Original Research Article

Studies on various levels of organic sources and major nutrients on growth and yield of sprouting broccoli (*Brassica oleracea var.italica Plenck*)

ABSTRACT

A field experiment was carried out at the Vegetable Research Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) during Rabi season 2021-22. The experiment consists of twenty-four treatment combinations of six sources of organic manure and four levels of major nutrients. The experiment was laid out in Factorial Randomized Block Design with replicated three times. Palam samridhi variety of broccoli was transplanted at spacing of 45x45 cm. Results of the experiment revealed that the growth characters of broccoli like plant height (cm), number of leaves plant^{-1}, plant spread, stem diameter and Yield attributes viz total head yield per plot(kg) and total head yield (q/ha) were significantly higher under M_6 (FYM 20t + Vermicompost 5 t + Poultry manure 5 t ha^{-1}) source of manure which was at par application of M_4 (Vermicompost 5 t ha^{-1}) whereas in case of major nutrients it was significantly higher under application of (140:80:80 kg NPK ha^{-1}) but it was at par with (120:60:60 kg NPK ha^{-1}) and significantly superior to rest sources of organic manure.

Keywords: Sprouting Broccoli, Nutrients, growth attributes, yield

Introduction

In India, broccoli farming is a boon for the rural economy. It is a cool season crop and can be grown in spring season. It is rich source of nutrition such as iron, calcium and vitamins. The crop contains 3.3% of protin content and high content of vitamin A and C. (Anonymous, 2022). Broccoli (*Brassica oleracea* var. *italica* L.) is a popular vegetable which belongs to the family Cruciferae. Broccoli is derived from the Latin word *brachium* and the Italian term broccoli, both of which imply "arm" or "branch." It is often divided into three groups: white, purple, and green, with the green form being the most nutritious. Morphologically, it is similar to cauliflower, with the exception of secondary heads that form in the leaf axils. Humans eat the terminal head as well as the sprouts with bud clusters. These heads are green, purple, and white in colour, and their wild form can be found throughout the Mediterranean region. It's eaten raw, half-boiled, in soup with other vegetables' juices, and cooked as a single or mixed vegetable with potato. In India, specific data on sprouting broccoli for area and production are unavailable. It is mostly grown in Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir, Nilgiri Hills, and the Northern Plains of India. It is becoming increasingly popular in India. Appropriate fertilization may ensure lucrative and high-quality crops, as well as the use of the right amount and combination of fertilizers to boost agricultural output. Despite its relevance, broccoli nutrition management has received little attention in our country. The purpose of this investigates / Research is to design growth and yield regimens for a broccoli production utilizing both organic and major nutrients.

Materials and methods

An experiment was conducted at Vegetable Research Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) during *Rabi* season 2021-22. The experiment was laid out in Factorial Randomized Block Design with 3 replications. The soil was sandy loam with organic carbon 0.34%, available N 152.0kg/ha, phosphorus 14.76 kg/ha and potassium 180.0 kg /ha at initiation of experiment. The broccoli variety Palam samridhi was used in the experiment, which is an early -maturity variety and takes around 70 days from transplanting to first harvesting. Twenty-four treatment combinations of six sources of organic manure and four levels of major nutrients. Organic sources *i.e.* M_1: Farm Yard Manure (20 t/ha), M_2:Vermicompost (5 t/ha), M_3: Poultry Manure (5 t/ha), M_4: Farm Yard Manure + Vermicompost (20 t/ha + 5 t/ha), M_5: Farm Yard Manure + Poultry

Manure (20 t /ha + 5 t/ha), M_6: Farm Yard Manure + Vermicompost + Poultry Manure (20 t/ha + 5 t/ha + 5 t/ha) and major nutrientsi.e. F_0: Control, F_1: 80 N + 40 P_2O_5 + 40 K_2O, F_2: 120 N + 60 P_2O_5 + 60 K_2O, F_3:140 N + 80 P_2O_5 + 80 K_2O. The crop was transplanted in plots size of 1.8m X 1.8m with a spacing of 45cm between rows and 45cm between plants. Organic manures were applied at the time of field preparation as per treatment. All remaining other recommended cultural practices were followed to raise healthy crop.

Results and Discussion:

Growth and yield attributes

Data recorded on growth and yield attributes viz; plant height, plant spread, stem diameter, number of leaves per plant as influenced by different levels of organic sources and major nutrients clearly indicated that increase significantly by the application of organic sources of FYM 20 t/ha + Vermi-compost 5t/ha + 5t/ha Poultry manure and 140:80:80 kg NPK/ha as compared to other doses of application. Maximum number of leaves i.e. 14.15 per plant was noted treatment M_6 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1}) which was on par with treatment M_4 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1}) and significantly superior to rest organic sources. The among organic sources M_6 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1}) being atpar with M_4 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1}) produced significantly taller plant than rest of organic sources. Minimum height was noted under M_1 (FYM 20 tha^{-1}) treatment. Maximum stem diameter i.e. 5.13 cm was noted treatment M_6 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1}) which was on par with treatment M_4 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1}) and significantly superior to rest organic sources. Least diameter of stem was associated with M_1 (FYM @ 20t ha^{-1}). Lowest diameter of stem was associated with M_1 (FYM 20 tha^{-1}). The highest plant spread of 61.20cm was obtained with M_6 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1}) which was at par with treatment M_4 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1}) and significantly superior to other organic sources. However, the plant spread was recorded with M_1 FYM (20 tha^{-1}) which was 54.78 cm. The maximum spread was obtained of 60.27 cm with F_3 (140+80+80 kg NPK ha^{-1}) which was at par with F_2 (120+60+60 kg NPK ha^{-1}) and significantly superior to over rest treatments. However, the lowest plant spread of 54.37 cm was recorded with F_0 (0+0+0 kg NPK ha^{-1}) nutrient level. The role of appropriate combination of organic sources *viz.*, FYM 210t/ha + Vermi compost 5t/ha + Poultry manure 5t/ha + Poultry manure 5t/ha and 140 kg + 80 kg

NPK/ha on increase of plant height, plant spread and stem diameter have been confirmed by Renand *et al.*, 2014, Mehdi *et al.*, 2018, Burhan and Al-Taey 2018 and Hamza and Al-Taey 2020.

Table-1: **Effect of organic sources and major nutrients on plant growth parameters**

Treatments	**Numberof leaf Plant^{-1}**	**Plantheight (cm)**	**Diameterof stem(cm)**	**Plant spread**
Organic sources				
M_1 FYM (20 tha^{-1})	12.30	48.93	4.43	54.23
M_2 Vermicompost (5 t ha^{-1})	13.10	52.38	4.73	57.78
M_3 Poultry manure(5 t ha^{-1})	12.50	49.70	4.45	54.78
M_4 (FYM 20 t ha^{-} +Vermicompost 5 t ha^{-1})	13.90	55.53	5.03	60.43
M_5 (FYM 20 t ha^{-} + Poultry manure 5t ha^{-1})	13.40	53.48	4.83	59.23
M_6 (FYM 20 t ha^{-} + Vermicompost 5 t ha^{-1} + Poultrymanure 5 t ha^{-1})	14.15	56.68	5.13	61.20
SEm(±)	**0.26**	**1.13**	**0.09**	**1.18**
CD (P=0.05)	**0.74**	**3.23**	**0.27**	**3.36**
Major nutrients				
F_0 (0+0+0 kg NPK ha^{-1}) Control	12.32	49.25	4.45	54.37
F_1 (80+40+40 kg NPK ha^{-1})	12.90	51.38	4.63	57.55
F_2 (120+60+60 kg NPK ha^{-1})	13.75	54.97	4.93	59.57
F_3 (140+80+80 kg NPK ha^{-1})	13.93	55.52	5.03	60.27
SEm(±)	**0.21**	**0.92**	**0.08**	**0.96**
CD (P=0.05)	**0.61**	**2.63**	**0.22**	**2.74**

Marketable head yield:

The data assembled on total marketable head yield kg plot^{-1} of broccoli was recorded. The sources was noted on marketable head yield kg plot^{-1} of broccoli and maximum marketable head yield kg plot^{-1} of broccoli i.e. 6.46 kg was obtained with M_6 (FYM 20 t ha^{-} + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1}) which was at par with treatment M_4 (FYM 20 t ha^{-} + Vermicompost 5 t ha^{-1}) which recoded 6.33 kg plant weight and these were significantly superior to other organic sources. However, minimum marketable head yield kg plot^{-1} was recorded with M_1 FYM (20 tha^{-1}) which was 5.80 kg. Application of different doses of major nutrient showed significant effect on the marketable head yield kg plot^{-1} of broccoli. Maximum marketable head yield kg plot^{-1} of 6.40 kg was obtained with F_3 (140+80+80 kg NPK ha^{-1}) which was at par with F_2 (120+60+60 kg NPK ha^{-1}) and significantly superior to over rest treatments. However, the lowest marketable head yield kg plot^{-1} of 5.78 kg was recorded with F_0 (0+0+0 kg NPK ha^{-1}) nutrient level. Marked influence of organic sources was noted on marketable head yield of broccoli and

maximum marketable head yield of broccoli i.e. 199.36 q ha^{-1} g was obtained with M_6 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1}) which was on par with treatment M_4 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1}) which recoded 195.51 q yield and these were significantly superior to other organic sources. However, minimum marketable head yield was recorded with M_1 FYM (20 tha^{-1}) which was 178.89 q ha^{-1}. Application of different doses of major nutrient showed significant effect on the marketable yield of broccoli. Maximum marketable yield of 197.38qha^{-1} was obtained with F_3 (140+80+80 kg NPK ha^{-1}) which was at par with F_2 (120+60+60 kg NPK ha^{-1}) and significantly superior to over rest treatments. However, the lowest marketable yield of 177.54 q ha^{-1} was recorded with F_0 (0+0+0 kg NPK ha^{-1}) nutrient level. The production of significantly higher level of marketable head yield has been achieved by the cumulative combination of average head weight size of head and head compactness. The significant effect of higher level of application of FYM 210t/ha + Vermi compost 5t/ha + Poultry manure 5t/ha + Poultry manure 5t/ha and 140 kg + 80 kg NPK/ha in achieving higher level of marketable head yield (190q/ha) which might be obtained due to higher yield attributing characters *viz.,* average head weight, head size and head compactness. Similar observations were also recorded by Biswas *et al.,* 2021, Singh *et al.,* 2021 and Tarafder *et al.,* 2022.

Table-2: **Effect of organic sources and major nutrients on yield attributes of Broccoli.**

Treatments	**Marketable head yield (kg $plot^{-1}$)**	**Marketable head yield (q ha^{-1})**
Organic sources		
M_1 FYM (20 tha^{-1})	5.80	178.89
M_2 Vermicompost (5 t ha^{-1})	6.21	191.69
M_3 Poultry manure(5 t ha^{-1})	5.91	182.54
M_4 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1})	6.33	195.51
M_5 (FYM 20 t ha$^-$ + Poultry manure 5 t ha^{-1})	6.03	186.19
M_6 (FYM 20 t ha$^-$ + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1})	6.46	199.36
SEm(+)	**0.12**	**3.71**
CD (P=0.05)	**0.34**	**10.57**
Major nutrients		
F_0 (0+0+0 kg NPK ha^{-1}) Control	5.78	177.54
F_1 (80+40+40 kg NPK ha^{-1})	6.01	185.42
F_2 (120+60+60 kg NPK ha^{-1})	6.21	191.77
F_3 (140+80+80 kg NPK ha^{-1})	6.40	197.38
SEm(+)	**0.10**	**3.03**
CD (P=0.05)	**0.28**	**8.63**

Conclusion

On the basis of results obtained from the present investigation, it can be concluded that among organic sources, M_6 (FYM 20 t ha^{-} + Vermicompost 5 t ha^{-1} + Poultry manure 5 t ha^{-1}) and a dose of F_3 (140+80+80 kg NPK ha^{-1}) major nutrients proved to be the most suitable for commercial cultivation under Kanpur conditions.

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