



## Safflower in Madhya Pradesh - an overview of 25 years of research and development

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### Abstract

Madhya Pradesh is a non-traditional region for safflower production, therefore it is significant that over a period of nearly three decades it has developed multiple varieties of Safflower, in three categories, namely Spiny, Spineless and Semi-Spiny. JSF-1 (Shweta) was the first Safflower variety released in 1984 even before the establishment of AICRP centre at Indore. Thereafter AICRP development work on safflower started in 1986 in Indore. This pushed the production area upward from small acreage to a splendid amount of 10,000 hectares (1988-89) in the Indore and Ujjain division. Fast forward to 2019, Nimar region farmers have now come forward for cultivation of Nonspiny Safflower varieties. After the establishment of AICRP centre, JSI-7 which is a high yielding spineless variety was released in 1990 for farmers. This was followed by the release of The JSI-73 (variety) in 1997, and quickly thereafter in 2004 came the bold seeded spineless variety JSI-97.

. The semi spiny variety JSI-99 (2004) is of extra early category with short stature and higher seed weight and a seed yield of about 1100 kg/ha under late planting condition in soybean-safflower sequence cropping. After mechanization in state the Spiny variety RVSAF 14-1 has been recently released in 2019.

**Key words:** spiny cultivars, adoption, yield, oil content, petals, medicinal use

## Introduction

Safflower [*Carthamus tinctorius* L.], popularly also called as Kusuma, Kusumbha, or Kardi, is an important oil-seed crop of subsistence agriculture. Farmers grow this crop invariably under rain-fed conditions for their valuable oil-rich seeds and reddish dye from flowers. Safflower is cultivated in post-rainy (*Rabi*) season on residual moisture. The oil produced from this crop is considered valuable for human consumption due to its various medicinal properties (Dajue, L. and Griffie, P. 2001). Globally, India ranks second with respect to its cropped area (1.4 m ha) and production (1.13 m tonnes) with an average productivity of 724 kg/ha (Sarada, et. al 2015). In India the crop is traditionally cultivated in the states of Maharashtra and Karnataka. To provide an additional income option to the farmers of, attempts were made to introduce safflower in the state. This review article gives chronological information on the research and development of safflower in Madhya Pradesh along with its main accomplishments.

## Background Information

Safflower was an alien crop in the state until the Agriculture College; Indore launched a programme to introduce the crop in Madhya Pradesh in 1971. The first step in this endeavor was to establish a quality research and develop programme to breed high yielding widely adapted safflower cultivars for the state and to identify its production constraints. In 1979, this initiative was strengthened further when International Development Research Centre (IDRC), Canada, decided to join hands in this cause by setting up its research sub-centre at the College campus at Indore. Soon the Indian Council of Agriculture (ICAR) started supporting this enthusiastic programme. These developments provided an ideal platform for launching well designed research and development activities in safflower.

## Field View of Safflower field during initial growth stag



### Breeding Programme

The start the breeding programme at the centre, a set of potential safflower germplasm and the available cultivars were introduced from ICAR; but found poorly adapted to the local environment. These genotypes were tall, late in maturity, produced low yields, unfriendly plant type, and bushy phrenology with sharp spines. These traits were not preferred by farmers as they posed enormous handling issues during the cultivation. Besides these, it was also observed that some genotypes suffered from diseases like *Alternaria* leaf spot (*Alternaria carthami*). Therefore, the breeding objective was to develop safflower early maturing cultivars with desired plant type; including no spines, short stature, disease resistance, good seed traits and high grain and oil yield.

From this programme a total of six safflower cultivars were released between 1984 and 2019. The comparative descriptors of these cultivars are given in the following text and in Tables 1-3.

**JSF-1:** This variety was developed by selecting a productive looking single plant from an open-pollinated bulk of germplasm accession IC - 11839 and advanced through pedigree breeding. The advanced generation progeny bulk of this selection was released for general cultivation in the state in 1984 as “JSF-1” and popular name “Shweta’. This variety is characterized with spines on its plants, white flowered and matured in 95 and 145 days, respectfully. Its seeds are white in colour, attractive and bold (6.2 g/100seeds) with oil content of 30%. On average it produces around 1500 kg/ha.

**JSI – 7: First nonspiny variety of state.** This variety was developed by selection from open pollinated JSF-1909 and advanced through pedigree breeding. The advanced generation progeny bulk of this selection was released for general cultivation in the state in 1990 .This variety is characterized with no spines on its plants; yellow orange flowered and matured in 97 and 145 days, respectfully. Its seeds are white in colour, attractive and small (4.5 g/100seeds) with oil content of 32%. On average it produces around 1300 kg/ha. Suitable in rain fed condition due thin hull content (Hull content 48.7%) and tolerant to wilt diseases.

**JSI - 73:—.** This variety was developed by hybridization of JSI -42 X JSI-7 and advanced through pedigree breeding. The advanced generation progeny bulk of this selection was released for general cultivation in the state in 1997 .This variety is characterized with no spines on its plants; yellow orange flowered and matured in 98 and 147 days, respectfully. Its seeds are white in colour, attractive and small (5.0 g/100seeds) with oil content of 31%. On average it produces around 1350 kg/ha.

**JSI – 97: First dual purpose early variety which farmers could harvest seed and petals.** This variety was developed by hybridization of NS-133 X JSI-62 and advanced through pedigree breeding. The advanced generation progeny bulk of this selection was released for general cultivation in the state in 2004 .This variety is characterized with no spines on its plants; yellow orange flowered and matured in 92 and 132 days, respectfully. Its seeds are white in colour, attractive and bold (6.5 g/100seeds) with oil content of 30%. On average it produces around 1500 kg/ha grain and 75-100 kg ha dry petals.

**JSI – 99: First extra early semi spiny variety tolerant to Safflower ahids (*Urolecon compositae*).** This variety was developed by hybridization of Maxican dwarf X BH-5 and advanced through pedigree breeding. The advanced generation progeny bulk of this selection was released for general cultivation in the state in 2004 .This variety is characterized with less spines on its plants; yellow orange flowered and matured in 78 and 120 days, respectfully. Its seeds are white in colour, attractive and bold (6.4 g/100seeds) with oil content of 29%. On average it produces around 1100 kg/ha grain .

**RVSAF - 14-1:** . This variety was developed by hybridization of JSI-120 XJSF-1 and advanced through pedigree breeding. The advanced generation progeny bulk of this selection was released for general cultivation in the state in 2019.This variety is characterized with spines on its plants; yellow orange flowered and matured in 85 and 137 days, respectfully. Its seeds are white in colour, attractive and bold (6.0 g/100seeds) with oil content of 30%. On average it produces around 1800 kg/ha grain.

## Petal Characteristics of Spineless Safflower Varieties

Among the available safflower cultivars in Madhya Pradesh, JSI-7, JSI-73 and JSI-97 have no spines on their plants. The petals can be easily harvested using a low-cost small mechanical picker. Besides some medicinal uses, the petals are also used for extracting valuable organic pigments. The petals are particularly rich in vitamin “C” and different vitamins of “B group” (Table 4). Thus, the petals of safflower provide an additional benefit to the growers and ultimately become a source of generating income which may provides incentives to farmers for cultivating safflower crop in their fields.

### Petals collection By Farmers



Marketing support by Marico industries and availability of seed on farmers field and procurement attract the farmers to grow the crops These developments helped in enhancing the safflower area from nearly zero to about **10,000 ha** by 1988-89. These increases were recorded in Indore and Ujjain divisions (Sawant, 1989).

Now Mr H.K.Mitra( Safflower extension expert ) and Aga khan non government organization come forward with group of farmers for cultivation in Khandwa and Burhanpur of Nimar region have taking interest to grow Spineless safflower. Because they could harvest two produce from one crop i.e. Seed and dry petals.

The area of safflower in Madhya Pradesh at present is now reaching on 29000 ha productivity is 724 kg/ha in 2014-15 (Sarada et al., 2015). For the first time in 2004 after around two decades, we were successful to eliminate the sluggish rosette stage (25-30 days) from the safflower crop by developing extra early safflower variety which have rosette stage only 15-20 days and fast growing, maturing in 100-110 days. This variety enabled farmers to grow three crops (early legume-safflower-late wheat) in a year. The semi spiny variety JSI-99 is of extra early mature in 100-110 days with short stature and higher 100 seed weight, It Yielded about 1100 kg/ha under late planting condition in soybean-safflower sequence cropping (Table 3). The aphid and disease problem was also low in this variety because of short stature and earliness. Due to the dwarf stature, harvesting and threshing is quite easy for this variety.

Now farmers have three type of safflower varieties for cultivation i.e. Spiny Safflower (JSF-1 and RVSAF-14-1), Non spiny Safflower (JSI-7, JSI-73 and JSI-97) and Semi spiny Safflower JSI -99

### Acknowledgement

. We greatly appreciate the guidance and support received from the Dean - College of Agriculture, Indore, Dr A.R.Sawant Ex Safflower Breeder and Dr. K.B.Saxena Ex. Pigeon pea breeder, ICRISAT to write review paper on safflower.

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**Table1. Information about the development and release of safflower cultivars in Madhya Pradesh**

Item/ Cv.	JSF-1	JSI-7	JSI-73	JSI-97	JSI-99	RVSAF 14-1
Project	Safflower Research Project, Indore	AICRP, Safflower Research Project Indore	AICRP, Safflower Research Project, Indore	AICRP, Safflower Research Project, Indore	AICRP, Safflower Research Project, Indore	AICRP, Safflower Research Project, Indore
Pedigree	Sel. from open pollinated IC-11839	Sel. from open pollinated JSF-1909	Sel. from cross 42 X JSI-7	JSI-Sel. from cross NS-133-I x JSI- 62	Sel. from cross Mexican dwarf X BH- 5	Sel .from cross JSI-120 X JSF-1
Breeding methods	Pedigree	Pedigree	Pedigree	Pedigree	Pedigree	Pedigree
Recomd. For	Entire Madhya Pradesh	Entire Madhya Pradesh	Entire Madhya Pradesh	Entire Madhya Pradesh	Entire Madhya Pradesh	Entire Madhya Pradesh
Year	1984	1990	1997	2004	2004	2019

**Table2: Characters of the released safflower cultivars in Madhya Pradesh.**

Trait/ variety	JSF-1	JSI-7	JSI-73	JSI-97	JSI-99	RVSAF 14-1
Spines	Present	Absent	Absent	Absent	Some	Present
50% flower (days)	95	97	98	92	78	85
Flower colour						
a) at blooming	White	Yellow	Yellow	Yellow	Yellow	Yellow
b) at withering	Dull white	Orange Red	Orange Red	Orange Red	Orange Red	Orange Red
Capitulum growth	Medium	Small	Medium	Bold	Bold	Medium
Maturity (d)	145	145	147	132	120	137
Grain yield (kg/ha)	1500	1300	1350	1500	1100	1800
Seed size	Bold	Small	Medium	Bold	Bold	Bold
Oil content (%)	30	32	31	30	29	30

**Table 3: Various morphological traits recorded in the released safflower varieties during 1984-2019**

Trait/ variety	JSF-1	JSI - 7	JSI -73	JSI-97	JSI-99	RVSAF 14-1
<b>Growth traits</b>						
Rosette (days)	20-25	22-27	24-28	20-22	15-17	18-22
Elongation (days)	25-30	25-30	25-30	25-27	20-25	20-25
Bud appearance (days)	20-25	22-28	24-30	20-22	17-22	15-20
Flowering (days)	20-25	25-28	25-28	18-22	15-20	18-22
Flower period (days)	3-5	3-4	3-5	3-5	4-6	3-4
Flowering (days)	20-22	22-25	22-25	15-18	7-10	20-22
Ripening (days)	40-45	40-45	40-45	35-40	30-35	35-40
<b>Seed trait</b>						
100 seed wt (g)	6.2	4.5	5.0	6.5	6.4	6.4
Hull content (%)	50.1	48.7	48.9	51.0	51.0	51.0
Kernel content (%)	49.9	51.3	51.1	49.0	49.0	49.0
Oil content (%)	30.0	32.0	31.0	30.0	20.0	20.0
Harvest index (%)	28.0	24.4	25.4	28.0	29.0	29.0
Grain colour	White	White	White	White	White	White

**Table 4. Mean nutritive values of safflower petals of non-spiny safflower varieties**

Description	Amount
Vitamin B 1 (mg/g)	0.185
Vitamin B 2 (mg/g)	0.061
Vitamin B 12 (mcg/g)	5.000
Vitamin C (mg/g)	189.3
Vitamin E (mg/g)	0,021
Oil (from 1g)	3.63%

AICRP on safflower report 2001 (Indore)

**Table 5: Production statistics OF safflower in Madhya Pradesh**

Year	Area (ha)	Production (t)	Yield (kg/ha)
2004-05	600	100	167
2005-06	1000	300	300
2006-07	600	200	333
2007-08	400	100	250
2008-09	400	100	250
2009-10	700	200	286
2010-11	400	100	250
2011-14	NA	NA	NA
2014-15	29000	21,000	724

Sarada et al (2015) Oil seed statistics 2015