

# EVALUATION OF TGMS LINE OF SAFFLOWER (*CARTHAMUS TINCTORIUS* L.) AT RAIPUR

Nirmala Bharti Patel and Rajeev Shrivastava

*Department of Genetics and Plant Breeding,  
Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.)*

**Abstract :** Safflower is an often cross pollinated oilseed crop. The oil of safflower contains lenoleic and oleic acid supposed to be the best for human health. Number of spiny or non spiny varieties of safflower has been developed through the India. Now there is constant plateau in the yield, varieties A-1, Bhima and JSF-1 are some of the high yielding varieties their yield level is not crossed by most of the newly developed varieties. This constant yield plateau in safflower can be broken down by exploitation of heterosis, through development of hybrid varieties. To develop male sterile lines number of genetic tools such as CMS, GMS and now TGMS lines are in use and under testing. The major constraint in hybrid development through GMS is maintenance of male sterile lines and required skill hence not popular. At Nimbkar Agricultural Research Institute (NARI), Phalton (Maharashtra), thermo genic male sterile (TGMS) lines TMS-3-6-7-9 in safflower has been identified. Its seed has been sent to Raipur for its evaluation for pollen sterility and its performance under rice based cropping system at Raipur.

**Keywords :** *Carthamus tinctorius*, crop, safflower

## INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is grown mainly as edible oilseed crop during winter and spring seasons, under rainfed irrigation conditions. India shares first rank in area and production with 50.6% share in the world area under safflower and 36.6% share in the world production (Anjani, K. 2012). There has been a decreasing trend in safflower area and production in the world since 1987, despite impressive improvement in productivity from 559kg/ha during 1987-88 to 890 kg/ha during 2008-09 (Damodaran and Hegde, 2010).

The productivity level has reached near plateau in the last one decade (1999-2008) due to various reasons like moisture stress, poor soil nutrient status, salinity and damage due to insect pests and diseases. These constraints together with limited genetic diversity with low genetic advance and variation in expression of yield and its components in different environments are some of the major limitations to progress for achieving quantum jump in seed yielding cultivars. Getting high jump in productivity at a rapid pace under adverse growing conditions is the real challenge to safflower researchers (Anjani, K. 2012). Exploitation of heterosis is one of the major way to break the yield plateau. High degree of heterosis was reported in safflower for number of characters like yield (177%) and oil yield (80%). The major ways to develop hybrids in safflower are through genetic male sterility system (GMS) introduced by Heaton and Knowles, (1980) and Joshi et al., (1983), CGMS system introduced by Hill (1989) and use of TGMS lines. The TGMS system is more feasible for this crop.

## MATERIAL AND METHOD

TGMS line (TMS-3-6-7-9) received from Nimbkar Agricultural Research Institute (NARI, Phalton) was

evaluated at Raipur. The TGMS line was sown on 23<sup>rd</sup> November, 2012 at Research cum Instructional Farm of IGKV, Raipur. The normal agronomical package of practices were applied. The plot size was 3X3 sq m, with a spacing 45 X 20 cm apart. After flowering the flowers were morphologically as well as cytologically examined for pollen sterility. As the temperature was raised the pollen behaviour of TGMS line was recorded. The pollen sterility was tested by bagging the flower as well as by I, KI solution under microscope.

## RESULT AND DISCUSSION

The flowering in safflower crop varieties generally varies from 80-110 days, depends upon the rosette period of the variety and responsible for early and delayed flowering of the varieties. In TGMS line TMS-3-6-7-9 the rosette period was for 20 days hence the crop flowered in around 80 days after sowing.

### Initial morphological study of the flower

The flowers were small and their opening was also very small and few florets were emerged from the flower. The capitulum was small to medium in size. The anthers coming out from them was thin and rudimentary, do not showed presence of any pollens either visually at field or under microscope in the laboratory, under Iodine- Potassium Iodide solution. No sign of the pollens were observed in cytological study at initial flowering stage. After four days there was 99.9% sterility were observed, which remains 99.8% till 25<sup>th</sup> February when the temperature was 29.8°C. After it the atmospheric temperature becomes gradually increasing and the pollen behavior was observed as in table-1.

### Pollen study at frequent intervals

After 10 days of first blooming the number of flowers were increased. The temperature during this

period was between 29-30°C. From 2<sup>nd</sup> week of March the cytological studies indicated the presence of 18% pollen fertility, which reached up to 32% on 20<sup>th</sup> March 2013 (Table-1,2). The meteorological data during the period indicated that from last week of February the Maximum temperature started increasing and reached up to 32.3 °C and in the third week of March the temperature shoot up upto 36.4°C, which reaches up to 38 in the end of March (table-3).

Similarly the five flowers were bagged by butter paper bags at frequent interval in order to study the pollen sterility through selfing. No seed setting was recorded till 1<sup>st</sup> March (Table -2). But with increase in atmospheric temperature the average seed setting was recorded from 5 to 9 seeds per capitulum up to 20<sup>th</sup> March when the temperature was 36.4°C.

The study indicated negative correlation between pollen sterility and the raised in environmental temperature, in low temperature the TGMS line TMS 3-6-7-9 had no pollen formation, but as soon as the temperature increases the sterility reduces and formation of fertile pollen grains starts. In low temperature or during winter flowering, the TGMS line TMS-3-6-7-9 showed 100% rudimentary anthers without pollen grains and worked as the male sterile line, and can be used as female parent in hybrid seed production programme at Raipur. Whereas, with the gradual increase in the temperature appearance of fertile pollen begins and as the temperature goes above 32 OC, the fertile reached up to 32%. This indicated that in higher temperature seed multiplication of this line can be done, as in higher temperature this line performs normal fertile line.

**Table 1:** Results of I-KI test for pollen sterility at Raipur.

S.No	Date of evaluation of Pollen grains for fertility	% Fertility	% Sterility
1	12.2.2013 (Flower initiation stage)	0.2	99.8%
2	16.2.2013	0.1	99.9%
3	25.2.2013	0.2	99.8%
4	1.3.2013	0.3	99.7%
5	10.3.2013	18	82
6	15.3.2013	30	70
7	20.3.2013	32	68

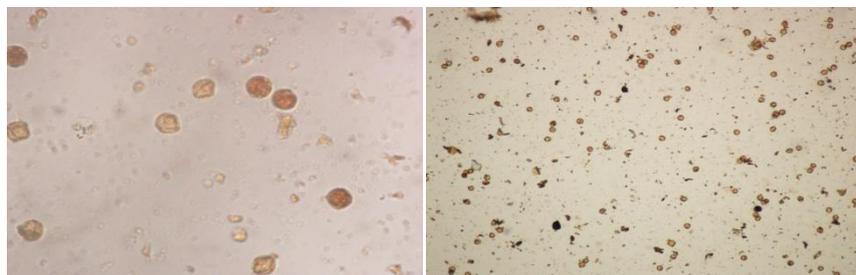
**Table 2:** Results of selfing of flowers by bagging at Raipur.

S.No	Date of evaluation of Pollen grains for fertility	No. of flowers bagged	% of seed setting
1	12.2.2013 (Flower initiation stage)	5	Nil
2	16.2.2013	5	Nil
3	25.2.2013	5	Nil
4	1.3.2013	5	Nil
5	10.3.2013	5	5 seeds (average)
6	15.3.2013	5	5 seeds (average)
7	20.3.2013	5	9 seeds (average)

**Table 3:** Meteorological data of the station during the study.

Meteorological week	Temp. in C		Rainfall (mm)	No. of Rainy days	Sunshine hr.	RH	
	Min.	Max.				Min. (%)	Max. (%)
32. Feb 05-11	16.8	30.0	0.2	0	6.7	44	86
33. 12-18	16.4	29.7	11.6	2	6.7	47	87
34. 19-25	14.6	29.8	0.8	0	9.9	36	84
35. 26-04	13.8	32.3	0.0	0	10.0	22	79
36.Mar. 05-11	14.8	34.3	0.0	0	9.6	19	71

37.	12-18	20.4	33.8	0.0	0	6.1	31	70
38.	19-25	20.2	36.4	0.0	0	8.3	22	66
39.	26-01	22.7	38.1	0.0	0	7.8	21	62



**Fig-1:** Study of pollen sterility in I-KI solution under microscope.



**Fig-2:** Flower of the TGMS line TMS-3-6-7-9.

## REFERENCES

**Anjani, K.** (2012). Genetic improvement in Safflower: possible avenues. Safflower research and development in the world: Status and strategies, lead papers, Indian Society of oilseeds research, DOR, Hyderabad pp: 1-26.

**Damodaran, T. and Hegde, D.M.** (2010). Oilseeds situations: A statistical compendium 2010. DOR, Hyderabad, India p.486.

**Heaton, T.C. and Knowles, P. F.** (1980). Inheritance of male sterility in safflower. *Crop Sci.*, 22: 520-522.

**Hill, A.B.** (1989). Hybrid safflower breeding. In: Proceedings of second International Safflower Conference. (Eds. Ranga Rao, V. and Ramchandram, M.), Hyderabad, India, pp. 169-170.

**Joshi, B.M., Nerkar, Y.S. and Jambhale, N.D.** (1983). Induced male sterility in safflower. *J Maharashtra Agril. University*, 8 (2): 194-196.

