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REVIEW PAPER

Evaluation of challenges and strategies for the development of oilseeds and problems of oil self-sufficiency in Iran

Mohammad Reza Zargaran Khouzani [1]*, Mohammad Hossain Gharineh [2]

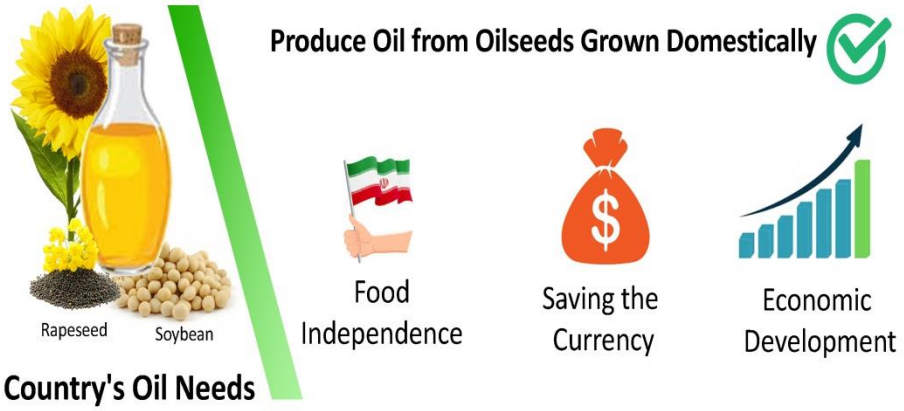
[1] Department of Agrotechnology, Majoring in Ecological Plants of Khuzestan University of Agricultural, Ahvaz, Iran

[2] Department of Plant Production and Genetics, Khuzestan University of Agricultural Sciences and Natural Resources, Ahvaz, Iran

Highlights

- Oil is one of the most important human food sources, so in recent years, the production of oil products has been a priority in the programs of the Ministry of Jihad Agriculture.
- Iran, with its great potential, can play an important role in increasing the production of agricultural products, especially oilseeds.
- In this study, while getting acquainted with the agronomic and nutritional characteristics of

Graphical Abstract



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Abstract

Oilseed production plays an important role in saving the currency, accelerating the process of economic development, security and food independence of the country. According to official reports, the country's annual crude oil demand is 1.5 million tons, but studies indicate that this amount has increased to 1.9 million tons in recent years with increasing capacity and market demand. There are three ways to meet the country's oil needs. The first is oil production from oilseeds, which is met from 3 million tons of oilseeds and 600,000 tons of crude oil. The second method is direct import of crude oil. For example, 510,000 tons of palm oil, 500,000 tons of sunflower oil and 100,000 to 200,000 tons of soybean oil are imported annually. The last method is to obtain oil from domestically grown oilseeds. In 1999, 270,000 tons of rapeseed, 110,000 tons of rapeseed oil and 50,000 tons of soybean, 10,000 tons of soybean oil were obtained, and the total production of oil from domestically grown oilseeds reaches 120,000 tons. This means that of the 1,900,000 tons of domestic demand, only the production of 120,000 tons is fully domestic. Annually, more than 30% of foreign exchange is spent on basic oilseed commodities and their extraction. Thus, in 2020, the value of imports of oilseeds, oil and flour amounted to 2.193 million dollars, which is equivalent to 9210 billion tomans in the currency of 4200 tomans. Therefore, the production of oilseeds plays an important role in saving the currency, accelerating the process of economic development, security and food independence of the country.

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*Corresponding author: mr.zargarankh@gmail.com (M.R. Zargaran Khouzani)

1. Introduction

Oil is one of the most important human food sources, which is very important for the supply of essential fatty acids and energy. In 2019, about 1822 tons of Iranian oil were consumed, of which about 1104 tons were consumed directly by households. Therefore, the direct per capita consumption of vegetable oil in the country is 12.9 kg and the per capita consumption, including domestic, trade and industrial consumption, is about 21.6 kg per year. Considering the increase in population in the last four decades and the current population of about 85 million people, according to the forecast of the Statistics Research Institute, if the fertility rate of the total population in 2050 will reach about 112 million. With the current situation of oil production in the country, which meets less than 10% of domestic demand. Every year, a significant part of the country's budget will be spent on importing vegetable oil, meal and oilseeds for livestock and poultry feed (Eyni-Nargeseh et al., 2020). For this reason, in recent years, the production of oil products has been a priority in the programs of the Ministry of Jihad for Agriculture. Due to the limited production factors, to make optimal use of these factors and achieve maximum production, it is necessary to develop the area under cultivation and increase the production of oil products in different areas based on the principle of Comparative Advantage. According to this principle, if a region has many factors and inputs of production and can produce and market the product at a lower cost than other regions, that region has an advantage in the production of that product (Mahboub Khomami et al., 2021). Comparative Advantage depends on the availability of resources and factors of production, production method, technological progress, manpower skills and efficiency of inputs. Iran has a lot of potentials, especially benefiting from natural resources, diverse climate, susceptible climate and fertile soil can play an important role in increasing the production of agricultural products, especially oilseeds. Iran's climatic position in terms of temperature, soil type and climatic conditions is such that it is possible to grow most crops and horticulture. Oilseeds are grown to extract oil from the seeds, but they are also a valuable source of protein and product residues after oil manufacture are used for this purpose. Both oil and meal are just as important and require special analysis that accuracy in cultivar purity is important. Very small impurities with other genetic materials may drastically reduce the quality of the oil obtained or the meal produced from them may contain toxic substances. Therefore, oilseed growers should be especially careful to prevent mixing or contamination of unsuitable pollen sources. In this study, while getting acquainted with the agronomic and nutritional characteristics of oilseeds, the country's ability to produce these oilseeds has been evaluated.

1.1. Rapeseed (*Brassica napus*)

Rapeseed contains 40 to 45% oil, 17 to 26% protein and its meal contain 50% protein. Rapeseed meal has a balanced composition of amino acids, so it has a high nutritional quality that can be used in animal feed and food. This food is comparable to a meal such as cotton seeds and works well in the diet of ruminants, especially sheep fattening; As a result, it contributes significantly to the food security of the country's livestock. On the other hand, as mentioned, its meal has a lot of protein and is very suitable for animal feed. It is also one of the best plants for producing nectar for bees and can play an important role in the development of the beekeeping industry (Eyni-Nargeseh et al., 2020).

Rapeseed is one of the most manageable crops. The yield of this crop depends on the date of cultivation. It has different cultivation history in different regions of the country. Because it must have a certain number of leaves (6 to 8 leaves) until the winter season. Root diameter should be 8 mm at the time of frost and root length should be 15 cm. In addition to soil fertility, canola rotation with cereals helps control pests, diseases and weeds. In addition, wheat yield after rapeseed cultivation will be higher compared to fallow. Date of rapeseed planting in cold regions of the country, 10 September to early October; In cold temperate regions, 20 September to 5 October; Caspian coastal areas (Gorgan, Mazandaran, and Moghan), 10 October to 15 November and tropical areas, early November to early December. Rapeseed plant density for free pollinating cultivars; 60 to 80 plants/m^2 and in hybrid cultivars 40 to 50 plant/m^2. Therefore, in free pollinator cultivars, the required amount of seeds is 6 kg and in hybrid cultivars, 4 kg/ha is required. The average amount of rapeseed is 8 to 10 kg/ha.

Due to the small size of rapeseed seeds, proper soil preparation and proper adjustment of the seeder is very important. Rapeseed seeds must also be disinfected with fungicides such as Vitavax at a rate of two per thousand (2 grams of fungicide per kilogram of seed) (Hamzei and Soltani, 2012).

Because rapeseed seeds are small, the culture medium must be soft and uniform to germinate easily. After harvesting, irrigate once if possible to allow weeds to grow and plow after the soil reaches the proper soil moisture. Before planting, it is better to disk the ground to crush the lumps and remnants of the previous crop and to even out the field soil. Then apply nitrogen fertilizers at a rate of 50 kg/ha, phosphorus fertilizers at a rate of 150 kg/ ha and potash fertilizers at a rate of 100 kg/ha (Mansour et al., 2017). The depth of rapeseed sowing is 1 to 2 cm and the distance between the seedlings is 60 cm. 2 to 3 rows are planted on each stack at a distance of 12.5 cm. Some farmers use seed fertilizers containing zinc and Humic Acid to improve rooting and plant establishment in the soil (Moradbeigi et al., 2019).

To control rapeseed weeds, 2 liters per hectare of Treflan toxin can be sprayed before planting and then applied with a shallow disc. The interval between spraying and mixing with soil should not exceed half an hour. To control broadleaf weeds of canola at the time of 4 leaves, use Lontrel poison and for narrow weeds of rapeseed, use super Gallant poison (Eyni-Nargeseh et al., 2020). Table 1 presents rapeseed cultivars in Iran with the characteristics of the cultivars.

Table 1. Introduction of rapeseed cultivars in Iran.

Rapeseed cultivars	Characteristics of cultivars
Talayeh	High yield, stability of cold regions
Hayola401	High yield, stable performance and tolerant to dormancy, suitable for warm areas
Sarigol	Late, stable performance of warm and temperate regions
Okapi	High productivity and stable performance of cold regions
SLM046	High yield, stability, yield, drought resistance, cold regions
Hyola 420	High yield, medium maturity, warm areas
Hyola 308	High yield, early warm regions
Zargol	High yielding warm and temperate regions
Esteghlal	High yielding warm and temperate regions
Opera	Medium maturity, high yield, rapid initial growth, cold regions
Lycord	High yield, stability of cold regions
RGS003	High yield, medium maturity warm regions
Moudna	High yield, stability of cold regions
Zarfam	Medium maturity, high yielding cold regions
Zafar	High yield, pod density in the main stem, Mian darband Mazandaran areas
Ahmadi	High yield, stability of cold regions
Delgan	High yield, stable performance of hot areas
Nima	High yielding, tolerant of *Sclerotinia sclerotiorum*, cold and temperate cold regions

The area under rapeseed cultivation in the crop year 2017-18 was 191,251 hectares and the production of this area is reported to be 329,843 tons. Golestan (55315), Fars (19000) and Khuzestan (18006) provinces have the first to third ranks of the area under cultivation of this crop. In production, Golestan (112548), Khuzestan (31223) and Fars (29375) had the highest production in the mentioned crop year. A noteworthy point in the production of this product is the average yield that Golestan with a yield of 2636 kg/ha is higher than the provinces of Kermanshah (2533) and Kurdistan (2490) and this shows the potential of these provinces in the production of rapeseed. Now, according to the new policies of the Ministry of Jihad for Agriculture, two methods have been considered for rapeseed cultivation, one based on the cultivation pattern and the other based on capacity, climate, water and soil conditions and temperature in the provinces. Therefore, for the 2020-2021 crop year, the cultivation of rapeseed at the level of 350,000 hectares and the encouragement of farmers to cultivate these seeds are emphasized.

1.2. Soybean (*Glycine max*)

Soybean is a plant in the legume family. Its pods and seeds provide food for millions. Soybeans are probably the result of the domestication of wild plants in East Asia. Oil extracted from soybeans is one of the most important types of oils. This oil contains very high linoleic acid and therefore it can not be used to prepare frying oil. Soybeans are poorer in methionine than Sesame, but high in the amino acid lysine. Soybeans are more similar to animal protein than other grains. Soybean oil contains 49% linoleic acid and 25% oleic acid. The soybean protein content is 30 to 50% and about twice as much as other oilseeds, and of course, the oil content is 18 to 25% less than other common oilseeds. The high protein content makes the extracted oil meal very suitable for human consumption. Soybean meal is obtained from soybeans after oiling and is one of the best and most common sources of plant protein in diets, which in addition to sufficient protein has the necessary amounts of essential amino acids and B vitamins.

Combining this meal with a fish meal is a very good combination in terms of providing essential amino acids in poultry diets. Therefore, in most countries, it is used as one of the main raw materials in diets. In Iran, some of this meal is produced and some is imported. Soybeans are planted in the spring as the first crop and in the summer as the second crop. Soybean is specific to the tropics but also works well in temperate regions. The optimum temperature is 30 to 32 °C. Soybean cultivation reduces pests, diseases and weeds in the fields. In terms of growth type, soybean has two types of determinate growth, indeterminate growth. This plant can produce the best product in soils with suitable depth and sufficient nutrients and optimal water storage capacity. Deep sandy soils or hard clay soils are not suitable for soybean cultivation due to their low water holding capacity. Soybean growth can be affected by high or low soil acidity. Fertile soil with medium texture and acidity between 6 and 7 is essential for soybean. Lack of organic matter in soil and alkaline acidity and salinity will reduce yield. The method of planting soybeans is row. In early sowing, more planting lines are chosen, but in late sowing, shorter line spacing is considered so that the soybean plant covers the soil surface sooner and does not reduce grain yield, and weeding and pest control are performed better. Seed consumption is less compared to broadcast planting. The seeds are placed at the right depth in the presence of moisture and it becomes easier to germinate.

The history of soybean cultivation in areas such as Mazandaran has started from the second decade of May and has used spring rains to make it green better. In Mazandaran, soybeans can be grown after wheat harvest. Soybean planting arrangement 40 by 8 cm with 60 to 70 kg of seeds per hectare is recommended. To succeed in the second crop, it must be harvested as soon as possible, because the later the soybean crop is done, 5 to 10 months, the lower the yield. In preparing soybean soil after wheat, care should be taken that the seedbed is soft and uniform, and because the soil dries quickly in this season, the distance between soil preparation and cultivation should be minimized. In the second crop, the amount of seed used should be increased and the distance between planting lines should be minimized, because in the post-wheat crop, due to the limited growing season, soybeans may not reach their full growth limit. Row cultivation is one of the conditions for success in this cultivation. Since the soil becomes weak in terms of nutrients after wheat harvest, the soil should be strengthened by adding chemical fertilizers.

Pest control such as Agrotis, Ticks and Caradrina is very important. To obtain maximum yield according to the soil test, fertilizer should be recommended. But in general, 50 kg of urea fertilizer, 50 kg of triple superphosphate fertilizer, 50 kg of potash fertilizer and 50 kg of sulfur fertilizer per hectare are required. Of course, urea fertilizer should be used 3 to 4 times at intervals of 10 days. To control soybean weeds, use 2 to 2.5 liters of Treflan herbicide before planting and mixed with soil, Imazethapyr for weeds. To control soybean weeds before planting 2 to 2.5 liters of Terflan herbicide and mixed with Imazethapyr soil for narrow-leaved and broadleaf weeds at the rate of 1 liter after planting and before the emergence of soybean weeds or in The early stages of weed growth should be used. Pendimethalin (Stomp) is recommended to control narrow-leaved and broad-leaved weeds at the rate of 3 liters per hectare after planting and before the emergence of soybean weeds. Adjusting the irrigation period will increase soybean yield. The first irrigation for soybean seeds to

germinate is done before sowing as a pyramid or after planting as a sprinkler. During the growing season, 5,000 to 6,000 m^3 of water is needed to achieve optimal soybean yield.

Table 2. Introduction of soybean cultivars in Iran.

Soybean cultivars	Characteristics of cultivars
Williams	High yield-Golestan
Line 504	High yield - indeterminate growth- Delayed cultivation-Dezful-South Garm
M9	High yield-Moghan, Lorestan
Gorgan 3	Productivity and performance stability-Golestan
Magic	Productivity and performance stability-Golestan
Zan	Productivity and performance stability-Moghan
Sepideh	High product
Sari	High yield- tolerant of *Macrophomina phaseolina*-Mazandaran
Talar	Productivity and performance stability-Mazandaran
Nader	High yield - relative tolerance to *Macrophomina phaseolina*-Mazandaran
Katoul	High yield- Stability of performance- Suffering from *Macrophomina phaseolina*-Golestan
Saland	High yield and performance stability- Safiabad Dezful-Khuzestan
Caspian	Performance stability- tolerant to *Macrophomina phaseolina* -Mazandaran
Saman	Performance stability- tolerant to *Macrophomina phaseolina*-Golestan
Kausar	Early - *Phytophthora* resistant-Lorestan-Chaharmahal and Bakhtiari
Amir	High product

The area under soybean cultivation in the 2017-18 crop year was 327 hectares and the production of this area was reported to be 83,303 tons. Golestan (18875), Ardabil (15150) and Mazandaran (772) provinces have the first to third ranks of the area under cultivation of this crop. In production, Ardabil (40174), Golestan (36100) and Mazandaran (6788) had the highest production in the mentioned crop year. A noteworthy point in the production of this product is the average yield that Mazandaran with a yield of 3101 kg/ha is higher than Ardabil (2652) and Golestan (1780) provinces and this shows the potential of these provinces in soybean production. Studies show that all soybean production in Iran is allocated only to these three provinces, while studying the environmental conditions and climatic needs of the product, other potential areas seem to be identifiable.

1.3. Sunflower (*Helianthus annuus*)

Sunflower is a plant that grows well in most temperate regions and similar cultivars can be grown in a wide range of climatic conditions. Only a few crops of this wide range show adaptability. Various morphological and physiological features are involved in its wide adaptability. Due to its dense roots with the power to spread to a depth of 2 meters, a sunflower grows well in soils whose texture varies from sandy to clay. Like corn, wheat or potatoes do not need very fertile soil to produce a satisfactory crop. The salient features of the sunflower plant include the following:

a. Tolerance to cold and high temperatures is involved in the adaptation of sunflower to different environments.
b. The title of a plant is indifferent to the length of the day because it flowers in a wide range of days.
c. It is not very drought tolerant but can produce acceptable yields when many plants are damaged.

Sunflower oil is extracted from sunflower oil seeds. This oil is used for food purposes. This oil is one of the common oils that is widely used for frying and cooking food. After extracting oil from sunflower seeds, the meal is used for animal feed (Seyedi and Hamzei, 2020). Today, sunflower seeds have undergone genetic modification and, using plant breeding, have produced better seeds and, as a result, better flowers that are both more productive and more resistant to plant diseases and pests. Sunflower oil contains saturated fatty acids (5 to 16%) and the rest is unsaturated. Sunflower meal is obtained from peeled sunflower seeds after oil

manufacture. It is widely produced in the former Soviet Union and Eastern European countries and used in livestock, poultry and fish diets. The sunflower protein content is reported to be 30 to 53% and its fat content is 0.8 to 13% (Imaz et al., 2010).

For spring-summer cultivation, the soil should be plowed a few months in advance so that the weather can penetrate deep into the soil and increase biological activity. The tools used for primary plowing soften the soil and increase the nitrogen and potassium available to the plant. In wet areas of autumn plowing, loamy and clay soils more than spring plowing cause the soil to soften and absorb moisture to germinate seeds in spring. Sunflower is one of the most important plants in rotation and can bring many elements to the surface from the depths of the earth. In the rotation program, you can plant a sunflower in the first year, soybeans in the spring of the following year, and autumn cereals in the fall of the following year. Beet, sunflower, barley or cotton, sunflower, barley or soybean, wheat or sunflower, barley or wheat crops can be included in the sunflower rotation program. The yield of sunflower in fertile soils reaches its maximum, so the residual effect of fertilizer application in other crops during the crop rotation is in favor of sunflower. In general, 20 to 30 tons of rotten manure are buried in the fall and 100 to 150 kg of nitrogen fertilizers, 50 to 100 kg of phosphorus and potash should be added to the soil before planting.

Studies have shown that tall and dwarf sunflower cultivars show different reactions to plant density and maximum grain yield in shorter cultivars is obtained from higher densities and narrower row spacing. Sunflowers, on the other hand, have a lower height in the second crop than in the earlier planting date. Therefore, in the second crop in the central regions of the country, the density of 80,000 to 90,000 plants/ha is recommended. The most suitable planting date in plain lands is the first half of March and in mountainous areas is the second half of April. Planting depth is on average 3 cm in suitable moisture conditions and in areas where deep soil moisture should be used up to a maximum depth of 10 cm. High-density delays flowering increases dormancy and increase fungal rot. The most suitable distance between rows is 60 and between plants is 20 to 25 cm. Abundant water at planting and subsequent surface irrigation at budding or seed filling can produce a moderate yield.

The area under sunflower cultivation in the 2017-18 crop year is hectares and the production of this area is reported to be 11,960 tons. Golestan (2800), West Azerbaijan (1469) and North Khorasan (1402) provinces have the first to third ranks under cultivation of this crop. In production, Golestan province (3375), West Azerbaijan (2526) and North Khorasan (2205) had the highest production in the mentioned crop year. A noteworthy point in the production of this product is the average yield that Qazvin with a yield of 400 kg per hectare is higher than the provinces of Hamedan (2200), Isfahan and Fars (2000) and this shows the potential of this province in the production of sunflower.

Table 3. Introduction of sunflower cultivars in Iran.

Sunflower cultivars	Characteristics of cultivars
Azargol	Hybrid - high oil content (47 to 48%), tolerant of downy mildew and rust
Goldis	Warm, moist and temperate
Golshid	Hybrid - high oil content (47 to 48%)
Farokh	Cold and temperate and cold
Ghasem	Hybrid - high oil content (47 to 48%), tolerant of downy mildew and rust
Barzegar	Cold

1.4. Sesamum (*Sesamum indicum*)

Sesamum with the scientific name of *Sesamum indicum* and belongs to the Pedaliaceae family. Sesame has hundreds of breeds and varieties and the length of the plant reaches 70 to 150 cm. Sesame seeds ripen unevenly and begin to ripen from the lower pods about 1.5 to 2.5 months after planting. It is a self-pollinated plant and has 4 to 5% cross-pollination. Sesame seeds contain 44 to 55% oil, 18 to 25% protein, 13.5% carbohydrates and 5% dry matter, and sesame oil contains beneficial antioxidants. Sesame oil has various vitamins and its meal

contains 40% of protein which is suitable for livestock diet. This plant needs warm days and plenty of light and is sensitive to low temperatures (Rahimi and Gharachorloo, 2020).

Sesame oil is an edible oil made from sesame seeds, which is a cooking oil used in South India, China, Japan and Korea, and is also used as a flavor enhancer in Southeast Asian cuisine. Ongoing research shows that the presence of fortified antioxidants and unsaturated fats in sesame oil can help control blood pressure. This oil is known as the most popular oil in Asia and also one of the main oil products. In order to extract oil, due to the limitations of manual extraction, modern methods are used to produce it (Fahim Danesh and Bahrami, 2015). Due to the fact that sesame seeds are weak, they need soft and fertile soil, they also need autumn plowing and light spring plowing. Adding 10 to 15 tons of rotten manure per hectare and applying nitrogen, phosphorus and potash fertilizers will increase the yield. Requires 50 kg of urea fertilizer, 100 kg of phosphate fertilizer before planting and 25 kg of road urea fertilizer when the plant size is 20 cm. Potash fertilizers can also be used during the second plowing. For cultivation, the seeds should be disinfected with a fungicide and planted in mid-May after the cold has cleared. Sesame needs a warm, moist substrate and a relatively high temperature to germinate. Planting time is when the soil temperature has reached 20 °C. The seedbed temperature should be 25 to 27 °C. Temperatures below 18 °C will delay seedling growth and below 10 °C germination will stop naturally. The required amount of seed is about 6 to 7 kg/ha. The distance between the rows is 50 to 60 cm and between the plants is 5 cm. Saline soils are not suitable for cultivation, acidity is suitable for cultivation 6.5 to 7.

Because the capsules do not arrive at the same time and reach from the bottom to the top occurs when the leaf begins to turn yellow. For machine harvesting, it should be harvested a little earlier and deterrents should be used to prevent spillage. After harvesting, the bunches should be standing in the field for a few days to reduce their moisture (Ahmadi and Bahrani, 2009).

Table 4. Introduction of sesame cultivars in Iran.

Sesamum cultivars	Characteristics of cultivars
5 Barazjan	High yield, late-ripening, warm regions of the country
Darab 2	High yield and tolerant of green flowers, warm regions of the country
Pakistani	High yield with light white grains suitable for confectionery, warm regions of the country
Synthetic Safiabad	High yield, warm south
Varamin 2822	High yield, warm south
Darab 14	High yield, warm south
Naz takshakheh	High yielding, Caspian coast
Oltan	High yielding, the northern half of warm regions
Yakta	High yielding, temperate northern
Dashtestan -2	High yield, warm south
Darab 1	High yield, warm south
Halil	High yield, warm south

The area under sesame cultivation in the 2017-18 crop year is 30,017 hectares and the production of this area is reported to be 30,649 tons. Kerman (9000), Fars (6000) and Khuzestan (4300) provinces have the first to the third category of the cultivated area of this crop. In production, Kerman (12010), Fars (6500) and Khuzestan (3655) had the highest production in the mentioned crop year. A noteworthy point in the production of this product is the average yield that Kerman with a yield of 1350 kg/ha is higher than the provinces of Ardabil (1286) and Isfahan (1250) and this shows the potential of this province in the production of sesame.

1.5. Safflower (*Carthamus tinctorius*)

Safflower, scientifically known as *Carthamus tinctorius*, is local to Iran and is currently cultivated in most parts of the world. This plant is known by different names in different regions of Iran. Safflower is an annual plant that reaches a height of about 60 cm. The leaves are broad, toothed and without petioles. The veins are

quite visible at the bottom of the leaf. The flowers are solitary, tubular and reddish-yellow, appearing at the end of the stem. The fruit is white and in the form of achene, the end of which has a thin bunch of fibers.

Safflower is one of the most important medicinal plants that is also used in cooking and it is called fake saffron. The safflower plant is also used in the dyeing industry. The nature of the plant is warm and dry. The most important properties of safflower in the treatment of diseases include anti-inflammatory properties, helping treat infertility, increasing sperm, lowering cholesterol and regulating menstruation. Safflower with favorable agronomic characteristics such as relative resistance to soil salinity and air dryness, high resistance to winter cold (autumn type), the presence of a favorable oil with more than 90% of unsaturated fatty acids, especially linoleic acid, has been proposed as an oilseed. The cultivation of this oil plant has recently increased in the country and in line with that, the research of this oil plant is expanding based on obtaining high-yielding, high-fat, thornless and cold-resistant cultivars. The most favorable planting date for spring safflower cultivars in warm regions is the second half of December .In temperate and cold regions, in autumn cultivation, it is mid-September to late October, and in spring cultivation, it is late March to late April (Javadi and Zamani, 2019; Jajarmi et al., 2014).

This plant is sensitive to over-irrigation early in growth and increases phytophthora disease. In general, irrigation is necessary for the post-planting stages, germination, rapid stem growth, budding, flowering (two stages), and granulation. In chemical control of weeds in safflower fields, Trelan toxin after plowing and before planting at the rate of 2.5 L/ha and Galant toxin (2.5 L/ha) after planting is recommended to control narrow leaf weeds. Safflower *Acanthiophilus helianthi* Rossiare is one of the most important pests that attack safflower. The best time to fight is in the budding stage and as soon as you see *Acanthiophilus helianthi* Rossiare on the farm. During it, systemic toxins such as Matasystox (2 per thousand) and Diazinon (2 per thousand) are used (Javadi and Zamani, 2019).

Table 5. Introduction of safflower cultivars in Iran.

Safflower cultivars	Characteristics of cultivars
Local Isfahan	Spring- High yield and thornless, cold and temperate regions
Varamin 295	Autumn - resistant to cold and high yields, cold regions of the country
Zarkhan 279	High yield- autumn- cold regions
Phenomenon	High grain yield and high resistance to cold, autumn - cold and temperate cold regions
Goldasht	Thornless, early, warm areas in autumn cultivation
Safeh	Thornless, red flower with high seed and oil yield, spring- in cold and temperate regions
Golmehr	Thornless, high-yielding and frost-resistant red flower, autumn- cold and temperate regions

The area under safflower cultivation in the 2017-18 crop years was 5239 hectares and the production of this area is reported to be 4470 tons. Fars (1983), Zanjan (870) and Isfahan (800) provinces have the first to the third category of the cultivated area of this crop. In production, Isfahan (1300), Fars (1217) and Sistan and Baluchestan (756) had the highest production in the mentioned crop year. A noteworthy point in the production of this product is the average performance. Isfahan with a yield of 1625 kg/ha is located higher than the provinces of Sistan and Baluchestan (1200) and Khorasan Razavi (984). However, cultivation in Isfahan and Sistan and Baluchestan provinces was irrigated and Fars and Khorasan Razavi were rainfed.

1.6. Camelina (*Camelina sativa*)

Camelina is a plant of the Brassicaceae family that has been cultivated as an oilseed nationwide in recent years. Oilseeds are of great importance among crops and are the second largest food reserves in the world after cereals. Vegetable oils are mostly obtained from oilseeds such as soybean, sunflower, sesame, safflower and rapeseed, which have a higher water requirement and have limitations in various aspects of cultivation and climatic conditions (Righini et al., 2019). The most important advantages of the medicinal-oily plant Camelina are its cultivation in autumn and its harvest in late April. Also less water requirement, better adaptation to

climatic conditions of the region, excellent resistance to drought and spring cold, less susceptibility to pests. This plant has a high resistance to common pests in oilseeds such as pollen beetle (Chaturvedi et al., 2019). The average production in European countries is 2-2.5 tons/ha and due to the limited history of its cultivation in Iran, the yield from planted farms has yielded a yield of 1-1.5 tons/ha in recent years. Soheil camelina cultivar is currently registered in the country and researchers in Iran are working to introduce a new cultivar of this oil plant, which will probably be introduced and registered next year.

Camelina plant oil is one of the highest quality oils, this plant has about 40% omega 3 and about 20% omega 6 in its oil and 5% of useful saturated fatty acids in its oil. In addition to oral consumption, the oil of this plant is also used medicinally. The meal of this plant can also be used as suitable food for livestock, poultry and aquatic animals. Camelina plant is very resistant to cold, heat, drought, salinity, pests and diseases, etc. This plant has been modified and localized by scientific methods, and in recent years, with the cooperation of research centers and agricultural colleges, it has been cultivated in different provinces, including Kermanshah province. Its compatibility has also been proven in rainfed fields. Considering the conditions of this plant due to low water requirements, autumn cultivation and adaptation to the climate of the region, it can be hoped that the development of the cultivation of this plant will be an effective step towards economization of agriculture and sustainable employment. If the market for the consumption of this oilseed is provided, the potential for the development of planting this plant is well provided in the country (Sarker et al., 2020).

Table 6. Introduction of Camelina cultivars in Iran.

Camelina cultivars	Characteristics of cultivars
Soheil	High yield-resistant to cold, heat, drought, soil salinity, pests and diseases, etc. Very resistant-all regions of the country in the form of rainfed and irrigated, the origin of Kermanshah

The introduction of new plants can be an effective step towards the economization of agriculture, creating new and sustainable employment by changing the cultivation pattern. Severe climate change, cultivation methods, market needs, technological advances, etc. have caused researchers in the field of agriculture to always look for new plants with suitable nutritional and economic capabilities. The camellia plant has been modified and cultivated by a research group at Razi University (in the form of a knowledge-based company). So far, only one cultivar named Soheil of this oil plant has been introduced in the country and its compatibility in dryland conditions for all climates of the country has been confirmed. But the process of research work on this plant continues.

Table 7. Comparison of properties of oils, rapeseed, safflower, soybean, sunflower, camellia, sesame (Sarker et al., 2020; Nowosad et al., 2016; Eyni Nargeseh et al., 2020; Rahimi and Gharachorloo, 2020).

Smoke point (°C)	Multiple unsaturated fatty acids			Oleic acid (ω-9)	Unsaturated fatty acids	Saturated fatty acids	Type of oil
	Multiple total	Alpha linolenic acid (ω-3)	Linoleic acid (ω-6)				
204	28.142	9-11	19-21	—	63.276	7.365	Rapeseed
210	—	—	—	12.820	75.221	7.541	Safflower (high oleic)
210	—	—	—	75.00	15.00	8.00	Safflower (high linoleic)
232	41.700	—	41	39	39.700	14.200	Sesame
238	57.740	7	50	24	22.783	15.650	Soybean
227	45.300	0.2	39.8	40.100	45.400	10.100	Sunflower (high oleic)
227	—	—	—	3.8	83.689	9.58	Sunflower (high linoleic)
246	59.67	35.81-36.67	22.08-23	15.44-18.36	34	11	Camelina

Safflower and sunflower have two groups of extracted oils: high oleic acid and high linoleic acid, which are presented collectively in the table. The numbers are based on (%) the total weight of the fat.

1.7. Challenges of domestic oil production and supply

Oil is one of the most basic items in the food basket of Iranian households. This is while almost 90% of this product is supplied through imports. So that the value of imports of oilseeds, oil and meal in 99 amounted to 2.193 million dollars, which was equivalent to 9210 billion tomans with a currency of 4200 tomans. Given this volume of imports, to get out of dependence on oil imports, at first glance, paying attention to domestic production may seem a good option. On the other hand, the people in Iran are seriously facing a shortage of resources, especially water and soil. This moves into this area with special considerations. It is very low in oil and about 10%. But given the potential of our country, especially water and soil resources, our expectation of this increase in self-reliance should not be at the level of complete self-sufficiency. Because the ecosystem of our system is fragile. Water and soil resources do not allow us to do this. On the other hand, per capita, oil consumption in our country is very high and we must manage this issue with culture and reduce oil consumption (Righini et al., 2019).

In the past, the consumption of oil was mainly from animal sources that were produced domestically, and on the other hand, the eating habits of the people of the country were such that the consumption of oil was very low. This has led to our self-reliance on edible oils is much higher in recent decades, at around 70 to 80%; But over time, this slope has become negative. From the 1940s onwards, however, the production of oilseeds increased. But due to the increase in consumption, the need to import an uptrend and our self-reliance coefficient found a downward trend. Another reason for the high consumption of oil in our country is the cheapness of this food, this issue is not ineffective in high consumption of oil. Increasing the production of oilseeds should not be considered as increasing the area of cultivated lands, but is a management priority. This means changing the cultivation pattern and limiting the cultivation of unnecessary crops with high water requirements and replacing them with the cultivation of oilseeds (Righini et al., 2019).

One of the principles of sustainable agriculture and environmental compatibility is the use of plants such as sesame and safflower that are local to the region. Because they have adapted over time, they cause less damage to the environment and put less pressure on the environment. Compared to these plants, rapeseed is an imported and new plant, which of course can not be ignored. The advantage of rapeseed is that its production per unit area is higher and its water consumption is relatively low. But this plant has drawbacks; First, its cultivation requires special care compared to other plants. The plant is sensitive and eventually sensitive to falling seeds and falls. Therefore, rapeseed cultivation should be done by leading, skilled farmers and agro-industrial companies. Because they have the necessary expertise and experience and more machines and tools at their disposal. Another point is that rapeseed has more advantages for some provinces, such as Mazandaran and Golestan due to the type of climate.

In contrast, sesame and safflower are local to our country and can be cultivated in a large area of our land. It is even possible to cultivate safflower dryland. The safflower plant is important if it is included in the rotation program of agricultural cultivation because it has deep roots and water penetrates the subsoil. Sesame can also be grown in most warmer areas. The quality of sesame oil is also much higher. Sunflower, which is mostly consumed as nuts in our country. This plant also has advantages and disadvantages. One of its advantages is its long cultivation history in Iran. This means that farmers are more familiar with sunflower cultivation. Although it is cultivated for nuts. Perhaps the most important advantage is that it is less sensitive to land preparation. One of the disadvantages of this plant is that it has a high water consumption. There are few machines for planting and especially harvesting for this plant. Another is that sparrow pest for this plant should be considered as a serious problem.

One of the problems with oilseeds is the lack of proper machinery for planting and harvesting. For plants, such as safflower, such problems are less. Because of this plant, special grain machines can be used for planting and harvesting. This is an important advantage for this plant. But about rapeseed, we must have special tools,

which unfortunately are not in a good condition now, and we face problems in this regard (Righini et al., 2019). There are existing factories within the current production of oilseeds. If we want to increase production, we have to do several things at the same time. The first is the issue of guaranteed purchase and creating a suitable network for purchasing these products. In the next stage, the existence of oil-manufacture industries is appropriate. It should also be noted that in the current situation in the discussion of imports, instead of ready-made oil, it is better to import oilseeds in a managed manner. With the development of oil manufacture, while using its added value, it will help create jobs in the country. Oil import turnover is very high and oil is a strategic commodity. Although it may not be as important as wheat; But its lack creates many problems for the country (Asadi and Jalilian, 2021; Righini et al., 2019).

2. Conclusion

Due to the limited production factors, in order to make optimal use of these factors and achieve maximum production, it is necessary to develop the area under cultivation and increase the production of oil products in different areas based on the principle of comparative advantage. Iran has a lot of potentials, especially benefiting from natural resources, diverse climate, susceptible climate and fertile soil can play an important role in increasing agricultural production, especially oilseeds. Oilseeds are grown to extract oil from the seeds, But they are also a valuable source of protein. Product residues after oil manufacture are used for this purpose. The production of oilseeds plays an important role in saving the currency, accelerating the process of economic development, security and food independence of the country. Relevant officials in the country should put the development of oilseeds production on the agenda, which in addition to supplying the edible oil needed by the country, also see a decrease in imports of animal feed. At present, domestic factories receive a license to import 9 kg of oilseeds per kilogram of domestic oilseeds. This means that domestic factories are only required to supply 10% of their needs from within. Due to the difference between the exchange rate price and the free currency price, the allocation of exchange currency reduces the price of imported products by 15 to 20% of the actual amount. Therefore, in the case of oilseeds, domestic products need to have a larger market share. Allocating foreign exchange is a deadly poison to support domestic production. One of the main reasons why oil mills are more inclined to import the oilseeds they need is their low price. At present, the import tariff for oilseeds has been set at 10%, which can be increased according to the current situation. In this regard, the number of permitted imports per kilogram of domestic purchases should be reduced so that domestic factories can supply more of their needs from within.

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