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# Post harvesting and value addition in marigold

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**Abstract**
Marigold is cultivated in most parts of India and has the most important area among flower crops. It is often used as a cut flower, loose flowers, and pot plants. it's one of the simplest annual flowers to cultivate having wider adaptability. The marigold (Tagetes spp.) is the most preferred loose flower in India and is extensively utilized in the religious and social functions in the form of a variety of garlands, and Gajra. it's planted as a decorative crop, a potted plant, and as a part of landscaping. There are 33 species within the *Tageteste*, with the 2 commonest being *tagetes erecta* also referred to as African marigold, and *tagetes patula* is additionally referred to as French marigold. Marigold holds a serious role in Indian flower society, it has become a necessity for farmers to know the lifecycle of the flower and must have to adopt effective measures for having the profitable with quality output. There are huge benefits from the marigold flowers as well, it's utilized in the health sector and also in the protection of crops from plant-parasitic nematodes because it produces compounds like α- *terthienyl* that act as allelopathic to the number of plant-parasitic nematodes. an efficient marketing channel and network are vital for the flourishing marketing of marigold in terms of production and profit. Proper marketing information and implementation will eventually improvise the cultivators' share of consumer costs.

**Keywords:** Marigold, marketing, post-harvest, employment, efficiency

## Introduction
Floriculture has become a major field of agriculture. India ranks second in flower production after China. India's current share within the global flower market is unimaginable (0.61%) as measured by the Netherlands (58%), Columbia (14%), Ecuador (7%), Kenya (5%), and Israel (2%), Italy (Italy). 2%), Spain (2%) *et al*. (10%) (Unknown, 2015a). In 2013-14, India is believed to have an area of 255020 hectares under total flowering with an annual yield of 1754500 MT and 47942 lakh cut flowers (Manpreet Kaur, 2020). India has exported 15695.29 MT worth 57598.40 lacs during the year 2020-2021 (APEDA 2021). Marigold is one of the most important commercial flowers in India and is very popular in Indian life, belongs to the Compositae, and is ranked third behind the rose and chrysanthemum in India. The main use of marigolds was by the Aztec people who attributed magical, spiritual and healing properties to marigolds. The first recorded use of marigold is within the De5 Crus-Badiano Aztec Herbal of 1552. Herbal reports on the use of marigolds in the treatment of constipation, lightning strikes, or "who wishes to cross a river or water safely". The Aztecs breed marigolds for their continued growth. It is said that during the 1500s, native marigold seeds were taken from the Aztecs by ancient Spanish explorers to Spain. Marigolds were grown in Spain and planted in ferry gardens. France and North Africa were territories where marigold seeds were exported from Spain. The long marigold, now called African American, originated in North Africa (marigold history, 2021). Marigolds are also used in the Hindu religion in ancient ceremonies. The account describes a marigold that was used as a flower to adorn the rural gods during the harvest season. Several hundred years after the first voyage from the Americas to Europe and Africa, marigolds were introduced to American farmers. This reunion did not occur until after the Revolutionary War. Marigolds were one of the many exotic plants in the world. By the end of the century, the delicious peas and asters were popular flowers among us. Since 1920 the parent marigold has developed many new varieties, making it an American tradition.
Marigold is an important single-crop flowering plant, widely grown for its beauty, profitability, religion, and society, with its easy planting and flexibility, wide attractive colors, texture, size, and beauty - to maintain quality. There are usually two types of marigolds grown, namely *Tagetes erecta* - African marigold and *Tagetes patula* - French marigold. Both French and African marigolds are believed to have originated in Mexico and the American tropics.

They were discovered in the early 16th century and brought to Europe and North Africa in the late 16th century, where they were quickly received in gardens. The family name, Tagetes, is derived from the mythical Etruscan goddess. The wild, *Tagetes patula*, French marigold, is an 18-inch tall, wooded shrub with fragrant, feathery leaves. The flowers are like daisy and grass. The African wild marigold is 4-5 feet tall with 2-4-inch flowers that vary in color from grass to deep orange. because of its durability and careless cultivation, its most important quality has attracted the attention of flower growers. In India, marigold production was around 1000 MT in 2016-17 and the marigold planting area was 68.33 000 ha (DAC & FW). Madhya Pradesh got the name of a major region that produces marigolds. Both yellow and orange marigolds are widely used in traditional Indian wedding varieties. Marigold is used in major Hindu festivals such as Diwali, Dussehra, etc. Glittering orange blossoms are hung for promising reasons and the flowers are given in rituals. Marigolds are therefore a major part of these Indian celebrations and have been in India for about 350 years. The spiritual significance of the flowers of Marigold is evident not only in Hindus but also in Christianity.

**Quality enhancement in Marigold**

**Floral Quality Parameters**

1. Flower (size, condition, maturity, shape, longevity, color, texture, appearance)
2. Stem (size, shape, strength)
3. Free from defects and disorders

It is important to do proper harvest and care of flowers even after harvesting for the increment of the vase life and to have a high-quality product.

**Factors affecting post-harvest longevity and quality of flowers**

1. Maturity stage/harvesting stage
2. Temperature
3. Relative humidity
4. Storage conditions
5. Packaging
6. Diseases

**Harvesting**

- Harvesting should preferred in cool hours of the day
- Proper irrigation should be followed before harvesting flowers for proper longevity and quality flowers.
- Grading and bunching followed harvesting
- Temperature and Humidity
- Marigolds require a mild climate of luxuriant growth and profuse flowering (18–30 °C)
- The relative humidity should be 84% to 90%Storage
- Cold storage (4 °C) gives maximum shelf life and quality to room temperature marigold flowers.

**Post-harvest handling of marigold**

1. Marigold flowers are dried on the floor under shade for 2-3 days.
- This process is done to increase its shelf life. By increasing the shelf life, the product remains usable for sale and consumption for a long period. While drying the marigold flowers should be spread out uniformly under a warm place with shade and should be left untouched.
2. The seeds are separated by hammering the flowers.
- After fully drying, the marigold flowers are beaten using a stick. This gives an impact on the flowers forcing them to break apart.
3. The straws are separated by winnowing the hammered flowers.
- Winnowing is the method of removing heavier substances from the lighter ones with the help of wind. This is a traditional method used till the current period. Straws as well as some unwanted particles from hammering the marigold flowers are discarded through this process.
4. The marigold seeds are thoroughly cleaned and graded before packing in poly bags.
- The seeds are cleaned to remove dust particles, straws, unwanted substances, etc. Grading is done to find the most quality enriched marigold seeds out in the market.
5. The seeds must be stored in a cool place.
- If not stored in a cool place, it might affect the quality of the marigold seeds. Once the quality is affected the seeds will no longer be marketable, causing a loss to the distributor.
6. Moisture content of the seeds must be examined before packing.
- Marigold seeds are best kept in paper bags while storing as well as packaging to remove excess moisture. Excess moisture should be removed so that the seeds do not get damaged by fungal attacks.

According to Iftikhar Ahmad and John Martin Dole, the longest shelf life i.e. 15.5-15.7 days was gotten when the stems were set constantly in jar arrangements with pop or citrus Kathon, or beat with citrus Al for 48 hours, which was 7 days longer than the shelf life of stems in tap water. Stems set consistently in pop or citrus Kathon until the end had the most worthy stem dry weight. Likewise, it had the most elevated new weight change during the jar period.

Further testing was done by Prashant Sharma and his colleagues, to find suitable packaging materials for marigolds. Polyethylene, cellophane, and newspaper are the preferred materials used as packaging materials. Tests were performed randomly so that the longest shelf life (4 days) with indicator of burn, high humidity, low weight loss, and small flower damage was seen in polyethylene-lined cardboard boxes compared to loaded cardboard boxes. With newspaper or cellophane material. To maintain a normal room temperature for more than 5 days. And in the case of cold storage, shelf life increased by 2 days.

**Effect of post-harvest process on self-life**

Pull down temperature helped to reduce field heat and respiration, prevent moisture loss from condensing on the flowers and reduce the risk of infection (Jadhav and Gurav, 2018) [20].

Storage of loose flowers under low temperature helped to increase the storage life inside the cold room and post-storage life at room temperature. The rate of respiration and other enzymatic activities were reduced, thereby delaying the senescence process in the florets (Shil *et al*., 2017).

In the present investigation, the beneficial effect of the combination of reduction of 1 °C per hour from 28 °C to 4 °C on the first day immediately after harvesting and low-temperature storage resulted in maintaining a better quality of flowers.

**How is post-harvest loss caused in marigolds?**

Due to a shortage of various facilities such as improper transportation, communication, lack of parking facilities, and truancy in post-harvest technology. Even infrastructure is also a withdrawal in this. Ultimately, all these parameters deteriorate the quality of the flower and intensify the post-harvest loss in marigold flowers.

Some implementations of suggestions are there to reduce this phenomenon: -

Maintaining a proper temperature after post-harvesting to rejuvenate the life of the flower.

Secondly, ventilation should be considered.

The relative humidity (Rh) factor is precisely regulated to check up respiration rate of flowers.

As to preserve from excess frost buds should be nurtured after post-harvesting also.

**Packaging material**

Different packaging materials are used i.e., Polyethylene, cardboard boxes, cellophane, newspapers, etc.

The ideal packaging material is cardboard boxes lined with polyethylene.

**Disease Management**

There are 5 main diseases found in marigolds

1. Damping-off: caused by *Rhizoctonia solani*
   Symptoms: brown round spots, girdling the radicle and cause pre-emergence mortality
   Management: soil drench with brassica (0.3%)
2. Leaf spots and Blight: Species of Alternia, Cercospora, and
   Septoria
   Symptoms: minute brown circular spots on lower leaves, premature defoliation
   Management: spray DithaneM-45 @0.2%
3. Powdery Mildew: caused by Oidium sp. And Levillulataurica
   Symptoms: whitish, tiny superficial spots on leaves and whitish
   The powdery form on aerial parts of the plant.
   Management: spray karathane @ 0.5% or dusting sulphur powder.

**Value addition of Marigold**

Value-adding was interpreted primarily as the difference between the total cost involved in making or purchasing an asset and the amount of revenue accumulated in its sale. Value-adding activities were largely about switching resources. For that reason, this chapter goes on to cost revenues at various levels obtained and obtained by flower producers who ultimately estimate the increase in marigold value.

The large size of the marigold garland is more beneficial than the variety of small flowers. The total profit for a large collection of marigolds was ₹ 11 and up again. The value addition of marigold in different industries are as follows:

- Genetic resources for crop improvement
- Cut flowers/cut foliages
- Flowering /foliage potted plants/hanging baskets
- Sources of phytochemicals
- Sources of essential oils
- Sources of plant pigments
- Sources of dyes
- Dried flowers and other plant parts
- Flower arrangements
- Flower ornaments and bouquets
- Used in the food industry
- Used in the veterinary industry.

**Textile Industry**

Natural colorants especially the flavonoids and carotenoids present in Marigold are extracted by different techniques and used as natural colorants in different fabrics.

Today with the worldwide concern over the use of environmentally friendly and decaying materials, worldwide, the demand for natural dyes in the textile industry is improving. Interest in the use of environmentally friendly and decaying materials creates the employment of natural dyes. In contrast, natural dyes are more environmentally friendly, exhibit better biodegradability, and are more environmentally friendly than synthetic dyes.

The main idea of extracting dye from the sources of marigold plants is to avoid environmental pollution and its properties such as antibacterial, antifungal, etc. The use of various mordants and marigolds offers countless shades such as brown, yellow, orange, and so on.

**Food industry**

The food industry uses marigold as a natural dye to provide the most appealing yellow cheese and butter. Dried flowers are also added to the tea to make it look more attractive. Another joy of cooking is sure to surprise the fried marigold. Marigold flowers are a natural source of xanthophyll, and their extracts are used as an additive in the food industry. The flowers lend a dash of color to many recipes while adding a soft flavor to the drinks, soup, and pesto.

**Veterinary sector**

African marigold leaves (Tagetes erecta) are commercially important as a natural source of lutein (yellow-orange color) and are widely used in the poultry industry as a food coloring ingredient in orange egg yolks and yellow chicken skin. Marigold has been widely used in the poultry industry to increase the xanthophyll present in maize and alfalfa feeds to stabilize the xanthophyll content in the feed. Chickens use a carotenoid to color the color as the color of the chicken skin is provided by these colors and is involved in the growth of metabolism and fertility.

**Pharmaceutical/Medicinal Industry**

Marigold tea is helpful in relieving stomach problems and ulcers and reducing stomach cramps. Extracted Marigold is used to treat bacterial ear infections and reduce pain. Flavonoids present in marigold flowers have been found to show cytotoxic, anti-inflammatory, and inhibitory functions against colon cancer, leukemia, and melanoma cells.

Marigold has various medicinal functions such as Anti-bacterial Activity, Anti-microbial Activity, hepatoprotective activity, insecticidal activity, Mosquitocidal activity, Nematocidal activity, wound healing activity, Antioxidant activity and Analgesic Larvicidal activity, Sub-acute toxicity studies also study Nematode Tagetes types. Managers

Many Tagetes sp. marigold oil produces a strong aromatic oil and is called Tagetes oil which is used in the cosmetics and perfumes industry. Oils found in fresh flowers include a deformed effect on the marrow of the spine. It is also used as an antiseptic.

Root extract is used as a laxative. Marigold leaves are used to

treat kidney and muscle aches. Infusion of florets is prescribed as a diuretic and carminative. Florets are used to treat eye diseases and ulcers. These oils can be used to relieve sunburn, warts, itching, acne, and sores, in addition to healing wounds, dry skin, and blisters.

**Marketing of marigold**

Marigold is the most important flower annual cultivated in India. Cultivation of marigolds is very profitable farming for farmers. In the market, the marigold crop is a high and good demand for hotels, houses, decorations, social functions, etc. For packaging purposes, in the local market marigold flowers are taken into gunny bags by people. In 2021-22, India has a 64,768-hectare area with an annual production of 300,000 metric tonnes of loose flowers. Loose flowers e.g., Marigold, jasmine, etc have a high production rate in an area of 2/3 of India. Local varieties are grown in most of the area. Marketing involves the transportation process through buses, rickshaws, trucks, mini trucks, etc. for the transportation of marigold flowers.

**Marketing pattern and value addition**

Marketing plays important role in the disposal of marigolds. The Yamuna Nagar district of Haryana does not have a "*phool mandi"* for marketing the flowers. The farmer sells the marigold through a retailer to the customer in the market. If the seller, sells large size marigold garlands than the small size marigold garland to the customers, it will be more profitable. It has wide adaptability to the environment and is easy to grow. It is used to be a cut flower and for making cosmetics, perfumes, etc.

**Producers**

Marigold producers sell their produce in the *Yamunanagar* flower market. Growers assemble 2-3% of their produce by themselves. To get better prices, growers carry their produce to market on their own. To avoid getting tricked in the market, small producers sell their products inside the village also.

**Wholesalers**

There are three channels through which marigold producers sell their produce. In channel 1, produce is directly sold by the producer to the consumers. Whereas, in channel 2, produce reaches the consumers through a retailer. In channel 3, the producer sells his produce to the wholesaler, and then the product is sold to the retailer after which, the produce reached the consumer.

The competitive market system requires sellers and buyers to be well-informed producer wholesalers and retailer consumers about the supply and demand of loose flowers i.e., marigolds. The wholesale market encourages speed in collecting, recording, and disseminating data of flowers is vital in a competitive economy and it also improves the quality of enterprise investment decisions as well as promotes resource allocation in the economy and loose flower production and distribution.

**Retailer**

The main purpose of the retailer is to purchase the marigold flower from the farmers and distribute it in the market for selling. In the market, the marigold flower was sold by various private shopkeepers. The retailer purchases the Marigold also in *phool mandi*.

**Demands of marigold**

Marigold flowers are also used in a variety of decorations in a marriage setting and for decoration purposes.

Marigold price increases due to high demands during *Navratras* and *Deepawali.*

Marigold flower has natural anti-inflammatory and anti-cancer properties that lead to the high demand for marigold flowers all over the world.

**Cost and Income returns**

Area preparation = ₹ 5,000
Planting material = ₹ 800
Machine charges = ₹ 2,000
Manures and fertilizers = ₹ 5,000
Plant protection = ₹ 1,000 Irrigation = ₹ 1,500
Labour Charges =₹ 10,000
Miscellaneous cost = ₹ 2,000
Marketing cost =₹ 2,000
Total cost = ₹ 29,300

**Income returns**

Yield price (per kg) = ₹ 45 according to *yamunanagar* market of Haryana on 12 April 2022.

Income for 3 tons (an avg. yield per acre) = 3,000×45 = ₹ 1,35,000.

**Profit and Returns**

=Income – cost of total

= ₹1,35,000 – ₹29,300 = ₹1,05,700 Hence the profit is ₹ 1,05,700.

**Table 1:** Production of Indian marigold

| | | Yield in tones | | |
|---|---|---|---|---|
| | | 2021-2022 | | |
| | State | Lose Value | Cut Value | Total Value |
| 1 | M.P | 224.62 | 0.25 | 224.87 |
| 2 | Chattisgarh | 36.84 | 20.32 | 57.16 |
| 3 | Assam | 4.16 | 5.68 | 10.14 |
| 4 | Others | 0.21 | 0.02 | 0.23 |
| | Page Total | 265.83 | 26.57 | 292.40 |

This table shows the data for Indian production of marigolds for the years 2021-22.

**Conclusion**

Marigold is a fragile flowering plant that takes a unique place in flower planting, cultivated mainly for its beauty, profitability, religion, and society, with its easy planting and flexibility, wide attractive colors, textures, size, and beauty. to maintain quality. Proper harvesting and care of flowers after harvest is essential to enhance the health of the vase and ensure the highest quality product. Lack of storage facilities, inadequate and underdeveloped transport and communication systems, lack of modern and technological harvesting technology, lack of infrastructure, and standard packaging method are the main reasons why flowers are inferior and improve flower loss after harvest. The cultivation of marigolds increases employment opportunities for rural people. The direct marketing channel works best while involving retailers and retailers work very well. Marigold has many value additions in various fields namely the food industry, pharmaceutical industry, textile industry, country planning, and floral decorations, garlands, and gajra in various religious and social festivals.

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