Journal of Scientific Research and Reports

Volume 30, Issue 5, Page 556-563, 2024; Article no.JSRR.115121
ISSN: 2320-0227

A Review on Effect of Bio-fertilizers and Chemical Fertilizers on Growth, Yield and Quality of Dioecious Cucurbits

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Authors' contributions

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

Article Information

DOI: 10.9734/JSRR/2024/v30i51971

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/115121

Review Article

Received: 20/01/2024
Accepted: 26/03/2024
Published: 29/03/2024

ABSTRACT

No vegetable group in India is as diverse as the cucurbits. They are adapted to diverse soil and climate condition and contribute significantly to total vegetable production. Dioecious cucurbits cultivation merge with trellising, staking, mulching, application of biofertilizers and growth regulators hold immense potential and promise for future vegetable production and market in our country. Biofertilizer can be defined as a substance which contains living organisms which, when applied to

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seed, plant surface, or soil, colonize the rhizosphere or interior of the plant, and promote growth by increasing the supply or availability of primary nutrients to the host plant. Biofertilizers are an chief component of integrated nutrient management system for sustainable agriculture and along with chemical fertilizers. Studies suggest that cultivation of dioecious cucurbits along with chemical and organic fertilizers gives immense result on account of yield and productivity. Our country possesses a rich diversity like spine gourd, ivy gourd, bitter gourd, sweet gourd, pointed gourd and has ideal climate and soil to cultivate these cucurbits. Mostly these miner cucurbits are largely grown or wild gathered and sold in the market by small and marginal farmers. Hence promotion of these cucurbits holds key to ensuring livelihood security and income generation for to the tribal's, marginal and small farmers in remote rural regions. Dioecious cucurbits mainly possess different important chemical compounds which can be used in nutraceuticals industries. These cucurbits has the potential to act as a source of income generation for rural farmers as they have immense market potential. These cucurbits need strong research support for better production and utilization.

Keywords: Biofertilizer; chemical fertilizer; dioecious cucurbits; pointed gourd; spine gourd; ivy gourd.

1. INTRODUCTION

Dioecious cucurbits, belongs to the biggest vegetable family i.e., Cucurbitaceae. These are having tremendous medicinal and food value so gaining popularity day by day in our country. To have higher production of dioecious cucurbits the expensive commercial inorganic fertilizers are recommended but use of excess of these inorganic fertilizers is harmful for both soil and environment. So, to get higher productivity and to maintain the soil health and environment balance judicious use of chemical fertilizers is need of the hour. Exhaustive use of only chemical fertilizers to bring off higher production has created many problems. Therefore bio-fertilizers now-a-days are one of the promising components of nutrient supply approach. Bio fertilizers along with inorganic fertilizers is a constitutive part of integrated nutrient management strategy and plays a significant role in plant nutrition. Biofertilizers are also environment friendly and it is a very low-cost input. The application of biofertilizers has a significant influence in sustainable agriculture. Hence the present information regarding the importance of biofertilizers along with inorganic fertilizers for production and productivity of dioecious cucurbits is reviewed here.

2. POINTED GOURD

Pointed gourd (*Trichosanthes dioica*) is a perennial cucurbitaceous vegetable crop cultivated in many parts of India. Popularly known as King of Gourds. Pointed gourd is plentily available during the lean period. Fruits can be harvested during the entire season of summer and rainy months. The fruits mature 80-90 days after planting. The harvesting must be done once in 3-4 days when the fruits are in immature and green stage before the seeds become hard. Pointed gourd has a slightly longer shelf life than ivy gourd and is mainly used as a vegetable in both rural and urban areas. Mainly propagated by vegetative means i.e., Stem cuttings. Seeds are generally not used for commercial propagation due to poor germination percentage and unpredictable sex expression. Fruits of pointed gourd are rich in proteins, vitamins and possess medicinal properties that can be able to lower blood sugar and serum triglycerides. They are available in the market for a longer period, the high nutritional, and medicinal properties of pointed gourd fruits make them the king of vegetable. Studies reported that Pointed gourd responds well to chemical fertilizers and biofertilizers. The studies by different researchers are listed below;

Das et al., [1] studied "N at 0, 30, 60 or 90 kg ha-1, P_2O_5 at 0, 20, 40 or 60 kg ha-1 and basal K_2O at 40 kg ha-1 and reported that plant growth and yield of pointed gourd increased with rising N: P rates, with the maximum average early yield and total yield being obtained at 90:60 kg per ha".

Kumar et al., [2] investigated "N at 0, 30, 60 or 90 kg per ha and P_2O_5 at 0, 20, 40 or 60 kg per ha. Half of N and entire P plus K_2O at 40 kg per ha were applied at planting and the remaining N was applied 60 days later and reported that the number of fruits per plant in case of pointed gourd crop increased from 111.3 at zero N to 167.16 at 60 kg N per ha and declined to 165.44 at the highest N rate. With P, the number of fruits per plant increased from 130.82 at zero P to 150.8 at the highest P rate".

Misra et al., [3] reported that "the application of 150 kg N ha-1, 35 kg P ha-1 and 67 kg K ha-1

gave the highest fruit yield and fruit quality in the Pointed gourd".

Tripathy et al., (1994) reported that "30:30:30 NPK kg ha-1 was best for higher fruit yield in pointed gourd. Fruit yield was highly and positively correlated with plant height, leaf area, fruit plant-1 and fruit weight".

Das et al., [4] investigated "the influence of nitrogen and phosphorus fertilization on growth and yield of pointed gourd and observed that plant growth and yield increased with rising N:P rates and with the maximum average early yield and total yield at 90:60 kg ha-1".

Singh et al., [5] studied the Integrated nutrient management for sustainable production of pointed gourd (*Trichosanthes dioica* Roxb.) cv.Rajendra Parwal 2 under Ganga diara of Bihar to determine the best combination of organic and inorganic nutrients. Treatments comprised: 50, 75 or 100% of the recommended NPK rate (80:60:40 kg NPK/ha) alone or in combination with 25 or 50% farmyard manure (FYM); and fertilizers applied total as basal or in three splits as basal, 30 and 60 days after planting. Fruit yield and other yield characters (i.e., mean number of fruits per plant and fruit diameter) were higher when the fertilizers were applied in three splits. The substitution of 25% nitrogen through FYM and 7% of the recommended NPK rate resulted in significantly higher fruit yield during the individual years and on a pooled data basis. This gain was consequently reflected in other characters (i.e., higher fruits per plant, fruit length, fruit diameter and fruit weight) on a pooled data basis. The same treatment also recorded higher benefit: cost ratio during the individual years and on a pooled data basis.

Saravaiya et al., [6] studied "to ascertain the best blend of organic and inorganic nutrients for sustainable production of pointed gourd under South Gujarat conditions by utilizing the cultivar "LOCAL" and it may be concluded that to get higher fruit yield of pointed gourd under Integrated Nutrient Management system the vine should be fertilized with the combination of 50 per cent recommended dose fertilizers (60:30:30 NPK kg/ha) along with 10 tons of bio-compost/ha".

Nayak et al., [7] studied "the effect of integrated nutrient management on productivity and profitability of pointed gourd and reported that application of 100 per cent recommended dose of fertilizer (RDF) i.e., 90:60:60 kg of Nitrogen, phosphorous and potash per ha in combination with biofertilizer, lime and organic manure to pointed gourd crop increased the vegetative growth characters like; length of vine, vine girth and number of branches per plant as well as yield attributes such as length of fruit, girth of fruit and single fruit weight. Combined application of inorganics with soil amelioration and organic addition enhanced the fruit yield and quality attributes (moisture content of fruit, total soluble solid, ascorbic acid, total sugar). A net profit of 241349 per hectare from the crop over an investment of 85961 with a benefit cost ratio of 2.80: 1 was obtained with combined application of lime, 100 per cent recommended dose of fertilizers along with biofertilizers and vermicompost. Thus, it can be concluded from the experiment that recommended dose of chemical fertilizer which was applied to pointed gourd crop in conjunction with biofertilizer and vermicompost in presence of lime, improved the quality of the produce i.e. (fruits) without hampering the yield potential of the crop".

Siva et al., [8] reported that "150:60:60 NPK kg per ha + 1.5m x 1m spacing recorded maximum growth, yield and quality parameters viz., number of nodes per vine, number of primary branches per vine, number of fruits per vine, fruit length, fruit diameter, yield per vine, yield per plot, total yield, number of seeds per fruit, fruit retention percentage, ascorbic acid content, protein content and total soluble solids and the minimum values were recorded for the parameters node at which first male flower appeared, node at which first female flower appeared, days taken to first harvest and days taken from fruit set to marketable maturity. However, the application 175:70:70 NPK Kg per ha + 1.5m x 1.5m spacing recorded maximum main vine length and internodal length whereas 125:50:50 NPK Kg per ha + 1.5m x 1m spacing recorded minimum days taken for opening of first male flower and days taken for opening of first female flower. The application of 150:60:60 NPK kg per ha + 1.5m x 1.5m spacing recorded maximum weight of edible fruit, 100 seed weight, reducing sugars and total sugars in pointed gourd".

Makireddi [9] studied "the effect of NPK levels and spacing on growth & yield of pointed gourd and reported that among the various N, P, K level studied, the maximum value for main vine length and internodal length was recorded with 175:70:70 NPK Kg per ha, consequently the minimum were recorded for floral parameters

like, days taken for opening of first male flower and days taken for opening of first female flower with 125:50:50NPK Kg per ha. The application of 150:60:60 NPK Kg per ha recorded the maximum values for the parameters number of nodes per vine, number of primary branches per vine, number of fruits per vine, fruit length, fruit diameter, yield per vine, yield per plot, total yield, number of seeds per fruit, fruit retention percentage, 100 seed weight, ascorbic acid content, protein content, reducing sugars, total sugars and total soluble solids and recorded minimum values for node at which first male flower appeared, node at which first female flower appeared , days taken to first harvest and days taken from fruit set to marketable maturity".

Sushree Choudhury and Debasis Sarangi [10] studied "the effect of NPK fertilizers and plant densities on growth and yield of pointed gourd (*Trichosanthes dioica* Roxb.) and the results showed that different levels of fertiliser and plant densities significantly influenced growth and yield of pointed gourd. The results of present investigation indicated that application of 100 per cent recommended dose of nitrogen, phosphorous, pottasium and medium plant density have given highest yield of pointed gourd. 125% recommended dose of fertilizer + low plant density (1.5m x 1.5m) spacing recorded maximum main vine length and number of branches per plant, however 100% recommended dose of fertilizer + medium plant density (1.5m x 1.0m) spacing recorded highest number of nodes per vine, weight of edible fruit and total fruit yield per hectare".

M. K. Adhikary, K. Kar and M. M. Ud-Deen [11] studied "the effect of fertilizer and irrigation on the yield and yield contributing characters of pointed gourd var. "BARI Patal-1". Different treatments showed significant performances, where the observations revealed that the combination of highest levels of fertilizers (application of Urea and MP both @ 35 g/pit) and irrigation (4 times) confirmed the minimum days to first flower initiation and first harvest. The above combination also ensured the best performances of pointed gourd in respect of nodes per plant, vine length, fruit length and breadth, individual fruit weight, no. of fruits per plant, no. of seeds per fruit, weight of fruits as well as fruit yield. Always control treatment showed the worst performance. Finally, the findings concluded that the yield of pointed gourd increases in an increased rate of fertilizer and irrigation up to a certain level".

Kamal Kant et al., [12] studied "the role of organic manures with biofertilizer on growth and yield of pointed gourd (*Trichosanthes dioica* Roxb.) and reported that the highest average green fruit yield was obtained from treatment combination of poultry manure (2 tonnes/ha) + Azospirillum with maximum net return per hectare with higher benefit – cost ratio of 4.08".

Nayak et al., [13] studied "the effect of fertigation and mulching on growth, yield and yield attributing characteristics of pointed gourd (*Trichosanthes dioica* Roxb.) cv. Swarna Alaukik and the results showed that the highest values for the growth components such as vine length, no. of leaves per plant, leaf area and yield and yield contributing characters such as no. of female flowers, no. of fruits per plant and fruit yield were recorded with the application of 100 percent N, P and K (Recommended Dose of Fertilizer) through fertigation and mulching which remained at par with treatment where 80 percent N, P and K is applied through fertigation and mulching. Thus, 80% fertigation with mulch was the most effective treatment with 20% fertiliser saving and 55.3% increase in yield compared to the control. The highest yield of these treatments were the sum total effect of different growth and yield attributing characters particularly vine length, no. of leaves per plant, leaf area, no. of female flowers, no. of fruits per plant etc. The fruit yield increased significantly due to maximum utilization of N, P and K that resulted in maximum vegetative growth, reflecting in turn better foliage production, increase in the vine length, yield contributing characters, and finally yield".

3. IVY GOURD

Ivy gourd (*Coccinia grandis*, L. or *Coccinia indica*) has been found from Africa to Asia extensively cultivated in India and is known by different names. Ivy gourd plant was used in Indian traditional medicines as a household remedy for various diseases, including biliary disorders, anorexia, cough, diabetic wounds, and liver disorders. The fruits come to first harvest in about 70 days after planting. Fruits should be harvested when they are tender before the seeds mature. It has very low glycaemic index so mostly preferred by diabetic patients. Preferably ivy gourd is widely cultivated in rural areas by small and marginal farmers. Application of chemical fertilizer and biofertilizers is very much beneficial for the crop in terms of growth and yield. Here are some findings;

Tolentino, Martin F [14] studied “the effects of humus of earthworm on ivy gourd growth and the results indicated that the fruit yield was highest at 15 days with 3612.39 kg/ha of humus and no chemical fertilizers, however, the total production of Ivy gourd fruit was no significantly different among the treatments. The fruit diameter was increased by the application of 237.91 kg/ha chemical fertilizer and 1805.55 kg/ha of humus of earthworm. So it can be suggested that the humus of earthworm may be used as substitute for the chemical fertilizer in ivy gourd production”.

Patel et al., [15] reported that combined application of Bio-compost along with 50% recommended dose of fertilizer was observed to be the best treatment when compared to other treatments for better yield and growth of little gourd.

Patel et al., [16] reported that “application of 50% RDF + Bio-compost had a beneficial effect on growth parameters like minimum days to flowering and fruit harvest, maximum dry biomass of shoot and dry biomass of root with near to neutral fruit pH. Maximum length of fruit, diameter of fruit, weight of fruit, maximum fruit yield per plant, highest fruit yield, maximum leaf nutrient content and soil nutrient status were also noted in 50% recommended dose of fertilizer + Bio-compost as compared to other treatment in ivy gourd”.

4. SPINE GOURD

Spine gourd (*Momordica dioica*) is one of the most important vegetables which belongs to cucurbitaceous family. Spine gourd a perennial climber, dioecious in nature having tuberous roots. It is widely found in tropical and sub-tropical regions of Indian subcontinent. Spine gourd found in all over the world. It is mainly identified for its medicinal as well as vegetable uses. In India Spine gourd is mainly considered as a wild vegetable. Immature, tender, small, spiny green fruits are used as vegetables. The fruits contain high amounts of protein, calcium, phosphorous, iron, and maximum amount of carotene amongst the cucurbitaceous vegetable crops. Spine gourd is popular in different pockets across the country due to its easy availability nutritional and medicinal values. It is consisting of anti-cancer, anti-inflammatory, anti-ulcer, anti-hyperglycaemic, anti-diabetic, and anti-microbial properties. High nutrient content, nutraceutical nature and other medicinal uses makes it to be a potential crop. The fruits have a higher demand in the market because of nutritional, therapeutic value, long shelf-life, suitable for long-distance transportation making it good for export purposes.Owing to its nutritional and medicinal value, high keeping quality, ability to withstand long distance transportation and high market price,spine gourd has huge potential to become major vegetable commodity which can increase the farmer’s income considerably. Some resource-poor farmers can enhance their income to many folds by adopting the largescale cultivation of spine gourd. The farmers need to be trained about the scientific method of cultivation of spine gourd by adopting improved cultural practices. Spine gourd can be able to play a vital role towards food security and income generation in a sustainable way. It can be able to supplement daily requirements of micronutrients. Spine gourd plays a momentous role in malnutrition alleviation and dietary supplementation. Now-a-days, it is a popular vegetable among consumers which may lead to cultivation expansion and may result in higher profits to the farmers. This vegetable has key demand in localized markets and the price also remains high throughout the year. The usage is limited as vegetable though it has several activities. Many activities are done by researchers using fruits. Still, more activities can be performed. This article can serve as reference to researches who are about to work on this wonder plant.

Rajesh Kumar et al. [2] reported that the plants received nitrogen at 0, 30, 60 or 90 kg per ha and phosphorous at 0, 20, 40 or 60 kg per ha. Half of nitrogen and all phosphorous plus potash at 40 kg per ha were applied at planting, and the remaining nitrogen was applied 60 days later. The number of fruits/plants increased from 111.3 at zero N to 167.16 at 60 kg nitrogen per ha and declined to 165.44 at the highest nitrogen rate.

Das et al. [1] reported that in 2-season trials plants of the cultivar SL-2 of pointed gourd received nitrogen at 0, 30, 60 or 90 kg per ha, phosphorous at 0, 20, 40 or 60 kg per ha and basal potash at 40 kg per ha.The crop was harvested 150 days later.

Tripathy et al. [17] studied the effect of cutting, node number and fertilizer on spine gourd (*Momordica dioica*) and reported that the terminal cuttings produced more nodes/plant and leaves/plant, and greater leaf area and internode length than basal cuttings. Two-node cuttings

produced taller plants with a larger leaf area than 3-node cuttings. Nitrogen, phosphorous and potash each at 90 kg per ha resulted in maximum number of nodes per plant and leaves per plant. Plant height and leaf area were highest with nitrogen, phosphorous and potash each at 60 kg per ha, while maximum yield per plant and largest fruits were obtained with each at 30 kg per ha.

Goswami and Sharma [18] reported that "increased fruit yield in spine gourd with increased levels of phosphorous up to 60 Kg per ha and potash up to 75 kg per ha and no significant interaction was observed between phosphorous and potash. Also, revealed that neither phosphorous nor potash had a significant effect on the length of the main vine and potash had no effect on ascorbic acid content but ascorbic acid content was highest when phosphorous was applied at 40 kg phosphorous per ha".

Vishwakarma et al*.,* [19] "with the 80 kg nitrogen per ha as well as 60 kg phosphorous per ha recorded minimum number of days taken for germination, first female flower appearance and earliest harvest. Highest mean values for number of nodes to first female flower, number of fruits per plant, fruit length, fruit diameter, average fresh weight, yield per plant, vine length, estimation of chlorophyll and total soluble solids also obtained in this treatment. Treatment combination of 80 kg nitrogen per ha + 60 kg phosphorous per ha emerged as superior over all other treatment combinations in relation to growth, yield attributing characters, yield, and quality for cultivation of spine gourd".

Dwivedi and Ashok Kumar [20] studied "the Interactive Effects of N and P Fertilizers on the Growth and Yield of Kheksa [*Momordica dioica* Roxb. ex Willd.] Under Agro-Climatic Condition of Zone V Prevailing in Giridih District of Jharkhand and the result showed that cultivation of spine gourd vines having single lobed leaves planted under fertilizer application of N @ 400 Kg per ha and potash @ 150 kg per ha will be remunerative and beneficial for farmers of Giridih district and adjoining areas of agro-climatic condition of Zone V of Jharkhand".

5. CONCLUSION

Cucurbits are important vegetable crops belongs to family Cucubitaceae.The fruits are mainly used as vegetables in the Indian cuisine. Cucurbits are grown in summer as well as rainy season in northern and eastern parts, while throughout the year in southern parts of India. In India, cucurbits are cultivated in several commercial cropping systems and grown as kitchen garden crops. Cucurbits have been ranked as excellent and good on world's healthiest food ranking scale and have an outstanding health benefit. Owing to their high water and lower caloric content, they provide more nutrients per calorie. By adopting modern production technologies like improved varieties or hybrids, staking, Integrated Nutrient Management, Integrated Pest Management, proper training to the farmers and better marketing facilities, can be able to improve the production and utilization of indigenous cucurbits significantly. Cucurbits are valuable source of nutrients such as carbohydrates, proteins, vitamin A and C, calcium, lycopene, phosphorus and potassium, cucurbits also possess ethno-medicinal uses and are very easy to digest. The dioecious cucurbits also have immense export potentials. However, finally we may conclude that if the farmers should follow suitable cultivation practices for dioecious cucurbits cultivation and they should be motivated to use organic fertilizers along with inorganic fertilizers for cultivation of these dioecious cucurbits which rarely happens can be able to increase the yield to manifolds. Thus, generating lucrative return to the growers.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/115121