

SUMMARY AND CONCLUSIONS

Safflower (Carthamus tinctorius L.) commonly known as Kardi in Marathi, is an important rabi oil seed crop of India raised over an area of 7.9 lakh hectares and producing about 6 lakh tonnes annually. Maharashtra and Karnataka are the most important safflower growing states. Ahmednagar, Aurangabad, Solapur, Pune, Bhir, Parbhani, Buldhana etc. are districts in Maharashtra where safflower is regularly grown. Oil extracted from seeds is rich in lenoleic acid and forms an important part of diet for heart patients due to its effective role in reducing blood cholesterol. Oil cake after extraction of oil is used as a cattle feed and as a manure. Young and tender shoots are popularly consumed as a vegetable. The crop is also grown for carthamin, an orange red dye extracted from brilliantly coloured florets. The genus Carthamus consist of 36 species among which three occur in India. Carthamus tinctorius is economically important and grown on a large scale.

Safflower is adapted to a wide range of climatic conditions and well grown in semiarid regions. It cannot withstand excess rainfall and humidity at any stage of its growth. The optimum sowing period varies depending upon rainfall. In India, it is sown from September to November. The sowing period, spacing, plant density, the use of fertilizers etc. significantly affect the yield of crop. Under normal conditions usually three irrigations are recommended, distributed as, at the time of sowing,

at about 35 days and the last during flowering stage. Most of the studies on safflower are carried out to assess the effect of fertilizers, water management, cultural practices on the seed yield. A few reports regarding the effect of sowing period on the growth and yield are available. However studies on physiological and biochemical analysis of safflower leaves and seeds and the effect of sowing dates on various physiological and biochemical parameters are scanty.

For the present study two safflower varieties namely Nira and JSI-7 were selected. Nira (NRS-209) is a spiny variety adapted to irrigated areas of Maharashtra. JSI-7 is a spineless variety grown mostly in Madhya Pradesh. The seeds of two varieties were obtained from Nimbkar Agricultural Research Institute Phaltan and sown in field plots of equal size in three different months (September, October, November) but on the same day. Three irrigations were provided, first after sowing and second and third was given 35 and 65 days after sowing respectively. Growth performance of plants with respect to various morphological parameters was analysed and compared in two varieties. Various biochemical constituents in the leaves were determined during first and second month to assess the nutritive value. Biochemical analysis of seeds during their development was undertaken after 10th, 20th, 30th and 40th day after seed setting in both the varieties. Major cellular constituents in mature

seeds were also determined. The results are summarised in the following pages under respective parameters.

A. GROWTH PERFORMANCE :

Root length and the number of leaves produced per plant in Nira were positively influenced by a late sowing in November. In JSI-7 root growth was not much influenced but number of leaves was doubled in October and November-sown plants. Fresh and dry weights were found increased in November-sown plants in both the varieties.

Different phenological parameters such as the emergence of branches, buds, flowerheads etc. were influenced by the sowing dates and exhibited about one to two weeks earliness in both the varieties with November-sowing. Thus all the parameters related to the yield were found influenced in late-sown (November) plants.

B. BIOCHEMICAL ANALYSIS OF LEAVES :

1. Photosynthetic Pigments :

Maximum value of total chlorophylls was observed in November-sown plants of Nira and October-sown plants of JSI-7. Chl. b appeared sensitive to the sowing period in both the varieties. Carotenoids were not much affected by the sowing period and exhibited a marginal increase with delay in sowing date in both the varieties.

2. Total Polyphenols :

Total polyphenols increased in both the varieties sown in November during the second month. In September and October-sown plants, the content declined during the second month.

3. Carbohydrates:

Total sugars and starch content were enhanced in the late sown plants remarkably and about five to six fold increase in total sugars and about four to nine fold in starch content appeared in November-sown plants of Nira and JSI-7.

4. Soluble proteins and free aminoacids :

The sowing period did not induce any remarkable change in protein content and its level was higher during the first month of growth in both the safflower varieties. The content of free aminoacids increased during the second month in both the varieties and was positively influenced in the November-sown plants during the early stage.

5. Ascorbic acid content :

Both the varieties revealed a rich source of Vitamin C and the amount was maximum in the September-sown plants in JSI-7 and in October and November-sown plants of Nira.

6. Mineral constituents :

A high nitrogen content was observed in October-sown

plants in both the varieties which did not vary much in the first and second month. Phosphorus content was maximum during the first month and found affected by late sowing in both the varieties. The growth stage and late sowing reduced the level of Potassium in both the varieties, maximum being recorded in September-sown plants in JSI-7 and October-sown plants of Nira. The ratio of Na:K declined with the growth stage suggesting a decrease in the content of both the elements. Magnesium and Calcium content was high during the first month in Nira and fluctuated with the date of sowing. In JSI-7 Magnesium was reduced with late sowing whereas Calcium content exhibited an increase during the first month. Iron level in JSI-7 was higher than in Nira during first month and September-sowing resulted in increasing its content. The studies revealed that the young leaves of both the varieties can provide a rich source of minerals.

C. ANALYSIS OF DEVELOPING SEEDS :

1. Dry matter and oil percentage :

The dry matter content in developing seeds increased continuously with a decrease in moisture percentage in both the varieties. Seeds of Nira exhibited high values of fresh weight and dry matter than JSI-7, however, the oil percentage was more in JSI-7 than in Nira. Oil content varied remarkably from young

to mature stages of seed development in both the varieties.

2. Quantitative analysis of lipids :

Iodine number and Free Fatty Acid value increased steadily during the seed development and reached to maximum in postmature or harvested seeds of both the varieties. Saponification value was high in young seeds and then decreased with the seed maturity in both the varieties.

3. Qualitative analysis of lipids :

Qualitative analysis in the developing seeds was carried out by Thin Layer Chromatography. About ten to twelve different lipid constituents were visible in Nira and JSI-7. Presence of mono- and diglycerides was observed during the young and premature stages in both the varieties. Triglycerides and methyl esters of fatty acids became prominent as the seeds mature. The concentrations of fatty acid also increased in the later stages of seed development in both the varieties. Some constituents remained stable throughout the seed development, whereas a few disappeared after the premature stage.

4. Analysis of harvested seeds :

Protein and carbohydrate content in endosperm and hull of harvested seeds was determined in both the varieties after oil extraction. Endosperm of both the varieties was rich in

proteins but the total protein content of seeds did not vary much in Nira and JSI-7. Total sugars and starch content were high in the endosperm and the hull respectively. The oilcake after extraction of oil can form a rich cattle feed and manure.

5. Qualitative analysis of seeds during storage :

Changes in Iodine number, Free Fatty Acid Value and saponification value of oil extracted from Nira and JSI-7 were recorded at an interval of 15 days upto 3 months. A marginal decline in all the parameters was observed during the storage of oil. The analysis revealed that the quality does not deteriorate with storage upto three months.

The work reports a positive influence of late sowing (in November) on the growth of Nira and JSI-7. Further the nutritive value of leaves can be increased by late sowing and tender leaves after first month of growth can be used as a leafy vegetable or fodder. The percentage of oil was also found increased in the late-sown plants of Nira and JSI-7. Thus the sowing period in November exhibited a beneficial effect in Nira and JSI-7.