Development of Safflower Petal Collector

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Introduction

Safflower [Carthamus tinctorius (L.)] is a multipurpose oilseed crop grown mainly for getting high quality edible oil rich in polyunsaturated fatty acids. India is the largest producer of safflower in the world with 402,000 hectares area under it, producing about 206,000 tons of safflower seed annually [1]. But its use in India is limited mainly to oil extraction from seed and leftover cake as an animal feed. It is mainly grown by marginal farmers in rainfed regions.

Safflower has another important plant part viz. flowers (petals) which are being neglected. Safflower petals are very important as a source of medicinal preparations, natural food colour and dyes for colouring fabrics [2]. Due to the recent regulations mandating replacement of harmful synthetic colours and dyes in India and abroad great interest has been evoked in safflower petals from dye and food industries. In addition to the colouring properties, safflower petals are thought to be useful for curing several chronic diseases such as hypertension, problems of blood circulation, coronory heart ailments, rheumatism and fertility problems in men and women [2].

NARI has been promoting these petals as "Herbal tea" for last many years and they have been widely used. The petals sell for between Rs. 300-400/kg (1 US $ ~ Rs. 45) as compared to safflower seed which is priced at Rs. 12-14/kg. Thus the sale of petals can tremendously increase the remunerations for the marginal farmers. Besides the petal collection and seed harvesting can take place nearly at the same time and hence there is no loss of seed production.

Anecdotal data suggests that there is an international demand of about 1000 tons/year for safflower flowers [3]. India has therefore a great potential to meet this demand and with the international price of about Rs. 600/kg ($ 13/kg), sale of petals can further increase the remunerations to the Indian farmers.

Majority of safflower varieties grown in India are spiny in nature, so petal collection from them by hand is difficult, slow and expensive due to its tedious, time consuming and labour intensive nature. Also, there is a considerable loss of petals which occurs during collection. From most of the spiny varieties grown in India the amount of safflower petals available for harvesting is ~ 60-70 kg/ha [4]. Hence there is a need to develop a technology for safflower flower collection which can collect this small quantity very easily and efficiently. This paper details the development of this technology.

Safflower petal collector

Two types of safflower petal collectors were designed and tested.

A) A small shoulder mounted battery-powered collector.
B) A larger spark ignition (SI) engine-based collector.

A) ***Battery-powered collector* :**

The petals at the time of seed harvesting are very dry and come off easily from the flower head. Hence a simple suction mechanism can collect the petals after dislodging them from the flower head. A knapsack-type petal collector was therefore designed, fabricated and tested [5]. The petal collector had the following components :

1. A battery-operated permanent magnet D.C. motor/fan assembly with suitable housing. The housing also contained a properly designed cyclone with fine wire mesh so that the petal collection efficiency could be improved.

2. A stand with battery housing and shoulder straps.

3. A suitably designed snout attached to the inlet pipe to loosen the petals from the inflorescence so that they could be easily sucked by the vacuum provided by motor/fan assembly.

Fig. 1 shows the petal collector and Table 1 gives the details of the collector.

Fig. 1. Battery powered petal collector

Table 1 : Details of Battery-operated collector

Sr. No.	Item	Characteristics
1.	Overall dimensions of collector	: 250 mm (L) X 230 mm (W) X 500 mm (H). All made of PVC pipes. It has two snouts.
2.	Weight of collector	: 9.4 kg (including battery)
3.	Motor used	: 12 V, 27 W; 5000 rpm PMDC (Denso India Ltd. make)
4.	Batteries	: One number; 12 V, 14 Ah lead acid (Exide make)
5.	Electronics	: On/off 5A switch for motor starting

The sizing of motor/fan assembly was done so that there should be enough suction for petal collection. Thus 30-35 mm of water suction pressure at snout was found to be optimum. If the suction pressure was more than this then, besides petals, other plant material including bracts, seed etc. was also sucked in [5].

Five petal collectors were fabricated and a large number of tests were done on them [5]. Data showed that on an average a person could collect 400-450 g of petals per day (6 hours/day). If the collection was done by hand from the same spiny variety, petal collection was only 200-250 g/day. Thus knapsack machine collected nearly twice as much petals than that by hand. The petal collection was nearly noiseless and the machine was very easy and convenient to use. It must however be pointed out that the laborers were not at all happy collecting the petals by hand since the spines bruised and injured them. Hence on large scale, petal collection by hand from spiny varieties is nearly an impossible task and points towards the necessity of petal collection machines.

One battery charge lasted for about 3 hours and hence a solar photovoltaic (PV) panel was designed to charge the batteries in the field. The PV panel (Fig. 2) had 1.52 m^2 area with open circuit voltage of 18.4 V (5.6 A output). It produced about 58 W at an average insolation of 800 W/m^2. As the battery charging time was 3 hours, the system was capable of charging two batteries per day to be used alternatively for one unit.

Fig. 2. PV battery charging unit

B) ***Spark Ignition (SI) engine-powered collector :***

Since the collection of petals per collector was small (< 1 kg/day/person) it was decided to develop a larger unit based on S.I. engine. Most of the safflower growing farmers use S.I. engine-based pesticide sprayers. These sprayers are shoulder mounted units with maximum total weight of ~ 16 kg. They use an 0.8 kW, 5600 rpm petrol-powered spark ignition engine. Such an existing unit was modified so that the engine provided the suction through a stainless steel cyclone collector housing. The cyclone was designed taking into account the input air flow rate and the amount of safflower petal collection rate. The suction developed was powerful enough to allow six snouts to be mounted on the housing so that six persons could do the collection simultaneously. The whole unit was mounted on a trolley for ease of use in the field. Fig. 3 shows the whole unit.

Fig. 3. S.I. powered 6-snout petal collector

Data collected on this collector showed that it could collect between 3.5-4 kg of petals/day and covered an area of about 150 m^2/day. Hence petal collection from one acre can be effected in about 27 days with this machine. Thus large scale petal collection could take place. The major drawback with this machine was increased noise and air pollution besides it being fossil fuel powered.

Tests on both the machines revealed that the rate of collection was directly proportional to capitulum size. Hence for varieties with larger capitula the petal collection will be higher. Efforts are underway at our Institute to develop plants with bigger sized capitula.

Economic Analysis

Economic analysis revealed that petal collection via the battery-operated unit is uneconomical. The cost of collection varied from Rs. 1275 to 6500/kg! However this lightweight unit may be useful for small experimental collection of flowers or even pollen. The collection cost for S.I. based unit varied from Rs. 95-136/kg and was affordable. This was even lower than the cost of collection by hand (Rs. 200/kg). The assumptions used in economic analysis are shown in Table 2.

Table 2. Values for economic analysis (from Ref. 5)

Sr. No.	Item	Battery-operated collector (two snout)	S.I. engine-based collector	Hand collection
1.	Cost of collector (Rs.)	20,000 (with solar panel) 5,500 (charging from grid)	7,800	-
2.	Loan repayment	Equal installments in 5 years	Equal installments in 5 years	-
3.	Labour used/day	2	6	1
4.	Labour cost (Rs./day) @ Rs. 50/day	100	300	50
5.	Petal collection; kg/day	0.8	4	0.25
6.	No. of days' collection/ year	15-30	15-30	15-30
7.	Interest rate on loan (% p.a.)	12	12	-
8.	Fuel charges (Rs./day)	2 (battery charging from grid)	80 (2 l petrol/day)	-
9.	Petal collection cost Rs./kg	1275-6500	95-136	200

Thus the most economical way to collect petals from spiny varieties is via S.I. engine-based unit. The advantage of this unit is that when it is not used for petal collection it can be converted back into a power sprayer and thus can be used by farmers throughout the year. Hence the petrol-powered unit is a dual-purpose machine.

The battery-powered unit is a lightweight machine and can be used in small plots for experimental purposes in evaluating flower characteristics and for varietal evaluations. It can also be used for entomological work for collecting insects or for pest control in organic farming. With slight modifications it can also be used for small scale pollen collection.

Recently NARI has released nationally a non-spiny variety NARI-6 and a non-spiny hybrid NARI-NH-1. The safflower petal collection cost by hand from these varieties comes to Rs. 80-85/kg, thereby making petal harvesting from them as most economical. Efforts are underway to spread these varieties on large scale. Since they are non-spiny, farmers prefer them to spiny ones as they are easy to harvest and cultivate. Besides NARI-NH-1 hybrid safflower also produces about 210 kg flowers per ha [6]. This yield is almost 3 times that of the existing released spiny varieties. Thus farmers can earn more profit from petals by cultivating the non-spiny hybrids.

Conclusions

Traditionally safflower varieties grown by Indian farmers are spiny and petal collection is extremely tedious and difficult. Safflower petal collectors (battery-powered and S.I. engine-powered) were therefore developed and tested. Economic analysis revealed that petal collection from S.I. engine-based unit is feasible and even more cost effective than hand collection. Recently with the national release of non-spiny varieties of safflower (NARI-6 and NARI-NH-1) it will be possible to collect petals economically on large scale without the help of a machine. Efforts are underway to spread these varieties on large scale in India.

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