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REVIEW PAPER

Potential and constraints of growing sunflower crop in Pakistan: An updated review

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Abstract

Sunflower scientifically known as *Helianthus annuus* belongs to family Asteraceae. First time in Pakistan, sunflower was cultivated in 1960's. Crop of sunflower is known as having great abilities and it can positively meet upcoming edible oil requirements of Pakistan. In Punjab, it was reported that during 2018-2019 areas under sunflower cultivation was 29919 hectares with production of 56777 tones. Sunflower has the capacity to fulfill the future oil requirements of Pakistan because it has high necessary oil ingredients. There are two kinds of sunflower oil; one is with high oleic and second with linoleic contents. By weight the seed of sunflower has 47% fats, and the quantity of protein is about 20-30%. In one tablespoon of seed, the amount of energy is above 48 %. Farmers are facing constraints while growing the sunflower crop in the country. These constraints are locust attack, non-availability of sufficient water, lack of technical knowledge of farmers, more nutrient requirements, less production, loss by different living organisms, non-availability of pure seed, attack by insect pests and different diseases and other competent crops. Some other problems are market related problems as there are no proper markets in the region which adversely affects the cultivation of sunflower.

Keywords: Adulterated seed, Constraints, Market problems, Sunflower, Water deficiency

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Introduction

Sunflower is scientifically known as *Helianthus annuus* and its family is Asteraceae (Khan et al., 2009; Luqueno et al., 2014). First time in Pakistan, sunflower was cultivated in 1960's (Ali et al., 2011). In Pakistan the crops grown for oil purpose sunflower is at third number after the cottonseed and rapeseed-mustard with respect to area and production (Khan et al., 2009; Shah et al., 2016). The edible oil imported from 2018 to 19 (July-March) was about 2.421 million tons and the import bill for this oil was about 192.203 billion rupees. Domestic production of edible oil during this time was only 0.5 million tons (Pakistan Economic Survey, 2018-19). Sunflower is significant crop for oil purpose. It is highly adaptive in the climate of Pakistan. That's why it is cultivated two times in a single year (Shafiullah et al., 2018). In Punjab, it was reported that during 2018-2019 area for sunflower cultivation was 29919 hectares with production of 56777 tones (Crop Reporting Service Punjab, 2019). In Punjab, suitable area for cultivation of sunflower is of rice and cotton belts. Crop can be obtained in spring as well as in autumn season (Pakistan Agricultural Research Council [PARC], (2020). Crop of sunflower known as having great abilities and it can positively meet upcoming edible oil requirements in Pakistan. It is highly adaptive in the climatic conditions of Pakistan. It needs 120 days for its whole life cycle. Best temperature required for the crop is between 20 to 25 °C but it can survive in temperature from 8 to 34 °C (Shah et al., 2005).

Sunflower has the capacity to fulfill the future oil supplies of Pakistan because it has high oil ingredients. In the country, the yield of edible oil is not enhancing but population is growing with the passage of time (Shah et al., 2013). There is a significant importance of sunflower oil in Europe. Sunflower oil contains fatty acids and oleic acids. The oleic acid makes it stable and thus, this oil can be used in many ways (Rab et al., 2008). The seeds of sunflower contain iron, phosphorus, vitamin A, nitrogen, vitamin B, and calcium. The oil extracted from its seeds has more vitamin E and less quantity of saturated fat. There are two kinds of sunflower oil one is high in oleic, and the second kind is linoleic. By weight the seed of sunflower has 47 percent fat, and the quantity of protein is about twenty to thirty percent. In one tablespoon of seed the amount of energy is above forty-eight percent (Arshad & Amjad, 2012). Sunflower is considered an environmentally friendly crop for many reasons. Some of these are: it uses less amount of nitrogen, less amount of water required for the development and less attacks of diseases and insects. Another important thing is that it can be adjustable in multiple cropping systems and has the ability to grow in vast range of environmental fluctuations. It is also a big source of pollen and nectar for the honeybees. Farmers take it as an easy crop (Debaeke et al., 2017).

Constraints of growing sunflower crop

Locust attack

Locusts, known for their insatiable appetite, vary in size from 10 mm to 70 mm during different stages of their growth cycle. An adult locust has the astonishing capacity to consume an amount equivalent to its own weight in food daily, roughly around two grams of fresh vegetation. These creatures thrive in regions abundant in rainfall and greenery, rapidly multiplying to form destructive swarms (Notezai & Rehman, 2020). The potential devastation caused by these pests is immense. The forecast outlined in the report predicts "severe damage" in areas where crucial Rabi crops such as wheat, chickpeas, and oilseeds are cultivated. According to the Food and Agriculture Organization (FAO), if the damage reaches 25%, the total potential losses for rabi crops could reach about PKR 353 billion, while for kharif crops, it could escalate to about PKR 464 billion (Notezai & Rehman, 2020). One significant challenge faced by sunflower farmers in Pakistan is the relentless locust attack. According to Khan (2020), the southern Punjab region experienced a severe locust infestation, posing a considerable threat to various crops. Among the crops affected, sunflower, mustard, and canola were particularly susceptible, with sunflower suffering the most substantial damage from these pests.

Water problem

The amount of available water greatly affected sunflower crop production. It was observed that sunflower's production is greatly dependent upon three major factors; one is irrigation schedule, second is the type of soil and third is the time of sowing. From these factors, improper irrigation caused significant effect on oil quality. Decreased irrigation was more problematic as compared to increased irrigation. Deficiency of water caused enhanced amount of oleic and reduced level of linoleic fatty acids in the oil of sunflower (Loose et al., 2019). A study was conducted on the challenges faced by sunflower cultivation in which several significant issues were identified that affected sunflower cultivation including a deficiency of water for irrigation, a shortage of seeds at the time of sowing, insect attacks, and damage caused by birds. Additionally, in some areas, there was a lack of proper markets for sunflower, and the absence of seed crushing mills posed further obstacles. Furthermore, decreased demand for sunflower oil, increased input prices, and decreased output contributed to the reduced cultivation of sunflower in the region (Khatun et al., 2016). Mercau et al. (2001) conducted research in six different zones to explore the challenges faced by sunflower crops. They found that rainfall occurring after the anthesis stage of the crop damaged the sunflower plants. Excessive moisture following rainfall created favorable conditions for diseases associated with fungi. Several factors led to lower sunflower production, including decreased soil fertility, initial water deficiency, insufficient phosphorus levels in the soil, damage caused by weeds, and diseases. The major diseases affecting sunflower crops were identified as *Verticillium dahliae* and *Sclerotinia sclerotiorum*.

Industrial problem

A study explored the industrial challenges within the sunflower sector and drew significant conclusions regarding the impact of several key factors on production in Tanzania (Njiku & Nyamsogoro, 2019). Their findings indicated that the location of the industry, the stage of development of the industry holders, and the physical activity of workers played pivotal roles in affecting production levels. Furthermore, they highlighted the crucial importance of the technical proficiency of the workers in achieving optimal results. One important observation was that the industries under study struggled with financial self-sufficiency, highlighting a significant difference between their inputs and outputs. This financial gap presented a substantial hurdle to their overall operational efficiency (Njiku & Nyamsogoro, 2019).

Lack of technical knowledge

Farmers growing sunflower have no sufficient knowledge about advance growing methods. There is knowledge gap between the present and required knowledge of the farmers by calculating the mean values (Raza et al., 2016). Mandal et al. (2015) concluded that farmers are facing difficulties in the cultivation of sunflower. It was identified by talking with farmers and taking their interviews. The farming community was facing medium type of difficulties in the cultivation of sunflower. Farmers were less trained for cultivation and their link with the information source was weak. Growers had less information about the recommended production technology of sunflower. Aski et al. (2010) conducted research and found that overall farmers had medium knowledge about the production technology of sunflower crop. It was observed that 45.49 % farmers follow recommended seed varieties, 60 % farmers had knowledge about recommended sowing time, 45.83 % population follow recommended seed treatment for sunflower crop, 35 % farmers responded that they had information's regarding proper plant population and 90 % farmers had information's regarding insect control.

Nutrient requirements and less production

The coastal belt of Sindh is considered to be the best for the production of sunflower (Khan, 2018). In 2010-11, the highest production was observed. But with the passage of time, it was observed that the area under sunflower was decreasing both in Sindh and in Punjab. The reason for decreasing area was that sunflower consumed more nutrients as compared to other crops resulting in increased inputs for cultivation as told by farmers.

Some other problems faced to farmers were decreased production and increased value of seed which was being used for sowing. Konyali (2017) concluded that enhanced input values and less production of the sunflower were main factors which were responsible for the decreased cultivation of sunflower. Another reason for the reduction in cultivated area was the decreasing price of sunflower. Input value of the cultivation increased because seed had to import from other countries by which the initial expenditures were increased.

Loss by different living organisms and non-availability of pure seed

Sunflower crop is tolerant to the water stress, but its production is low in some areas due to some factors like attack of birds, attack of fungal diseases and uneven distribution of plants in the field (Debaeke et al., 2017). That's why the area under cultivation of sunflower was decreasing in the study period. Jariko et al. (2011) concluded that there were some problems which affected the cultivation of different varieties of sunflower. These varieties were hysun-38, hysun-33 and hysun-37. The main constraint observed was the poor quality of seeds available in the market. The seed was packed in the certified bags but the quality of seed was found to be very poor. This thing negatively affected the yield of sunflower. Farmers were converting the sunflower cultivation area towards other crops due to non-availability of purified seed of the sunflower.

Social and financial issues

Gender has a significant impact on sunflower production. Lekunze et al. (2011) concluded that mostly males were growing sunflower. It was observed that males had lot of time as compared to female for cultivation. Reason was that females were also busy in the household works. Yield was more where growers were male. Results also showed that social and financial factors such as insufficient investment, increased equipment values, land occupancy and environmental fluctuations reduced the production of sunflower (one more reference).

Attack by insect pests and different diseases

Different insects, nematodes and diseases attack the sunflower crop damage it and ultimately lessen its yield. In a research study conducted by Mukhtar (2009) reported that among insects, nematodes and diseases, more damage was caused by the diseases. Mainly fungi were involved in different diseases. Diseases which attacked sunflower were leaf blight, rust, charcoal rot, downy mildew, Sclerotinia stalk rot, Verticillium wilt, head rot, and leaf spots. These diseases reduced the total production of crop. Alba et al. (2010) found that cultivation of sunflower was in the month of March; filling and oil deposition was observed in June-July. In these months the temperature was very high and if at that stage there was deficiency of water then it reduced grain size. When there was reduced grain size then the production was also decreased. High characteristics of the plants were associated with the proper amount of available water. When there was deficiency of water at flowering stage of plants, it decreased the yield and also oil contents of sunflower. Okoko et al. (2008) found that there were some constraints to the farmers during the cultivation of sunflower. These problems were low yield of crop, decreased management of pests and other diseases, non-availability of hybrid varieties, decreased fertility of land, at sowing time low quality seed available, rate of produce was very low, a smaller number of seed available for processing purpose, unavailability of sunflower markets and less communication between the farmers and extension department.

Other competitive crops

In the article "Issues in sunflower cultivation" (2007), it was reported that growers of sunflower were facing some problems during cultivation of sunflower (Dawn, 2007). One problem was the sowing date of wheat and sunflower was almost same. In this situation, farmers preferred wheat crop instead of sunflower because wheat was more beneficial than sunflower crop. Another constraint was sunflower consumed more nutrients from the soil and after its harvesting there was more need of nutrients for the cultivation of other crop. When cotton was grown after the sunflower, then it was observed that there was increased insect pest attack on cotton crop. In the article "Sunflower cultivation, 2006" it was found that main issue to sunflower was its sowing period overlaps with wheat crop (Dawn, 2006). Another thing was its maturity period was observed at the time of sowing of cotton crop which resulted in late sowing of the cotton in this way the production of cotton was also reduced. As cotton was considered a cash crop and farmers focused on its timely sowing, they did not afford its late sowing. Sunflower required more nutrients resulted in the increased inputs. Looking at these problems, farmers was decreasing their area for the cultivation of sunflower. Shah et al. (2005) concluded that the main problem that farmers faced was sunflower as new produce.

Another difficulty was sunflower interacted with the cotton and wheat cropping system. Decreased production of sunflower was obtained due to many factors which affected sunflower crop. These factors were low quality seed for sowing, damage by birds at the ripening stage of crop, absence of proper market and less price of produce. It was found that great variation in the cultivated area was due to fluctuation in the market rate of the sunflower produce. Badar et al. (2002) found that there were three kinds of problem which were faced by the farmers. In cotton growing areas the main problem was adjustment of sunflower. In cotton growing belt if the farmers had grown sunflower instead of wheat, then farmers faced difficulties in growing cotton crop like the chances of attack of

insects increased, late sowing of cotton and decreased yield of cotton crop. By observing these problems farmers preferred to grow wheat crop instead of growing sunflower. Another problem was enhanced fertilizer requirement after cultivation of sunflower. Damage by the insects increased and production decreased after the cultivation of sunflower. Another major problem was no proper markets for sunflower selling which resulted in decreased production.

Miscellaneous problems

Eleven crucial parameters that impacted sunflower cultivation were examined in the study area (Habib et al., 2017). Notably, several of these parameters were identified as key influences in driving farmers away from sunflower cultivation. These included factors such as the prospect of higher profits from other crops, the absence of high-quality sunflower seeds, challenges in marketing, weak communication between farmers and extension workers, and a declining output value for sunflower crops. Badhan et al. (2017) conducted research and reported significant challenges faced by sunflower growers in their fields. Out of these challenges, five were particularly remarkable. The foremost issue was the rotting of plant stems due to disease infestations. The absence of an efficient irrigation system in the region was the second major problem. Costly sunflower seeds were the third challenge, with losses resulting from bird attacks as the fourth issue, and losses caused by human interference rounding out the top five concerns. It was found in a study that farmers encountered a total of fifteen difficulties while engaging in sunflower cultivation (Mandal et al., 2015). Three of these difficulties emerged as the most critical. These included the high cost of sunflower seeds, the poor quality of available seeds, and the exorbitant prices associated with irrigation for the fields. Singha et al. (2014) identified constraints experienced by sunflower farmers, with the unavailability of modern technology being the most pressing concern. Other challenges included reduced seed germination rates, damage from weeds, inadequate irrigation systems, disease-related crop damage, soil fertility issues, and a reduced supply of quality seeds for sowing. Shah et al. (2013) reported that the yield and area of sunflower were increased from few years. Yield as well as area was enhancing but it was observed that the yield was less as compared to the potential yield from per unit area. Results showed that factors responsible for decreased yield were disease attack, damaged by birds, adulterated hybrid seed, and increased seed rate, available seed was costly, difficulties in market and after harvesting improper facilities. Hybrid varieties were suggested for cultivation, but these varieties were not locally available. These varieties were imported.

In regions characterized by arid and semi-arid climates, sunflower yields and productivity suffer from the effects of drought stress (Hussain et al., 2018). The presence and quality of water resources significantly influence the oil and seed yield of sunflowers (García-López et al., 2016). The application of different irrigation techniques in arid and semi-arid environments has been observed to notably impact the yield and associated attributes of sunflower hybrids (Abdou et al., 2011; García-López et al., 2016; Surucu et al., 2020). Furthermore, sunflowers possess genetic potential to thrive in regions moderately affected by salinity, provided the electrical conductivity threshold remains at ECe 2.5 dS m^{-1} (Douaoui et al., 2006). However, the cost of production escalates due to the high prices of imported hybrid seeds and other costly inputs. This poses a challenge for most growers who find it financially challenging to invest in hybrid seeds, particularly considering that these seeds cannot be utilized in the subsequent generations and might struggle to adapt to local climates. Consequently, there is a pressing need for the development of local hybrids with high yield potential, demanding a substantial investment in time (Hussain et al., 2012). Javed et al. (2003) reported that Pakistan was deficient in the production of edible oil that's why it had to import oil for its local consumption. It was found that if farmers cultivate sunflower, it could fill the oil deficit gap. But farmers were facing some problems in the cultivation of sunflower. These difficulties to the sunflower were damaged by the pest and increased seed rate than suggested. These two things were responsible for the reduction in the production of sunflower. Some other factors were improper preparing of land, fertilization, and sowing with the help of drill.

Potential of growing sunflower crop

Sunflower stands as one of the most significant oilseed crops globally and is ranked as the 3rd most crucial oilseed in Pakistan after cotton, rapeseed, and mustard. Pakistan relies heavily on imports for 82% of its edible oil, producing only 18 % domestically. Sunflower contributes approximately 11 % to the local oil production, prompting the government to initiate a subsidy program aimed at amplifying its cultivation within the country. With 40 % oil content, sunflower seeds serve as a rich source of vitamins A, B, and K. The oil derived from sunflower is highly regarded for its heart-healthy attributes, containing 90% unsaturated fatty acids, comprising 30% monounsaturated Omega-9 and 59% polyunsaturated Omega-6. One of the striking features of sunflower is its short growth cycle, spanning 100-120 days, and its potential for two harvests per year, making it adaptable to diverse crop rotations. The importation of edible oil constitutes a major portion of the market, satisfying only 30 % of the domestic demand. Among locally produced edible oils, cottonseed, sunflower, canola, and rapeseed & mustard contribute 55.91 %, 29.12 %, 7.6 %, and 7.37 %, respectively (Govt. of Pakistan, 2008). Sunflower particularly stands out as a high-yielding crop, cultivated in both spring and summer seasons. Its high oil content not only benefits the farmers but has also led to a significant surge in

cultivation and production over the last decade. The area under sunflower cultivation expanded from 144,191 hectares in 1998-99 to 323,067 hectares in 2006-07, with production escalating from 194,544 to 407,224 tons during the same period. It is a vital cash crop integrated into the local cropping system across Pakistan.

Okoko et al. (2008) recognized sunflower as a high-value cash crop, pivotal in providing high-quality edible vegetable oil. Its potential to meet the future demands for oil has been acknowledged, thriving across diverse climates in Pakistan. Sunflower requires roughly 120 frost-free days and thrives in temperatures ranging from 8 to 34°C, with an optimal temperature between 20 and 25 °C (Shah et al., 2005). The suitability of various districts in Punjab for sunflower production includes Rawalpindi, Gujrat, Sialkot, Lahore, Sheikhupura, Kasur, Sahiwal, Multan, Rajanpur, Muzaffargarh, D.G. Khan, Vehari, Bahawalpur, Rahimyar Khan, Okara, Sargodha, and Faisalabad. Efforts are ongoing to bolster local sunflower production. In 2006-07, a substantial increase was witnessed in the area and production of sunflower. However, fluctuations in sunflower cultivation were observed due to volatile oilseed prices in the market. Despite promises of fair prices, farmers often end up selling their produce to middlemen at lower rates, facing exploitative practices such as unjustified deductions and misrepresentations of grain weight. The Public Sector's Pakistan Oilseed Development Board (PODB) has set the price of sunflower products at Rs. 1600/40 kg, encouraging more farmers to expand their acreage yearly. This study aims to analyze trends in sunflower acreage, production, and trade patterns while assessing its potential to elevate oilseed production in Pakistan. It also aims to identify the factors and constraints contributing to the fluctuation in sunflower acreage and production.

Conclusion

Sunflower has the capacity to fulfill the future oil necessities of Pakistan because it has high oil ingredients. In the country, the yield of edible oil is not enhancing but the population is growing with the passage of time. Sunflower is considered an environmentally friendly crop for many reasons. It has been observed that sunflower production is greatly dependent upon three major factors; one is irrigation schedule, second is type of soil and third is time of sowing. Farmers are less trained for cultivation and their link with the information source is weak. Growers have less information about the recommended production technology of sunflower. Some other problems are reduced germination of seeds, damage by the weeds, improper irrigation system, damage caused by the different diseases, soil fertility problems and decreased amount of quality seed for sowing. For obtaining good yield of the sunflower crop these constraints should be eliminated.

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