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INFLUENCE OF BIO-FERTILIZERS APPLICATION ON GROWTH, YIELD AND QUALITY ATTRIBUTES OF CUCUMBER (*CUCUMIS SATIVUS* L.) : A REVIEW

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Abstract

Cucumber (*Cucumis sativus* L.) is a warm season vegetable, grown throughout the world under tropical and subtropical conditions. It is said to be the native of northern India. It is an important salad crops grown extensively throughout India as well as the world. It is having high medicinal value so it is becoming popular day by day in the country. To achieve higher production of cucumber the expensive commercial fertilizers are recommended but use of excess inorganic fertilizers as per the recommendations soil health and environment sustainability is on sake. So to achieve higher productivity and to maintain the environment balance judicious use of chemical fertilizers is needed. Intensive use of only chemical fertilizers to achieve high production has created problems. Therefore Bio-fertilizers have emerged promising components of nutrient supply system. Application of bio fertilizers which is environment friendly and low cost input with inorganic fertilizers as part of an integrated nutrient management strategy and play significant role in plant nutrition. The application of biofertlizers fertilizers has received great attention in sustainable agriculture. Hence the present information explaining the importance of biofertilizers combined with inorganic fertilizers is reviewed here.

Key words: Biofertilizer, NPK, Growth, yield, quality, cucurbits

Introduction

Cucurbit is a term coined by Liberty Hyde Bailey for cultivated species of the family Cucurbitaceae. Cucurbits belong to family-Cucurbitaceae, having 118 genera and 825 species (Jeffery, 1980). These crops are mostly monoecious and growth of vine has well established correlation with yield and yield contributing factors. Further, these crops respond significantly towards nutrient application from various sources.

Indiscriminate and over application of inorganic fertilizers without adding organic or bioactive ingredients in soil the physico and biochemical properties of soil has been deteriorated. It also reduces different microbe's activity in soil, decreasing humus content of soil, increased the pollution of soil, water & air (Singh and Kallo, 2000). The higher prices of chemical fertilizer and its negative impact on soil, environmental and human health forced the farmers to change previous farming activities and adopt new practices *i.e.* use of different organic and biofertilizers in place of inorganic fertilizers.

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Biofertilizers have ability to harness carbon, solar energy and atmospheric nitrogen to soil effectively, to enrich soil for better plant growth. Bio-fertilizers are efficient, eco-friendly / environmentally safe, cost effective, economically viable and ecologically sound. These are playing a significant role in improving nutrient availability to crop plants. Amongst bio-fertilizers, *Azotobacter*, PSB, Rhizobium strains play an important role in harvesting the atmospheric nitrogen through its fixation in the roots. It is given a primary importance in non-symbiotic and associative nitrogen fixation and was recognized to play a unique role in nitrogen economy of many crops. Biofertilizers like PSB, VAM and *Azotobacter* can improve plant survival, vegetative growth, Leaf Area Index, Harvesting Index and tuber yield in potato through effective nitrogen utilization and release of plant growth promoting substance (PGPS) (Lallawmkima *et al.*, 2018). Phosphorus solubilizing bacteria (PSB) is effective in phosphorus mobilization by solubilizing the inorganic phosphates which are largely

Table-1: Important biofertilizers, nutrient sources and benefited crops

Contributing Plant Nutrient	Microorganisms	Crop Benefited
A) Nitrogen	**1) Symbiotic organisms**	
	a) Rhizobium (Symbiosis with Legumes)	Pulse Legumes: Chickpea, Pea, Lentil, Moong, Urad Bean, Pigeon Pea
		Oil Legumes: Groundnut, Soya bean
		Fodder Legume: Be seem, Lucern
	b) *Azolla* (Water Fern) + BGA Symbiosis	Rice
	2) Associative symbiotic organisms	
	a) *Azospirillum*	Sorghum, Perl Millet, Rice, Wheat, Finger Millet, Maize, KodoKutaki, Tomato, Chilli
	3) Non-symbiotic organisms	
	a) *Azatobacter*(Heterotrophs)	Cereals: Wheat, Rice, Maize, Sorghum, Sugarcane
		Vegetables: Onion, Brinjal, Tomato and Cabbage
		Flowers: Chrysanthemum, Marigold
	b) Blue Green Algae (Photoautotrophs)	Rice
B) Phosphorus	1. "P" solubilizers and mineralizers	For All Crops
	a) Fungi - *Aspergillus*, *Penicillium* b) Bacteria - *Bacillus Pseudomonas*	
	2) "P" Absorbers (Root Fungus Symbiosis)	
	a) Vesicular Arbuscular Mycorrhiza (VAM)	
	b) Ectomycorrhiza	
	c) Endomycorrizae	Linseed, Maize, Wheat, Soya bean

unavailable to plants. Bio-fertilizer helped in plant growth, increase plant yield and provide the nitrogen to plant which is structural component for plant body so significantly contributes to plant growth (Khan *et al.* 2009).

Commonbio-fertilizers used in crop production

The common microorganisms which have shown positive increase in crop yield and can possibly be used as bio-fertilizers are given in table-1.

Application of inorganic nutrient sources in Cucurbits

Nutrients are essential for crop growth and they give maximum contribution. Inadequate amount of these nutrients causes certain disorders, which automatically reduce the yield and leads to loss for the growers. In cucurbits, excessive nitrogen and consequently enormous vine growth requires to be avoided. The response of cucumber plants on NPK fertilizers has been described through table 2.

Biofertilizers application for growth in Cucurbits

Growth is an irreversible increase in size, shape of the plant and it is affected by the complex interaction between environmental factors and physiological processes which are influenced by the application of external inputs like water and nutrients. The role of biofertilizers, in promoting various attributes of plant growth has been positively established. A significant number of work has been done by many authors, some of these have been reported here.

Sareedha *et al*. (2006) conducted an experiment in gherkin *(Cucumis sativus* L.) and found that the highest number or leaves, inter nodal length in the treatment with application of pressmud @ 25 t/ha with recommended dose of inorganic fertilizer and humic acid @0.25 per cent, followed by the treatment with application of vermicompost @ 5 t/ha in combination with RD Fhumic acid @ 0.2per cent. Similarly, maximum growth, yield and yield attributes with good quality cucumber has been reported due to incorporation of 2 tons of vermicompost+ 50% recommended dose of fertilizers (50: 30: 30NPK) + bio-fertilizers (5 kg *Azotobacter* and 5 kg phosphorus solubilizing bacteria) per hectare (Bindiya *et al*., 2006) while increased vine length and early flowering has been reported due to application of 50% RDF along with 2t/ha vermicompost and 2kg/ha azospirilum+2kg/ha phosphobacteria (Prabhu *et al*., 2006).

In addition, many authors have reported earliness in flowering, larger fruits, high fruit set, high fruit weight,

Table 2: NPK application in cucurbits and their response

NPK application	Response/ effect	References
Application of nitrogen	Increased vine growth and branching in bitter gourd.	Reddy and Rao (2004)
Increase in dose of phosphorus	The germination of seeds, flowering and harvesting was earlier in bitter gourd.	Bacha *et al*. (2005)
Nitrogen levels	A significant effect on number of days required for initiation of earliness and flowering, number of days required for first fruit set in cucumber cv. Poinsette.	Umamaheswarappa *et al.* (2005)
Phosphorus levels	Positive effect on flower initiation and development in cucumber cv. Poinsette.	Umamaheswarappa *et al.* (2005)
Levels of potassium	No significant effect on flowering, fruit set of cucumber cv. Poinsette.	Umamaheswarappa *et al.* (2005)
Application of nitrogen & phosphorus	Earliness in recorded germination, days of first pistillate flower anther days to first picking, no of nodes to first pistillate flower appearances in spine gourd.	Vishwakarma *et al.* (2007)
Application of inorganic fertilizers	Increased the growth characters, namely, vine growth, branching and leaf area in cucumber.	Eifediyi and Samaon (2010a)
Increase in inorganic fertilizer	Induced earliness in flowering and fruiting in cucumber.	Jilani *et al.* (2009)
Application of NPK as fertigation	Early flowering, fruiting and picking with, maximum number of fruits per plant, more weight, length of fruit and higher yield in cucumber.	Arshad *et al*. (2014)
NPK fertilizer	Significantly affected the vine length, flowering, fruiting and marketable yield in water melon (*Citrulus lanatus*L.).	Oga and Umekwe (2013)
Application of inorganic fertilizers	Increased yield and yield attributing traits, viz. leaf count, vine length, fruit count, primary branch count, length & girth of fruit, average fruit weight and fruit yield of cucumber.	Eifediyi and Samaon (2010b)
Application of nitrogen	Increased the length of vine, branching and per plant fruit yield in bitter gourd.	Reddy and Rao (2004)
Highest level of nitrogen	The maximum core diameter of fruits in cucumber.	Kade *et al*. (2009)

better vine length, branching and yield in Spine gourd (Vishwakarma *et al*., 2007); in Cucumber (Anjanappa *et al*., 2012; Kanaujia and Daniel, 2016) due to application of biofertilizers. Application of 100% RDF in combination with vermicompost and bio-fertilizers (*Azotobacter, Azospirillum* and phosphorus solubilizing bacteria) increased length of vine, number of primary branches per vine whereas number of days of female and male flower appearance and node number to which male and female appear was earliest (Thriveni *et al*., 2015).

Biofertilizers application for yield and related attributes in cucurbits

Yield of cucurbits is function of vine length, earliness with respect to female flowers, number of nodes, internodal length, number of female flowers, fruit set, fruit development, etc. These all attributes depend on nutrient level of soil and plants. A number of authors have worked on improvement of yield in cucurbits through nutrient application. Prabhu *et al*. (2006) reported highest numbers of fruits, fruit size and weight through INM practices comprising organic, inorganic and biofertilizer inputs. Application of biofertilizers along with organic and inorganic inputs under protected conditions resulted highest fruit yield per vine and total fruit yield (quintal) per hectare when 75% RDF + 75% FYM+ Azetobactor + Phosophobacteria + Trichoderma was applied (Anjanappa *et al*., 2012).

Das *et al.* (2015) observed that treatment is equal amount of N+ Organic sources + Azotobacter and PSB gave maximum primary branch count, fruit count, average fruit weight, fruit size in bottle gourd. Ibrahim and El-Kader (2015) in their experiment on bitter gourd revealed that by application of 75 % RDF of NPK along with rice straw, compost, humic acid and effective microorganism increased dry matter content, length of stem, leaf count, fruit count, weight of seed per fruit and seed index.

Bindiya *et al*. (2016) reported maximum growth, yield and yield attributes with good quality cucumber due to incorporation of 2 tons of vermicompost + 50% recommended dose of fertilizers + bio-fertilizers (5 kg

Table 3: Application of biofertilizers and INM practices for high yield in cucurbits

NPK application	Response/ effect	References
Application of 75% mineral nitrogen and 25% organic nitrogen	Increased the growth of plant, yield and quality in cucumber.	Mahmoud *et al*. (2009)
Application of biofertilizers	Increase thefruit count, length of fruit, average fruit weight and fruit yield in cucumber.	Jilani *et al.* (2009)
Application of vermicompost	Fruit weight and yield was maximum in ridge gourd.	Kameswari*et al*. (2010)
Application of FYM or vermicompost	Increased the yield in cucumber.	Narayanamma*et al.* (2010)
Application of biological fertilizers	Increased yield and yield attributing characters of cucumber .	Isfahani and Besharati (2012); Saeed *et al.* (2015)
Cow dung application	Organic manure is best alternative in place of inorganic manure for increasing production of pumpkin.	Uwa (2013)
Vermicompost application	Higher cucumber yield and cucumber fruit weight.	Ghasem*et al*. (2014)
Seed treatment with phosphorus solubility bacteria (PSB)	Higher yield in pumpkin.	Alekar*et al*. (2015)
Poultry manureN: P: K (20:10:10)	Significantly increased the number of leaves, fruit size and count, quality, weight and yield in cucumber.	Okoli and Nweke (2015)
Application of biofertilizers.	Length and diameter of fruit, fruit count, average fruit weight, and yield had significantly increased in cucumber.	Kanaujia and Daniel (2016)
Application of NPK fertilizers along with cow manure	Increases fruit yield, length of fruits, diameter of fruit and branching in bottle gourd.	Prasad *et al*. (2016)
Application of poultry manure @ 20t/ha	Yield of cucumber was higher.	Khan (2017)

Azotobacter and 5 kg phosphate solubilizing bacteria) per hectare. Mohan *et al*. (2016) revealed that 60 per cent each of RDF and vermicompost along with *Azotobacter*, *Trichoderma* and PSB were found to be superior among all the combinations of organic, inorganic and bio-fertilizer sources of nutrients for characters, namely minimum number of days to 50 per cent flowering, average fruit length, fruit weight ,edible fruit count and maximum edible fruit yield per hectare in cucumber cv. Swarna Ageti under polyhouse conditions. Kumar *et al.* (2017) studied the effect of cow-urine and bio-fertilizers at varying levels of drip irrigation on various parameters of cucumber in a naturally ventilated polyhouse during summer season and revealed that combined application of bio-fertilizers and fertilizers has positive effect on yield, growth and quality parameter due to addition of nutrients and saving of at least 50% of water and hence can be exploited as sustainable practices under INM. Dash *et al.* (2018) has also reported the greatest impact on fruit weight in cucumber due to application of INM [half recommended NPK + 10 tons of FYM + 2 tons of Vermicompost + Bio-fertilizer (4.0 kg Azotobacter+ 4.0 kg PSB)] per hectare. Some additional information of work has been cited in table-3.

Biofertilizers application for quality improvement in cucurbits

Biofertilizers and organic matters play critical role in chelation and absorption of micronutrients which contributes to a number of biochemical processes and so synthesis of many vitamins and bioactive substances. These chemicals improve quality of fruits in cucurbits. Further role of biofertilizers against diseases and pests is well established fact which prevents the qualitative deterioration in fruits. Das *et al.* (2015) in their study reported that quality character like Total Soluble Solid (TSS) was increased by application of biofertilizers. Sayed *et al*. (2015) recommended that application of 75% RDF as N and P in comparison to biofertilizers (Nitrobien and phosphorien) significantly increased the Vitamin C content and TSS content of fruit. Kanaujia and Daniel (2016) reported that Vitamin C content & TSS content increased by application of 50% NPK + 5 ton per Vermicompost

and biofertilizers. Mohammed (2017) reported significant interaction between biofertilizer to increase the concentration of plant chlorophyll.

Conclusion

The application of biofertilizers like *Azospirillum* and Phosphobacteria, inorganic fertilizers has significant and vital effect on growth parameters of *cucurbits*. In light of the reviews from different scientist, biofertilizers are effective alternatives as a source of macro and micronutrients and have a potential to improve the growth parameters.

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