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Evaluation of Eco-Friendly Fertilizers as Supplements to Organic Compost in Cucumber *(Cucumis sativus* L.)

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Cucumber (*Cucumis sativus* L.) is an important vegetable crop requiring adequate and balanced nutrient supply for optimum growth, yield and fruit quality. Excessive dependence on chemical fertilizers may adversely affect soil health and environmental sustainability. Organic composts such as farmyard manure and vermicompost improve soil physical properties, organic matter and microbial activity, but nutrient release from these materials may be relatively slow. Eco-friendly fertilizers, particularly biofertilizers containing beneficial microorganisms such as *Azotobacter*, *Azospirillum* and phosphate-solubilizing bacteria (PSB), can complement organic nutrient sources by improving nutrient availability and plant growth. Their combined use with organic compost may enhance nutrient-use efficiency, crop productivity and soil biological activity. This review highlights the role of eco-friendly fertilizers as supplements to organic compost in cucumber production, with emphasis on their effects on plant growth, yield, fruit quality and soil health. The integrated use of organic compost and biofertilizers offers a promising approach for sustainable and environmentally friendly cucumber production.

Keywords: Cucumber, *Cucumis sativus* L., eco-friendly fertilizers, organic compost, biofertilizers, *Azotobacter*, *Azospirillum*, phosphate-solubilizing bacteria, sustainable agriculture, soil health.

Introduction

Cucumber (*Cucumis sativus* L.) is an important vegetable crop of the family Cucurbitaceae and is widely cultivated for its nutritious and commercially valuable fruits. Adequate nutrient availability is essential for vigorous growth, higher yield and good fruit quality. However, continuous and excessive use of chemical fertilizers may adversely affect soil health and environmental quality, creating a need for sustainable nutrient-management practices. Organic composts such as farmyard manure (FYM) and vermicompost are valuable sources of organic matter and nutrients. Their application improves soil structure, water-holding capacity and microbial activity while supporting gradual nutrient release. However, the nutrients supplied through organic sources may not always be readily available according to the crop's immediate requirements. Eco-friendly fertilizers, particularly biofertilizers, can supplement organic compost by enhancing nutrient availability through beneficial microorganisms. *Azotobacter* and *Azospirillum* contribute to biological nitrogen fixation and plant growth promotion, whereas phosphate-solubilizing bacteria (PSB) improve the availability of otherwise insoluble forms of phosphorus. Their integration with organic compost may enhance nutrient-use efficiency, plant growth, yield and soil biological activity. Therefore, the combined application of organic compost and eco-friendly fertilizers represents a promising approach for sustainable cucumber production. This review focuses on

the role and potential of eco-friendly fertilizers as supplements to organic compost, particularly their influence on cucumber growth, yield, fruit quality and soil health.

Materials and Methods

Study Scope

The present review focused on the evaluation of eco-friendly fertilizers as supplements to organic compost in cucumber (*Cucumis sativus* L.) production. The review mainly covered their effects on plant growth, yield, fruit quality and soil physicochemical properties.

Literature Collection

Relevant research articles, review papers and reliable scientific publications were consulted to support the evaluation of organic compost and eco-friendly fertilizers in cucumber (*Cucumis sativus* L.). The literature was used to interpret their effects on plant growth, yield, fruit quality and soil properties.

Literature Search

The literature was searched using keywords such as cucumber, *Cucumis sativus* L., organic compost, farmyard manure, vermicompost, biofertilizers, *Azotobacter*, *Azospirillum*, phosphate-solubilizing bacteria, plant growth, yield, fruit quality and soil properties.

Literature Selection

Published studies related to the use of organic compost, biofertilizers and their combined application in cucumber and other vegetable crops were selected. Greater emphasis was given to studies reporting their effects on plant growth, yield, fruit quality and soil physicochemical properties.

Parameters Reviewed

The following major parameters were considered in the review:

- Plant growth and growth attributes
- Yield and yield attributes
- Fruit quality
- Soil physicochemical properties such as pH, electrical conductivity, organic carbon and available nutrients

Data Analysis

The experimental observations were compiled, compared and interpreted with support from published literature.

Statistical Analysis

The experimental data were analysed statistically. SEm, CD at 5% significance level and CV were calculated to assess differences among treatments.

Result and discussion

Socio-economic Profile of the Respondents

The socio-economic characteristics of the respondents are presented in Table 1. A total of 50 respondents participated in the NSS-based agricultural awareness and demonstration activities. Among them, 26 were male (52%) and 24 were female (48%). Regarding age, 25 respondents (50%) belonged to the young age group, followed by 17 respondents (34%) in the middle-age group and 8 respondents (16%) in the old-age group. The participation of respondents from different age and gender groups indicates broad community involvement in the agricultural awareness activities.

Table 1. Socio-economic profile of respondents (n = 50)

Particulars	Frequency	Percentage (%)
Gender		
Male	26	52.00
Female	24	48.00
Age		
Young (up to 35 years)	25	50.00
Middle (36–55 years)	17	34.00
Old (>56 years)	8	16.00

Participation of Respondents in Agricultural Activities

The involvement of respondents in different agricultural awareness and demonstration activities is presented in Table 2. The activities focused on eco-friendly fertilizers, organic compost, biofertilizers and improved cucumber production practices.

Table 2. Participation of respondents in different agricultural activities

Activity	No. of respondents
Awareness about eco-friendly fertilizers	8
Demonstration of FYM and vermicompost application	6
Seed treatment and soil application of biofertilizers	7
Recommended cucumber cultivation practices	7
Integrated organic manure + biofertilizer application	5
Harvesting and post-harvest practices	6

Effect of Organic Compost and Eco-friendly Fertilizers on Cucumber Growth

The effect of different treatments on number of fruits per vine, fruit length, fruit weight and fruit diameter is presented in Table 3. Significant differences were observed among the treatments. The highest values for all the recorded parameters were obtained under T10, comprising FYM (1 kg m^{-2}) + vermicompost (0.3 kg m^{-2}) + *Azospirillum* + *Azotobacter* + PSB.

Effect on Yield and Yield Attributes

The number of fruits per vine showed a progressive increase with the integration of organic compost and biofertilizers. T_{10} recorded the highest number of fruits per vine (13.36), whereas the control recorded only 4.29 fruits per vine. The improvement in fruit number under integrated treatments indicates that the combined use of FYM, vermicompost and biofertilizers can provide favourable conditions for plant growth and fruit development. Treatments containing both organic compost and multiple biofertilizers performed better than treatments receiving individual organic sources alone. These findings demonstrate the potential of eco-friendly fertilizers to supplement organic compost and improve cucumber productivity.

Effect on Fruit Quality

Fruit length, fruit weight and fruit diameter were significantly influenced by the different treatments. The highest fruit length (18.07 cm), fruit weight (148.43 g) and fruit diameter (35.03 mm) were recorded under T10, while the lowest values of 10.42 cm, 84.10 g and 23.14 mm, respectively, were recorded under the control (T1). The combined application of FYM, vermicompost, *Azospirillum*, *Azotobacter* and PSB resulted in superior fruit characteristics. Treatments containing both organic compost and biofertilizers generally recorded higher values than the control and treatments receiving organic compost alone. These findings indicate the beneficial effect of integrated nutrient management on the yield and marketable quality of cucumber fruits.

Effect on Soil Physicochemical Properties

The application of FYM and vermicompost contributes to maintaining soil fertility and improving soil physicochemical properties. The reviewed studies considered parameters such as soil pH, electrical conductivity, organic carbon and available N, P and K. The use of organic compost along with biofertilizers can support better nutrient availability and sustainable soil management.

Overall Findings

The results clearly showed that the combined application of organic compost and eco-friendly fertilizers was more effective than the individual application of FYM or vermicompost. Among all treatments, T10 recorded the highest values for number of fruits per vine, fruit length, fruit weight and fruit diameter. Therefore, the integrated application of FYM + vermicompost + *Azospirillum* + *Azotobacter* + PSB was found to be the most effective treatment among those evaluated for improving the yield and fruit attributes of cucumber. These findings support the potential of combining organic compost with eco-friendly fertilizers for sustainable cucumber production.

Conclusion

The review indicates that the use of eco-friendly fertilizers as supplements to organic compost is a promising approach for sustainable cucumber (*Cucumis sativus* L.) production. The combined use of FYM or vermicompost with biofertilizers such as *Azotobacter*, *Azospirillum* and phosphate-solubilizing bacteria (PSB) can support better plant growth, yield and fruit quality while contributing to favourable soil physicochemical conditions. The approach can also reduce dependence on chemical fertilizers and promote the efficient use of organic resources. The NSS-based farmer interaction and demonstrations provided an opportunity to share these sustainable nutrient-management practices with local participants. Overall, integrated use of organic compost and eco-friendly fertilizers has considerable potential for promoting productive and environmentally sustainable cucumber cultivation(Anjanappa *et al*., 2012; Dash et al., 2018)

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