

BIOSALINITY NEWS

SAFFLOWER

SAFFLOWER: A SALT-TOLERANT OIL CROP FOR THE ARID ENVIRONMENTS

A MEMBER of the thistle family (Compositae/ Asteraceae), Safflower (*Carthamus tinctorius* L.) is a multi-purpose salt-tolerant crop grown in various parts of the world. Its origin is believed to be in the Levant where it was domesticated more than 4,000 years ago. Safflower is an annual herbaceous bush with many branches that terminate in the *capitulum* (the flower head), which is surrounded by stiff bracts. Its composite flower head includes 20-180 florets and has different colors (white, yellow or orange). Following germination, the seedling produces a circular arrangement of leaves called a rosette. After one month approximately the central main stem emerges. The stem may grow to maximum length (30-150 cm) at the time of flowering. Both stems and branches have leaves which generally possess numerous hard spines that deter animals such as goats, sheep and camels to graze on plants. Safflower produces white seed which is four sided and has a thick and smooth hull (pericarp). The average seed length is 6-7 mm and the average seed weight is 40 mg. The plant has a long taproot system that can grow to 2-4 m deep in the soil.

Safflower grows well in relatively deep and well drained soils. Sandy loam soil with good water holding capacity is considered to be best for the crop. At germination, the optimum temperature is 15.5°C, while at flowering time 24-32°C will give the higher seed yield. The seed rate is 10-25 kg ha⁻¹ with 45-60 cm of row spacing. In arid lands the seed yield is about 500 kg ha⁻¹ while in



Safflower seed can contain 24-36% good quality oil



Safflower is a highly branched plant

irrigated areas it may produce more than 1000 kg ha⁻¹, but with improved agronomic practices the yield can be doubled. Mexico is the biggest producer of safflower seed followed by India which has the largest area under safflower cultivation. The United States of America, Kazakhstan, Ethiopia and China are other important safflower-growing countries.

Safflower is a drought-tolerant crop which fares

reasonably well in dry or semi-arid regions providing moisture at sowing time. The Safflower plant has a strong, deep and extensive root system which can penetrate hard subsoil creating conduits which ultimately make water and air movement into the soil possible. Due to its profound root system the plant can survive long drought spells by extracting deep subsoil water at the depth of 4 m.

Among different environmental strains, salinity is a serious threat to various crops. Both soil and water salinity, particularly in arid and semi-arid areas, can reduce crop production significantly. Safflower is considered to be a moderate to high salt-tolerant crop that makes it better than wheat and equal to barley for planting in saline soils and therefore its

cultivation on salt-affected land can prove beneficial to farmers. It is tolerant of sodium with its salinity threshold value being 6.4 dS m⁻¹ for the seed yield. Salinity at medium level does not seem to affect its seed yield and oil quality, though it impairs the seed germination. However, the crop can also help in hampering the spread of salinity in arid areas. Safflower has a deep root system and long-growing period which help in lowering the brine water tables from recharge areas to hinder the expansion of salinity as well as water-logging in affected areas.

In areas where birds, rodents and other animals are a problem to various crops, safflower which is relatively secure due to its spiny nature can be grown successfully with modest maintenance. Safflower planting in between different cereal crops breaks the lifecycle of diseases like crown and root rot as it is not a carrier of these plant infections. Safflower planting in cereal cropping system is also less laborious as it does not need further land tilling. Being a late-sowing crop, it can replace the crops that fail for a variety of reasons.

Safflower seed contains 24-36% oil, which does not have flavor and color and is nutritionally closer to sunflower oil. It has two types of oil based on different fatty acids composition: polyunsaturated and monosaturated produced by different safflower genotypes. The polyunsaturated oil contains about 80% linoleic acid and 15% oleic acid making it suitable for soft margarine production and salad oil. Since this class of oil polymerizes on

heating, it is less appropriate for cooking especially frying. Polyunsaturated oil is also used in the production of cosmetics, paints, varnish, drugs, lubricants and biodiesel. The monounsaturated type of safflower oil possesses around 80% of oleic acid and 15% linoleic acid which makes it comparable to olive oil. This kind of oil is excellent for frying. Various scientific studies have revealed that the daily use of safflower oil leads to a decrease in body fat and increase in muscle weight. Monounsaturated oil also helps to improve blood sugar, inflammation and good cholesterol (HDL). After the extraction of oils from seed the leftover meal which contains 20-45% protein is used to feed poultry and livestock. In addition to oil production, safflower seed is used as birdseed and to feed some domestic and wild animals.

It is not only the seed oil which is beneficial; its flowers (petals) can also be used for different purposes. The safflower petals are being used as an inexpensive alternate for saffron as it has almost the same color and flavor. Since synthetic colors and dyes are thought to be hazardous for health, some of them can be replaced with brilliant safflower petals, which in the past had been used to dye fabrics and other stuff. Apart from coloring, the petals are considered to have some medicinal properties to cure high blood pressure, rheumatism, arthritis, infertility and some other ailments.

Safflower produces gorgeous flowers of various colors that give it high ornamental value. Though most safflower growing countries cultivate



Safflower planting at ICBA

safflower for its oil, it has huge scope to be used for fresh-cut and dried flowers. In Europe, where safflower is grown mainly for ornamental purposes, cut-flowers worth millions of dollars are sold every year. It is possible to introduce it as an ornamental in other parts of the world where it is grown mainly as an oilseed crop. Some work



One flower might produce about 20 seeds



Spineless safflower varieties are ideal for cut-flowers



The orange color safflower petals are used to make cheap alternate for saffron

in China, India, Iran and the USA has been done to select the spineless cultivars, which is necessary for successful floriculture. However, more breeding effort is required to evolve improved spineless safflower varieties.

Safflower also has great potential as a fodder crop. The spineless cultivars can be used as forage to feed farm animals at any phase, while spiny safflower accessions are used at the early stage when plant lack spikes. Green safflower plant is used to make high quality silage to feed livestock. The use of safflower as fodder seems to improve the fertility rate in ewes considerably. One hectare of safflower can produce about 22 tons of dry matter with good digestibility.

The International Center for Biosaline Agriculture (ICBA) has a collection of 640 genotypes of safflower that belong to more than 20 different countries around the world. Thorough research on more than 630 safflower accessions was carried out in 2000-01 and 20 different physiological, morphological and yield related characteristics of the genotypes were studied to identify oil, forage and ornamental types (Jaradat

and Shahid, 2006*). In addition, the genotypes were investigated to identify their tolerance against salinity. The evaluation of the germplasm set showed the presence of vast diversity, particularly within the safflower accessions from the Middle East, which is considered to be the center of origin for the crop. The accessions with better yield and other desirable characteristics can be introduced as a multi-use crop into various farming systems with salinity problems. Furthermore, the safflower breeders can utilize the variation within the collection to evolve cultivars of desired traits under different growing environments, especially in different countries of the Arabian Gulf. ICBA is also providing safflower seed to different agricultural scientists working in the UAE and overseas. Till now more than 450 seed samples have been distributed to various research centers around the world to facilitate safflower study, especially in relation to its salt tolerance.

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