

Broccoli : Growth and Yield Effected By Different Biofertilizers and Inorganic Matter – A Review

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ABSTRACT

Sprouting broccoli is most of the important winter vegetables in India which belongs to family Brassicaceae (Cruciferae). It is herbaceous annual vegetable grown for its green tender curd and biennial for seed production. Broccoli is more resembling with cauliflower. United states of America is the largest producer broccoli in the world. Apart from U.S.A the other major producers of the crop are Italy, Northern Europe and cooler regions in their for East. In recent year, cultivation of broccoli has gained momentum in India. It has three types of head colour viz. green white and purple out of which green type is highly nutritious. It cultivated mainly in protected structure and produce best quality of fruits. In sub-tropic region strawberry require 20°-25° temperature maximum in day time. The edible part of broccoli contains 5.7% carbohydrate, 3.6% protein, 0.35% fat 1.4% fiber, 3150 IU vitamin A and 104 mg vitamin C. The curd diameter performance significant result when subjected to different treatment of biofertilizers. Despite these findings it should be possible to automate the processing of broccoli in order to increase the quality of bioactive compounds. The effect of processing on selenium compounds has so far been poorly studied and this subject should therefore be looked into in the future. Lastly, the influence of the operating conditions on the quality of bioactive compounds in broccoli in various drying processes should be studied in greater depth.

Keywords: Broccoli, Biofertilizers, Growth, Yield

INTRODUCTION

Broccoli is an edible green plant in the cabbage family (the Brassicaceae family, the Brassica genus) whose large head and stalk are eaten as vegetables. The word broccoli

originates from the Italian broccolo plural, which means "a cabbage's flowering crest" and is the diminutive form of brocco, which means "small nail" or "sprout."

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Broccoli is named for the species *Brassica oleracea* in the *Italica* cultivar category. Broccoli has huge, typically dark green flower heads arranged in a tree-like structure branching out of a thick stalk that is typically light green. Surrounded by leaves is the mass of flower heads. Broccoli resembles cauliflower, a separate category of cultivars of the same genus *Brassica*.

The first produced leaves are ovate to oblong with lobed petiole. In its first place, plants are 40–60 cm tall and mature stage of vegetation and 1.5–2.0 m tall in the second flowering stage. Most plants have dense, alternating leaves with margins ranging from wavy to wavy, highly lobed to dissect and Plants have fibrous and shallow root systems. Broccoli can be grown in a wide variety of soils type. To get improved yield from broccoli harvest sandy and silt loam soils are most ideal. The soil pH has to be in between 5.5 pH – 6.5 pH. In north India, both mid and late season cultivars of broccoli can be grown by sowing them in September and October and these will be ready for harvesting from late November to early December and may continue till early February (Bose & Som, 1986).

From around the sixth century BC Broccoli cultivated *Brassica* crops in the northern Mediterranean. Broccoli originates in the Roman Empire's primitive cultivars. It is eaten raw or fried. Broccoli is a especially abundant source of vitamin C and K. The contents of its signature sulphur-containing glucosinolates compounds, isothiocyanates and sulforaphane, decrease by boiling, but are well conserved by sweltering, heating. The sprouts lead to broccoli's branching habit and young, edible inflorescences. They are introduced from the eastern Mediterranean into Italy, where broccoli-like vegetables are diversified. Broccoli has many health-promoting effects that attribute to the antioxidant and anti-carcinogenic compounds. Sulforaphane contributes to the anti-inflammatory properties and stimulates phagocytosis to minimize and remove inflammatory insults. Researchers also found

that sulforaphane could be a new therapeutic agent for rheumatoid arthritis because it is a potent anti-inflammatory agent. Broccoli sprout are a rich source of glucosinolate particularly 4-methylsulfinyl butyl glucosinolate (glucoraphanin). The precursor of the chemoprotective isothiocyanate (sulphoraphanin) a compound associated with reducing risk of cancer. It is also a rich source of sulphoraphane, a compound associated with reducing the risk of cancer (Thamburaj & Singh, 2001). Obviously, due to the awareness of its higher nutritive values and influx of tourist in the country, this crop has gained popularity among Indian growers for the last couple of years and its area and production are also increasing day by day. It is mostly cultivated in hilly areas of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir, Nilgiri Hills and Northern plains of India (Chadha, 2001).

In this time mainly in the cities and towns, a huge amount of human excreta is flash out with water, which is called Sewage. The solid portion of Sewage is known as Sludge, which contains 1.5 - 2.0 per cent nitrogen, 1.5 - 2.0 per cent phosphorous and 3.5 - 4.0 per cent potassium (Tiwari, 1995). Vitamin C, Quercetin, and Sulforaphane can be linked to analgesic effects of the Broccoli extract. Integrated management of nutrients is a balanced use of inorganic fertilizers, organic manures, crop residues and biofertilizers in combination to achieve the optimal crop yield and to conserve soil health (Hazra, 2007).

Effect of biofertilizers and Inorganic matter on Broccoli:

In a study Hovadik (1956) conducted an experiment in laboratory as well as field and revealed that inoculation of cabbage seed with *Azotobacter* had a favourable effect on early plant growth, root development and final yield. He further reported that use of *Azotobacter* in sprouting broccoli as a seed inoculant enhanced yield 17 by 14-32 per cent.

Sharma (2000) conducted an experiment at Lari (Spiti valley, Himachal Pradesh, India) on integrated nutrient management influence of broccoli sprouts

cultivar” Green Head” and revealed that integration of organic and inorganic fertilizers significantly increased the head yield over inorganic fertilizers alone and also over control. The treatment 175:75:60 NPK along with 12.5t/ha farmyard manure recorded the maximum yield (63.12q/ha) which was at par with 150:75:60 NPK along with 12.5t/ha farmyard manure (yield 57.59q/ha), but significantly superior over rest of the treatments in terms of yield and net profit.

Kalyani et al. (1992) has been reported study the interaction of Azospirillum and nitrogen-fixers in cauliflower cv. Jawahar Moti and revealed that soil inoculation of Azotobacter improved growth and nutrient uptake and saved up to 50% of the recommended nitrogen.

Sharma et al. (2008) studies on the response of broccoli to INM applying organic manure and Azotobacter alongwith the synthetic fertilizers and concluded that an application of 100%NPK+Azotobacter+20t/ha cow manure resulted in the excessive increase in the contents of organic carbon and available nitrogen, phosphorous and potassium by 36, 32 and 19%, Accordingly, overcome their initial status in the soil. About 31, 8.4 and 12.5 kg/ha of nitrogen, phosphorous and potassium, Cow manure at 20t / ha and Azotobacter in combination with synthetic fertilizers can respectively be saved in broccoli production.

Sharma et al. (2009) conducted an experiment to observed that influence of Biofertilizers alone or in addition with chemical fertilizers in the absorption of cauliflower nutrients and residual fertility of soil and concluded that the highest nitrogen, phosphorous and potassium uptake was recorded with integrated inoculation of Azotobacter and Phosphorous Solubilizing Bacteria. The maximum soil fertility build up was observed in treatment combination of bio-inoculants integrated with recommended dose of nitrogen, phosphorous and potassium , which was to the tune of about 17.10 and 15.00 Kg NPK/ha over the initial soil status.

Mahapatra et al. (2014) conducted two years of work on the management of nutrients

in broccoli at the Regional Research and Technology Transfer Station, Keonjhar, Odisha. The test crop was treated with four manure treatments: i) no manure, ii) FYM @10 t / ha, iii) vermicompost (VC) @ 5 t / ha, iiv) FYM @ 5 t / ha + VC @ 2.5 t / ha; which are super imposed with six treatments, namely: (i) control (ii) bio inoculants (BI) alone (iii) 75% NPK (iv) 100% NPK, (v) 75% NPK + BI (vi) 100% NPK + BI. The highest yield of curd (139.49 q /ha) recorded at 100% NPK + bio inoculants along with FYM @ 5 t/ha and vermicompost (VC) @ 2.5 t/ha. The N uptake mixed between 3.5-98.8 kg/ ha, phosphate 0.4-12.0 kg/ ha and potash 2.0-53.3 kg/ ha. At maximum fertilizer dosage, the highest amount of nutrients was added, and the lowest in absolute control. When the crop was the highest nutrient recovery (58.6 per cent N, 47 per cent P, and 17.6 per cent K) applied with VC alone or 50% each of FYM and VC.

Thriault et al. (2009) revealed that red clover (*Trifolium pratense* L.) and alfalfa (*Medicago sativa* L.) as persistent living mulches and green manures for the fertilization of broccoli. Living mulches have the probable to provide N but should be more frequently to reduce the main crop competition.

Though a good work has been done on broccoli for yield, plant production, nutrient uptake, and as compared to manure (control) and mineral fertilizer application under field conditions in 2009 and 2010 with inoculations of *Bacillus cereus* (Nitrogen fixing), *Brevibacillus reuszeri* (Phosphate solubilizing), and *Rhizobium rubi* (both Nitrogen fixing and Phosphate solubilizing) on root (Yildirim et al., 2009). Bacterial manure inoculations compared to control dramatically improved yield, plant weight, head diameter, chlorophyll content, nitrogen content (N), potassium content (K), calcium content (Ca), phosphorus (P), magnesium content (Mg), iron content (Fe), manganese content (Mn), zinc content (Zn), and broccoli content copper content. Manure with *Rhizobium rubi* (RR), *Bacillus cereus* (BC), and Inoculations of *Brevibacillus reuszeri* (BR) increased yield by

17.0 percent, 20.2 percent, and 24.3 percent, respectively, and chlorophyll content by 14.7 percent, 14.0 percent, and 13.7 percent. Bacterial inoculations with manure substantially increased the uptake of broccoli macronutrients and micronutrients. In conclusion, seedling inoculation with BR and especially RR can partly replace expensive synthetic fertilizers in broccoli.

Chaterjee et al. (2005) studied the effect of organic nutrition in sprouting broccoli *var.* Green Country. They tried different treatments of biofertilizers *viz.*, Azotobacter, Phosphate Solubilizers, Potashmobilizers and Vesicular-Arbuscular- Mycorrhizae. The study revealed that the Organic nutritional sources produced significantly better quality of curd parameters than inorganic sources. Among all the treatment combinations, the treatment mustard oil cake + biofertilizer II (Azotobacter + Vesicular – Arbuscular - Mycorrhizae + Potashmobilizer) produced curds having significantly highest chlorophyll (32.80mg/100gm edible portion), ascorbic acid (80.30mg/100gm edible portion) and reducing sugar (2.20%).

CONCLUSION

From the investigation with biofertilizers and Inorganic matter on Broccoli it can safely be concluded that significantly increase the growth and nutrient uptake, enhanced seed yield, better quality of curd, highest chlorophyll, early plant growth, root development and positively increase net profit.

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