



# A Review on Effects of Biofertilizers and Bio Capsules on Vegetative Growth, Flowering and Fruiting Attributes of Strawberry

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

This paper analyzes the impact of biofertilizers and bio capsules the vegetative growth, flowering, and fruiting attributes of strawberries (*Fragaria x ananassa*). Biofertilizers are natural substances containing beneficial microorganisms that enhance nutrient availability in the soil, while bio capsules encapsulate beneficial microbes for controlled release. Many researchers have concluded their positive finding with regards to application of various biofertilizers and biocapsules in

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strawberry as well as in other horticultural crops. This paper provides current findings and explains the role of biofertilizer and bio capsules and its effect on different stages of strawberry development. This review highlights the potential of these sustainable agricultural practices in optimizing strawberry cultivation in an eco-friendly way.

**Keywords:** Bio-fertilizer; bio-capsule; strawberry; flowering; fruiting.

## 1. INTRODUCTION

Biocapsules could be used to deliver additional nutrients, improve major elements deficiency in strawberries (Lokesh et al. 2020); [1]. "Biofertilizers are considered as economically attractive and ecologically sound route for reducing external inputs augmenting nutrient supply and to improve the quality and quantity of internal resources with maximum outputs. These biofertilizers act as carriers containing beneficial micro-organisms in a viable state, intended for seed or soil application, designed to improve soil fertility status and also helps in plant growth by increasing the number and biological activity of desired microorganisms in root environment" [2]. In the study of Singh et al., 2008 they concluded that the treatment combination with azotobacter azospirillum and plant growth regulators shows maximum growth and yield in strawberry.

As Chemical fertilizers, boost agricultural yields but leave hazardous residues that hurt humans, impair sustainability, and pollute water [3]. So, there is need for variable rate of Nano-fertilizers and Biocapsules application to avoid these problems by having knowledge of the scale of variability of soil and tree characteristics within field. Nano fertilizers are the small particles of different fertilizers that plays an important role in plant growth and productivity on other bio capsules (PGPR) are soil bacteria which have the potential for direct and indirect effects on plant growth [4].

Strawberry (*Fragaria × ananassa* Duch.) is a member of Rosaceae family, possesses a huge spot in organic product industry, since it is developed in both in fields as well as in slopes. It is herbaceous yield with prostate development propensity, which acts as a yearly in sub-tropical area and persistent in temperate area and has acquired the situation with being one of the main delicate product of the world after grape [5]. Strawberries have more huge amount of L-ascorbic acid, phenolics, and flavonoids than other berry products [6,7]. Strawberry is one of the significant delicious and delicate organic product among the berries. Different strawberry

wild species can be grown everywhere, except the developed strawberry depends on two American species *Fragaria chiloensis* and *Fragaria virginiana*. Cross breed between these two species was the progenitor of all the cutting edge strawberry cultivar [8]. Strawberry plant is kept under care of around a half year after planting [9]. It is industrially developed overall for its exceptionally valued sweet, fragrant, and delicious natural product. The US is the world's powerful manufacturer of strawberries delivering north of 36 billion pounds in 2012 and representing 29% of the complete world creation [10].

## 2. ROLE OF BIO-FERTILIZERS

Synthetic manures are fundamental for meeting supplement necessities, however, they should not to be utilized too much in a inadequate amount. This can hurt individuals' well-being and the climate, exhaust the synthetic and actual properties of the dirt, and ultimately bring about low harvest yields. Table 1 showing use of different bio-fertilizer in cultivation of strawberry. A kind of bio-manure (like Azotobacter, PSB, and Azospirillum, an others) can fix nitrogen from the air and solubilize phosphorus in the soil, subsequently expanding the nutrient movement and richness of the soil.

Strawberry quality was also improved by using bio-fertilizers. In the investigation by Rueda et al., 2016 the inoculation and co-inoculation of bacterial culture of Azotobacter spp. and *Azospirillum spp* was performed in combination with three nitrogen levels and found that this combination showed significant increase in growth and yield of strawberry.

"Bio-fertilizers are one of the greatest nature gifts of our agricultural science as a replacement to chemical fertilizers. Bio-fertilizer contains microorganisms which encourage the adequate supply of nutrients to the host plants and ensure their proper development of growth, development and regulation in their physiology" [11]. "Biofertilizer are the derived product of living microorganism that are capable to fixing

**Table 1. List of bio-fertilizer used in cultivation of strawberry**

<b>S. No.</b>	<b>Name of bio-fertilizer</b>	<b>Effect</b>	<b>Source</b>
1.	Pseudomonas	Effective root colonizing bacteria.	Fikki et al. (2008)
2.	Azotobacter	Increased vegetative growth.	Singh et al. [20]
3.	Azospirillum	Fix atmospheric nitrogen, solubilize phosphorus, and promote soil fertility, biological activity and plant height. more vegetative growth.	Singh et al. [20]
4.	Azotobacter	TSS increased, fruit size, weight and volume.	Mishra et al. [21]
5.	Phosphorus Solublizing Bacteria	Plant height, development of inflorescence, increased berry size.	Mishra et al. [21]
6.	Phosphorus Solubilizing Bacteria	Increase biological nitrogen fixation and phosphorus availability, which are necessary for robust vegetative development.	Deshmukh et al. [22]
7.	Phosphorus Solublizing Bacteria	Promote root growth.	Prasad et al. [23]
8.	Azotobacter	Enhanced yield and growth of strawberry.	Soni et al. [24]
9.	Azospirillum	Fix atmospheric nitrogen, solubilize phosphorus and promote soil fertility, biological activity, and plant height. more vegetative growth.	Kumar et al. [19]
10.	Azotobacter	Increased number of leaves, numbers of runners and plant height.	Kumar et al. [19]
11.	Pseudomonas	Increased plant height and induced early flowering.	Negi et al. [25]

atmospheric nitrogen and also convert insoluble phosphorus to soluble phosphorus for uptake of plants" [12]. In the study proposed by Tripathi et al., 2016 in strawberry cv. Chandler, they concluded that the plants treated with Azotobacter @ 7kg/ha results significantly increase in vegetative growth, flowering, yield and quality of plants.

## 2.1 Impact of Bio-Fertilizers On

### 2.1.1 Vegetative growth

"In an experiment, the strawberry was treated with the combination of poultry manure + Azotobacter + wood ash + phosphate solubilizing bacteria + oil cake recorded the highest values of growth attributes, for plant height (23.39 cm), plant spread (24.21 cm), runners per plant (13.03) and yield (238.95 g/plant) as well as the earliest blooming (10.33 days), along with better quality" [13].

### 2.1.2 Flowering

Sood et al., [14] in their experiment, on strawberry with three different biofertilizer concentration and plant growth regulators, in which the treatment with Phosphate solubilizing bacteria (6kg/ha) and gibberellic acid (100ppm) suitable for plant growth and takes least time to produce first flower (57 days) as compared with control.

"Another findings had been studied to test the response of strawberry towards photoperiod. They compared the responses of two short day (SD, Junebearing) cultivars (Redgauntlet and Torrey) and threeday neutral (DN) cultivars (Aptos, Brighton and Hecker) of strawberry to various day length and temperature regimes. They observed that the day length (9 or 15.h) and day/night temperature regime (18/13, 21/16 or 30/258C), during inflorescence initiation had major effects on yield parameters in the short day cultivars. Floral initiation was repressed in long days, with poor fruit set and development compared with flowers initiated under short-day conditions" [15].

### 2.1.3 Fruiting attributes

The experimental finding by Kumar et al., [16] revealed that "the sole inoculation of Azospirillum and Azotobacter and in combination with PSB significantly influenced the plant height and leaf size compared to control and 100% RDF

treatment. Through the application of biofertilizer, duration of fruiting and the yield per hector area has increased significantly over control. Harvesting span was observed maximum in 75% RDF + Azospirillum @ 2g/plant + PSB @ 2g/plant + topdressing of 25% K (70 days)" [26-32].

## 2.2 Impact of Bio Capsules On

### 2.2.1 Vegetative growth

"In the meristematic region of plants, cell elongation and cell division are also benefited by PSB, according to research on the behaviour of biofertilizers. The biological soil fixation of nitrogen and the availability of phosphorus, which are necessary for healthy vegetative growth, are increased when biofertilizers like PSB are used". [17] "The application of PSB in trials on banana and strawberry plants has increased the nitrogen availability in the soil and increased the value of plant growth characteristics, including the maximum and minimum values for plant height, spread, the number of leaves per plant and leaf area" [14].

### 2.2.2 Flowering

"Using of Biocapsules and Azotobacter in various doses can increase the number of crowns and runners per plant and increased nitrogen and phosphorus availability in plants as well as increased nitrogen and phosphorous transfers from root to flower through plant foliage due to nitrogen fixers and phosphorous solubilizers" [18].

### 2.2.3 Fruiting attributes

"Strawberry fruit is also impacted by the use of biocapsule. The overall plant growth, flowering, fruit ion content, fruit production, fruit quality and the overall yield attributable to more fruits being produced per plant, larger and heavier berries may be considerably enhanced by a suitable combination of biocapsule and PGRs" [19].

## 3. CONCLUSION

From the examination of bio-composts and bio-containers on strawberries, it can securely be presumed that fundamentally increment the number of leaves per plant, length of leaves, plant spread, width of leaves, length of petioles, level of plants, absolute number of natural products, quantities of sprinters, weight of

organic product per plant, weight of organic product per berry, T.S.S. content of organic products, though created most extreme Ascorbic corrosive limit of leafy foods corrosive substance.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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