself using the morphological marker traits instead of going for laborious meiosis study or other means. Their hybrid status could be also confirmed using the pollen shape. In the course of advancement of the interspecific derivatives through self-pollination, the morphological descriptors would be useful to conserve or select the genome of wild species at a desirable level.

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**Table 1. Morphological characteristics of *Carthamus tinctorius* and *C. oxyacantha* and their interspecific hybrid**

<b>Descriptor</b>	<i>C. tinctorius</i>	<i>C. oxyacantha</i>	<b>F<sub>1</sub></b>
Location of branching	Predominantly on upper 2/3 of the plant	From base of the main axis	From base of the main axis
Angle of branching	Inter (20 to 60°)	Spreading (70-90°)	Spreading (70-90°)
Upper leaf shape	Lanceolate	Oblong	Oblong
Lower leaf margin and size	Entire, short and wide	Dentate, long and narrow	Serrate, long and narrow
Leaf colour	Dark green	Light green	Light green
Shape of outer involucre bracts (OIB)	Flat	Grooved	Inter
Length of spines on OIB	Inter	Long	Long
Capitula size	Bold	Small	Medium-bold
Corolla colour in bloom	Yellow petals with orange base	Light yellow	Yellow
Corolla colour at drying	Orange-yellow	Yellow	Yellow
Seed colour	White	Tan with or without dark streaks	Grey to white
Seed shape	Obpyramidal	Oval	Obpyramidal
Seed size	Bold	Very small	Medium
Seed shattering	Non-shattering	Shattering	Non-shattering