

RESEARCH ARTICLE :

Assessment of distinctiveness, uniformity and stability of Safflower (*Carthamus tinctorius* L.) varieties based on morphological descriptors

■ S.M. JANJAL, PRITI SONKAMBLE, M.B. KHEDKAR AND T.H. RATHOD

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SUMMARY : Morphological characterization of safflower varieties is essential for their protection under Plant Variety Protection (PVP) legislation, because varietal testing for Distinctness, Uniformity and Stability (DUS) are the basis for granting protection of new variety under PPV&FR Act, 2001. Keeping this in view, a total of 22 released varieties of safflower were grouped for various agromorphological descriptors. In safflower overall 27 characters are proposed for observation at various stages of crop growth. Out of 27, four characters were recorded on first leaf of safflower. Safflower varieties were classified on the basis of 50 % flowering which is one of the essential character and JSI-99 showed very early, A-300, AKS-207, Nira, Sharda, MSV-10-1-5 and GMU-2369 were early flowering where as remaining were late. The other two essential characters were recorded at flowering stage *i.e.* petal colour and change of petal colour after 10 days of flowering. Classification on the basis of plant height only one variety *i.e.* JSI-99 was very short and remaining were under short and tall group. Considerable variability was observed for seed size, 5 varieties were grouped as small seed size, 10 varieties grouped as medium and remaining 7 varieties as large seed size. The information generated on range of variability will be valuable for comparison of newly developed cultivars.

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Author for correspondence :

S.M. JANJAL
Seed Technology
Research Unit, Dr.
Panjabrao Deshmukh
Krishi Vidyapeeth,
AKOLA (M.S.) INDIA
Email : seed_technology
@yahoo.co.in

See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Safflower (*Carthamus tinctorios* L.) is a member of the family Asteraceae (Compositae), cultivated mainly for the high quality edible oil extracted from the seeds. The crop has been grown in India since ancient times initially for the dye extracted from its florets and later as an oilseed crop. Safflower oil is rich in polyunsaturated fatty acids (linoleic

acid 78%) which play an important role in reducing blood cholesterol levels and is considered to be a healthy cooking medium. Breeding initiatives in India have resulted in the development of many improved varieties and a few hybrids (Anjani and Mukta, 2008).

The enactment of the Indian legislation - Protection of Plant Varieties and Farmers' Rights (PPV & FR) Act, 2001 was followed

by the establishment of the Plant Varieties and Farmers Rights Authority.

(PPV&FRA) in 2005 for implementation of the provisions of the Act. The provisions of this legislation have been critically analysed (Brahmi *et al.*, 2004). Under the Act, protection of plant varieties is based on the establishment of Distinctiveness (D), Uniformity (U) and Stability (S) of characteristics listed in the crop specific guidelines. The Draft guidelines for the conduct of DUS tests for safflower were formulated in 2004 (Mukta and Hegde, 2006) and have been finalized and published (Anonymous, 2009). Information on range of character expression in released cultivars is required for the grant of rights through the establishment of distinctiveness which is based on the difference of the candidate variety as compared to the reference variety and should include at least one essential trait. With this perspective, twenty two released varieties of safflower were characterized in accordance with the guidelines to form the basic database for the selection of appropriate reference varieties during the conduct of DUS testing for candidate varieties. The frequencies for expression of different states of all characteristics in accordance with the safflower guidelines are discussed. The information generated on range of variability will be valuable for comparison of newly developed cultivars.

RESOURCES AND METHODS

The experiment was conducted at Research Farm of the Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola From Rabbi season of 2014 to 2016. Each genotype was raised in 8 rows of 5 m length with a spacing of 45 x 20 cm. The experiment was laid out in randomised block design with two replications during rabi seasons of 20014 to 2016. Recommended agronomic practices and prophylactic measures were adopted for raising a good crop. Observations were recorded on 4 traits at six leaf stage of rosette, 2 at flowering of main capitula, 11 at full flowering and 9 at maturity. The data on state of expression of each trait was harmonized on the basis of the finalized guidelines (Anonymous, 2009). The material for present investigation comprise of breeder's seed of varieties varieties *viz.*, MSV-10-10-1, JSI-7, PBNS-12, GNU-2369, Bhima, AKS-207, Manjira, JSI-99, Nira, A-1, JSI-97, A-300, NARI-6, JSI-7, Girna, Sharada, PBNS-12, JSI-73,, A-2, JLSF-414, PBNS-40 and JSF-1 obtained

from the respective breeders.

OBSERVATIONS AND ANALYSIS

The guidelines for conduct of DUS testing in safflower comprise of 27 traits of which 13 are essential characteristics which are marked by an asterisk (Anonymous, 2009). In safflower overall 27 characters are proposed for observation at various stages of crop growth. Out of 27, four characters were recorded on first leaf of safflower *i.e.* length, width, length to width ratio, and dentation. Dentation denotes the difference between the varieties eg. NARI-6, & MSV-10-1-5 shows absent or very weak dentation, where as A-300, Girna, JSF-1, Sharda, PBNS-12, JLSF-414, and GMU-2369 had lobbed leaves categorized in to very strong group and other varieties A-1, A-2, AKS-207, Nira, and Nari-38 show strong dentation and remaining varieties were as medium (Bhima, JSI-7, JSI-73, JSI-99, Manjira, PBNS-40, MMS) and weak (SSF-658) group.

Time of flowering being asterisk (*) *i.e.* essential character and difference ranges from 65 to 95 days, for 50% flowering. In the present material only a single variety JSI-99 show 50% flowering before 65 days (very early) and A-300, AKS-207, JSI-97, Nira, Sharda, NARI-H-15, MSV -10-1-5 and GMU-2369 are group under early category (upto 65-75 days). A-1, NARI-6, and MMS were group under late category ranging from 86-95 days and remaining A-2, Bhima, JSF-1, JSI-7, JSI-73, Manjira, PBNS-12, JLSF-414, PBNS-40,, Girna, SSF-658 and Nari-38 varieties were group under medium category.

The other two essential characters were recorded at flowering stage *i.e.* petal colour and change of petal colour after 10 days of flowering. In the present collection only two genotype *i.e.* JSF-1 and MMS shows white petal colour which changes to grey white at faded stage. Only one variety Bhima shows pale yellow coloured flower which changes to pinkish white at faded stage, where as three genotypes NARI-6, SSF-658 and NARI-38 shows orange colour petal which shows red colour on faded stage and remaining Manjira, A-1, A-2, A-300, AKS-207, Girna, JSI-7, JSI-73,, JSI-99, Nira, Sharda, PBNS-12, JLSF-414, PBNS-40, MSV-10-1-5 and GMU-2369 genotypes were group under yellow type petal colour which shows orange colour faded stage.

At flowering stage two characters on plant *i.e.* (a) for height of insertion of first branch from ground level and (b) length of longest primary branch were recorded.

All the parameters of length, width, ratio of length to width, no. of spines and dentation already recorded on first leaf of seedling (at sixth leaf stage) and shows the comparatively similar results.

Out of five observations recorded on capitulum, four of them were recorded at flowering stage (on outer involucre bract (OIB)) of main capitula for length, width and ratio of length/width and number of spines. Diameter of main capitula was recorded at dough grain stage.

At harvest (maturity) plant height upto main capitula was measured and recorded as essential character. Only one genotype JSI-99 shows height less than 51 cm. and group as very short genotypes. A-2, JSF-1 and JSI-7 group under short category *i.e.* height of 51-60 cm and 4 genotypes Nira, Nari-38, SSF-658 and MMS genotypes shows height in the group of 71-80 cm and grouped under tall group. NARI-6, showed height greater than 80 cm and group under very tall, and remaining A-1, A-300, AKS-207, Bhima, Girna, JSI-73, Manjira, Sharda, PBNS-12,

JLSF-414, PBNS-40,, MSV-10-1-5 and GMU-2369 genotypes were grouped under medium category.

The data on seed size, seed colour and test weight of safflower genotypes indicated that JSI-7 and NARI-6 comes under very low test weight (< 41 gm) whereas MMS, A-2, Nira, JSI-99, MSV-10-1-5 and JSI-73 grouped under low category having test weight 41 to 50 gm; in high category (*i.e.* between 61 to 70 gm) varieties like Bhima and A-1 can be grouped. The variety JSF-1 and Sharda having test wt. > 70 gm is under into very high category. The remaining varieties PBNS-12, A-1, Girna, AKS-207, JLSF-414, A-300, Manjira, GMU-2369 and PBNS-40 grouped under medium category seed weight ranges between 51 to 60 gm.

Out of 27 genotypes 5 genotypes were grouped as small seed size, 10 genotypes grouped as medium and remaining 7 genotypes as large seed size.

Only one genotype *i.e.* MMS showed yellowish brown colour of seed. JSI-99 showed brown colour of

Table 1 : Frequency distribution for various states of characteristics in 27 Indian varieties of safflower

Characteristic	State #
First leaf: Length of blade (cm)	Very short (1), Short (2), Medium(3), long(6) Very long (10)
First leaf: Width of blade (cm)	Narrow(3), medium(3) ,Broad(7),Very Broad(9)
First leaf : Ratio (Length/width of blade)	Medium(6),High(11), very high(10)
First Leaf : Dentations	Very weak(2), weak(1), medium(7),Strong(5), very strong(7)
Plant : Time of 50% flowering (days)	Very early(1), early (6), medium(12), late(3)
Petal : Colour	White(2), pale yellow(1), yellow(18), orange(2)
Petal : Change of colour (Faded stage)	Grey white(2), pinkish white(1), golden yellow(0), orange(16), red(3)
Leaf : Length of blade (cm)	Short(2), Medium(3), Long(16),
Leaf : Width of blade (cm)	Medium(5), broad(17)
Leaf : Ratio (Length/width of blade)	Low(1), Medium(17), high(3),Very high(1)
Leaf : Shape	Fusiform(11), obovate(13)
Leaf : Number of spines	Absent(2), Few(3), medium(3), many(7), Very many(8)
Leaf : Dentations	Absent(3),Weak(3), medium(5), strong(3) Very strong (8)
Capitulum : Length of outer involucre bract of main capitula (cm)	Short(6), medium(16)
Capitulum : Width of outer involucre bract of main capitula (cm)	Narrow(20), medium(2)
Capitulum : Ratio of length/width of outer involucre bract	Low(3), medium(16), high(3)
Capitulum :Number of spines on outer involucre bract of main capitula	Absent(3), sparse(3), dense(14)
Capitulum : Diameter of main capitula (cm)	Small(3), medium(17), large(2)
Plant : Height of insertion of first branch (From ground level) (cm)	Short(2), Medium(7), tall(10), very tall(3)
Plant : Length of longest primary branch	Very short(10), short(1), medium(5), long(1)
Plant : Height upto main capitula (cm)	Very short(1), short(3), Medium(13),tall(4), very tall(1)
Seed : Colour	White(14), white yellowish(4), brown(1),yellowish brown(1)
Seed : Number/main capitula	Medium(19), high(3)
Seed : size	Small(5), medium(8), large(7)
Seed: 1000 seed weight	Very low(2), Low(6), medium(11), high(1), very high(2)

seed. Whereas GMU –2369, Manjira, MSV-10-1-5, JSI-73, genotypes showed white yellowish seed colour and remaining Sharda, A-300, PBNS-12, A-1, JSI-7, Girna, JSF-1, A-2, Nira, AKS-207, NARI-6, Bhima, JLSF-414 and PBNS-40 genotypes white colour of seed.

Authors' affiliations :

PRITI SONKAMBLE, M.B. KHEDKAR AND T.H. RATHOD, Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, AKOLA (M.S.) INDIA

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