

Fruit Bagging: A Shield for Quality Production

Fruit cultivation requires constant care and monitoring to ensure the production of fruits of high quality. Fruit bagging stands out among the several methods used by fruit growers for its potency in preserving fruit quality as well as boosting sustainability. This technique has gained significant popularity and recognition within the realm of horticulture and agriculture due to its numerous benefits in improving fruit quality, appearance, and market value. Using this method, one can protect individual fruits from pests and diseases, harsh weather conditions and physical damage by enclosing them in bags made of different materials, such as paper, plastic or fabric. Fruit bagging not only safeguards the fruit's integrity but also contributes to improved fruit appearance and quality by creating a microenvironment around the fruit. It may seem like a simple idea, yet it is crucial to the development of quality fruit crops.

VARIOUS good horticultural practices (GHP) are becoming popular throughout the world for high-quality fruit production with fewer necessities for synthetic chemicals. Pre-harvest fruit bagging has become a popular and successful method among these. In addition to improving the fruit's appearance by enhancing skin colour and minimizing blemishes, bagging is a physical protection technique that can alter the microenvironment for fruit development, which can have a number of positive effects on the internal quality of the fruit. Fruit cracking, insect pest and/or mechanical damage, sunburned skin, disease incidence and bird damage can all be reduced with pre-harvest fruit bagging. Bagging is laborious and costly, benefit ratio must be investigated in order to promote adoption of the method in much of the World. The purpose of this article is to communicate the advantages of fruit bagging so that commercial growers may think about implementing this technique.

The primary goal of fruit bagging is to protect the fruit from different external factors that can adversely affect its quality and marketability. These factors include pests, insects, diseases, adverse weather conditions, physical damage and exposure to excessive sunlight. By providing a protective barrier, fruit bags effectively reduce the risk of fruit infestation and damage, ensuring a higher yield of unblemished and visually appealing fruits. Moreover, fruit bagging helps to promote uniform fruit colour, size, and shape, which are crucial factors for consumer preference and market demand. The controlled environment within the fruit bag helps in optimizing the ripening process, allowing the fruit to attain a desirable colour, texture, and taste. This technique is especially beneficial for fruit crops such as apple, pear, peach, citrus fruits, mango, grapes, guava, etc.

Fruit Bagging Techniques

Fruit bagging can be carried out using various materials, depending on the specific requirements of the crop and grower preferences. Common materials include paper bags, plastic bags, fabric bags and netting. The choice of material is crucial, as it impacts factors like moisture retention, air circulation, and light penetration, all of which can influence fruit development.

Necessity of Fruit Bagging

Pest and Disease Management

One of the primary reasons for adopting fruit bagging is the effective protection it offers against pests and diseases. Many insects and pathogens can wreak havoc on fruit crops, causing significant damage and reduced yields. Fruit bagging serves as a physical barrier, preventing direct contact between pests and the fruit. Common pests such as fruit flies, codling moths, and birds are unable to penetrate the barrier, thus protecting the fruit from external damage and infestation. Moreover, fruit bagging also shields fruits from environmental factors like wind and rain, which encourages the spread of fungal diseases. This also reduces pesticide usage which leads to a more sustainable and eco-friendly approach to fruit production. The bagging of fruits using brown paper bags before 6-9 weeks of harvesting in guava and 30 days before harvesting in mango reduced the incidence of fruit fly. Fruit bagging before 60 days of harvesting using brown paper bags reduces the incidence of anthracnose and stem-end rot in mango.

Environmental Conditions

Fruit bagging also shields fruits from adverse environmental conditions. Extreme weather, such as heavy



Infestation of sooty mold in mango

Fruit damage due to hail storm

rain, hail, or excessive sunlight, can cause fruit cracking, sunburn, or blemishes. By covering the fruit with bags, growers can mitigate these issues, ensuring that the fruit remains intact and free from cosmetic damage. Pre harvest bagged litchi fruit were free from blemishes due to a low incidence of sunburn and fruit-cracking.

Enhanced Aesthetic Appeal

Consumers are becoming increasingly discerning when it comes to the appearance of fruits. Fruit bagging plays a crucial role in ensuring that fruits remain blemish-free, unmarked, and aesthetically appealing. Bagging helps prevent scarring, sunburn, and wind damage, which can significantly impact the market value of fruits. As a result, fruit growers can command higher prices for bagged fruits, which are often preferred in premium markets. Pre-harvest bagging of ‘*Doyenne du Comice*’ pear increased the fruit acceptability for export primarily by minimizing bird damage and skin blemishes.

Consistent Ripening

Fruit bagging regulates the fruit’s exposure to sunlight, resulting in more consistent ripening. Fruits that ripen uniformly have a better taste and texture, making them more appealing to consumers. This uniform ripening also allows for better planning of harvest times, reducing post-harvest losses and waste.

Improved Fruit Quality

The protection offered by fruit bagging extends beyond physical defense; it also affects fruit development. Bagged fruits tend to have higher sugar content, improved flavour, and increased nutritional value. This is because the bags create a microenvironment that enhances the photosynthesis process, ultimately leading to better fruit quality. Sweetness in ‘Granny Smith’ apple fruit was improved by bagging in brown paper bags at the golf-ball size of fruit development.

Better Fruit Size and Shape

Fruit bagging encourages uniform growth and prevents fruit deformation. The consistent shading provided by the bags helps maintain the fruit’s size and shape, resulting in a more desirable and marketable product. Bagging of mango var. ‘Nam Dok Mai #4’ fruits with different wave

length selective bags increased fruit weight, size and sphericity over un-bagged fruit.

Reduces the Need for Chemicals

Reducing the reliance on chemical pesticides is not only environmentally friendly but also healthier for consumers. Fruit bagging can minimize the need for chemical treatments, promoting sustainable and organic farming practices. Double layered bagged apple fruits had lower concentrations of heavy metals (Pb, Cd and Cr) and pesticide residues than non-bagged apple fruit. It was therefore concluded that apple-bagging was an effective measure to improve sanitation and safety.

Extended Shelf Life

Fruit bagging not only benefits growers and consumers but also extends the shelf life of the fruit. By creating a protective barrier, the bags reduce the risk of physical damage and microbial contamination during handling and transportation. As a result, the fruit can remain fresh for a more extended period, allowing growers to reach distant markets and consumers to enjoy fruits over a more extended timeframe. This increased shelf life reduces food waste and contributes to economic sustainability. Pre harvest bagging with double layered bag increased shelf life of mango cv. Alphonso.

Sustainable Agriculture

In the era of sustainable agriculture, minimizing the use of chemical pesticides and promoting responsible farming practices is paramount. Fruit bagging aligns with these sustainability goals. By reducing the need for pesticides, fruit bagging decreases the environmental impact of fruit cultivation. Additionally, the increased



(A) Mango cv. Mallika showing the effect of without bagging and (B) bagging on quality, appearance, shelf life, disease incidence and severity

Table 1. Effect of pre-harvest fruit bagging in fruit crops.

Fruit crop/ Cultivar	Time of bagging	Type of bagging material	Conclusion
Mango 'Keitt'	100 days before harvest	White paper bags	Reduced the incidence and severity of anthracnose and stem-end rot
Apple 'Imperial Gala'	40 days after flowering	Transparent micro-perforated plastic or non-textured fabric bags	Control of fruit fly, oriental fruit moth, apple leaf roller and woolly apple aphid
Apple 'Gamhong'	4-5 weeks after full bloom	Ca-coated paper bags	Reduction in bitter pit
Mango	Pre-harvest	Brown paper bags	Reduction in the incidence of fruit fly, maintained higher total soluble sugars and better physical quality of fruit

(types of bagging materials, size, time of bagging in different crops used, their benefits etc may be included)

market value of bagged fruits allows growers to make more revenue with fewer inputs, contributing to the economic sustainability of fruit farms.

Challenges and limitations of fruit bagging

The effectiveness of microclimate control depends on the quality and type of bags used. It can be challenging to maintain optimal conditions consistently, particularly in regions with fluctuating weather patterns. Bagging of fruits is a labour-intensive process, which can be especially challenging for large-scale orchards. It requires significant manpower and time, making it less economically viable for some growers. Bagging of fruits requires proper skill and training to ensure that the bags are correctly placed to adequately protect the fruit. Bagging practice is also dependent on the climate of an area. In areas with high humidity or excessive rainfall, bags can become a breeding ground for molds and fungi, defeating the purpose of protection. Response to bagging may vary according to fruits and varieties. Some fruits may benefit greatly from bagging, while others may not show a significant improvement in quality or appearance. Consumers may have aesthetic preferences regarding the appearance of bagged fruits, but some may perceive bagged fruits as less natural or appealing compared to unbagged ones.

Future prospects

As agriculture continues to face challenges related to climate change, resource scarcity, and consumer demands for safer and more sustainable practices, incorporation of bagging may boost the fruit crop production by improving quality and promoting sustainability. By protecting the fruit from adverse weather conditions, pests, and diseases, bagging can result in higher crop yields and subsequently increased profits for farmers. Innovations in this field can have significant implications for crop yield, quality and sustainability.

- Development of biodegradable and environment friendly materials for fruit bags, reducing plastic waste and its environmental impact. Innovations in bio-based polymers and compostable materials are paving the way for more sustainable bagging practices.
- Manufacturing bags with UV-blocking properties to shield fruits from harmful ultraviolet radiation, which can cause sunburn and affect fruit quality.
- Incorporate nutrients or bioactive compounds into



Paper bag for bagging Glimpses of fruit bagging in orchard

the bagging material. This allows for the controlled release of substances that can positively influence fruit development and quality.

- Incorporating nano-coatings or antimicrobial properties into the bagging material to prevent microbial growth, reduce spoilage, and extend fruit shelf life.
- Integration of sensors and monitoring devices within the fruit bags to assess fruit growth, quality, and health. This data can be used for real-time decision-making and precise management of the crop.
- Automation technologies, including robotics, are being integrated into bagging processes. Automated systems can efficiently cover fruits with bags, ensuring uniform application and reducing labour costs.

CONCLUSION

Fruit bagging is a time-tested technique that provides a multitude of advantages to fruit crop cultivation, from pest and disease management to improving fruit quality and appearance. This practice not only enhances the marketability of fruits but also aligns with the principles of sustainable agriculture by reducing the need for chemical pesticides and aligning well with sustainable and organic farming practices, which are increasingly gaining recognition and support. Its importance in modern agriculture cannot be underestimated. For modern fruit farmers, incorporating fruit bagging into their cultivation methods is a wise choice, offering both economic and environmental benefits.

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