Biological Forum – An International Journal **16(6): 68-71(2024)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Response of Broccoli (*Brassica oleracea* L. Var. *italica*) to different Fertigation Levels and Microbial Consortia under Drip Irrigation and Plastic Mulch

Saste D.N., Danawale N.J.*, Mane M.S., Khedkar D.D., Kale K.D. and Jamdade S.S.
Inter-Faculty Department of Irrigation Water Management,
Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra), India.

(Corresponding author: Danawale N.J.)*
(Received: 03 April 2024; Revised: 22 April 2024; Accepted: 15 May 2024; Published: 15 June 2024)
(Published by Research Trend)

ABSTRACT: The present investigation entitled "Response of broccoli (*Brassica oleracea* L.var. *italica)* to different fertigation levels and microbial consortia under drip irrigation and plastic mulch" was conducted on the farm of Interfaculty Department of Irrigation Water Management, Post Graduate Institute, MPKV, Rahuri, Dist. Ahmednagar (Maharashtra) with a view to study the growth and yield potential of broccoli during *rabi* season, 2022-23. The present investigation was laid out in split plot design with three replications.The three main plot treatments comprised of three fertigation levels *viz.*, F_1: 50% RDF, F_2: 75% RDF and F_3:100% RDF whereas subplot treatments comprised of five microbial consortium *viz.*, C_0: Control, C_1: MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*), C_2 : VNMKV Biomix, C_3 : Arka microbial consortium, C_4 : IFFCO NPK Liquid Biofertilizer Consortium. Biofertigation of microbial consortium was done at transplanting, 15 DAT, 30 DAT and 45 DAT. Application of fertigation at 100% RDF fertigation level registered maximum and significantly higher growth contributing characters *viz.*, plant height (49.36 cm), plant spread (63.75 cm) and dry matter content plant^{-1} (70.27g) at last harvesting stage, as compared to rest of fertigation levels. It was at par with 75% RDF fertigation level. The yield attributing character *viz.*, diameter of curd (19.99 cm), weight of curd plant^{-1} (2023 g) and total yield (74.62 t ha^{-1}) was maximum and significantly higher in application of fertigation at 100% RDF fertigation level. It was followed by 75% RDF fertigation level. The minimum values of all the yield attributes were registered at 50% RDF fertigation level. Scheduling of biofertigation of microbial consortium of MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*) proved its superiority by recording significantly higher growth contributing characters *viz.*, plant height (49.77 cm), plant spread (63.75 cm) and dry matter content plant^{-1} (71.11 g) at time of harvest of crop as compared to rest of biofertigation of microbial consortium. Similarly, scheduling of biofertigation of microbial consortium of MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*) obtained significantly higher yield attributing characters of broccoli *viz.*, diameter of curd (23.06 cm) and weight of curd plant^{-1} (1983 g) and total curd yield (75.73 t ha^{-1}).The minimum values of all the yield attributes were registered with control.

Keywords: Broccoli, Fertigation levels, Microbial consortium, *Azotobactor, Trichoderma.*

INTRODUCTION

Broccoli (*Brassica oleracea* L.var. *italica*) is an important vegetable among the cole crop belongs to the family Brassicaceae or Cruciferacea and originated from the Mediterranean region. The name broccoli is derived from the Latin word "brachium" which means arm or branch. Broccoli is known as the "Crown of jewel nutrition" as it is a rich source of many minerals, vitamins such as vitamin A and C, carotenoids, fiber, calcium and folic acid besides its antioxidant and anti-carcinogenic properties. It also contains a few important phytochemicals, sulphoraphane, betacarotene, indole-3-carbinol, glucosinolates which help to fight against many cancers (Aires *etal*., 2006). Nowadays, more attention to broccoli is due to its multifarious use and great nutritional value (Talalay and Fahey 2001; Rangkadilok *et al.*, 2000). The United States is the largest producer of sprouting broccoli followed by India. Broccoli is cultivated in hilly areas of Himachal Pradesh, Uttar Pradesh, Jammu and Kashmir, Nilgiri Hills and Northern plains of India. On average, the total global amount of broccoli and cauliflower produced is around 25.5 million tons.

Fertigation provides a variety of benefits to the users like high crop productivity, quality, resource use efficiency, and environmental safety, flexibility in field operations, effective weed management and successful crop cultivation in fields with undulating topography. This remarkably increases fertilizer and water-use efficiency, which reduces production costs (Bar-Yosef, 1999; Solaimalai *et al.*, 2005). In this context, fertigation, where water-soluble solid fertilizers or liquid fertilizers are applied through a drip irrigation system, can be a logical approach. Previous studies have reported significant fertilizer savings of 20-60% along with 8-41% increases in yields of horticultural

and vegetable crops as a result of fertigation (Jucilene *et al.*, 2009; Singh *et al*., 2010).

In addition, microbial consortia has a positive role in helping the plants through contain of microorganisms, which are capable of mobilizing nutrient elements from unavailable form to available form through different biological processes. Also, microbial consortia offer an economically attractive and ecologically sound means of reducing external inputs and improving quality and quantity of vegetable produce. The fertilization boosted the output of cruciferous vegetables like broccoli, according to many researchers who reported and approved this finding (Selim *et al*., 2009). *Azotobacter* and Phosphorus Solubilizing Bacteria (PSB) are the biofertilizers which nourish the crops and soil by liberating the growth promoting substances and vitamins. *Azotobacter* fixes atmospheric nitrogen in the root zone of the plants where as PSB solubilises unsoluble fixed phosphates already present in the soils. These biofertilizers are organic and thus absolutely safe and provide mechanical support, vigour and health to the seedlings. Therefore, the application of biofertilizers are economical, eco-friendly (pollution free) and are based on renewable energy sources and provide sustainability to the farming system.

MATERIAL AND METHODS

The present field experiment entitled, "Response of Broccoli (*Brassica oleracea* L.var. *italica)* to different fertigation levels and microbial consortia under drip irrigation and plastic mulch." was carried out at Instructional farm of Inter-Faculty Department of Irrigation Water Management, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri during *rabi* season, 2022-23. Geographically, the Instructional Farm of Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri is situated between 19º47' and 19º57' North latitude and between 74º19' and 74º32' East longitude. The altitude is 495 to 569 m above from sea level. The soil of experimental field was well drained clay loam in texture and low in available nitrogen (185.10 kg ha^{-1}), medium in available phosphorus (17.80 kg ha^{-1}) and high in available potassium (365.45 kg ha^{-1}) content. The soil was slightly alkaline in reaction (pH 7.51) with 0.61% organic carbon. The electrical conductivity of soil was 0.33 dSm^{-1} at 24 ºC. The field capacity and permanent wilting point was 38.11 and 19.90%, respectively. The bulk density of soil was 1.11 g cm^{-3}. Agro climatically the region located in scarcity zone of Maharashtra (drought prone area). The mean maximum temperature during experimentation period was ranging from 31.0ºC to 36.6ºC, while mean minimum temperature was ranging from 9.7ºC to 17.9ºC. The three main plot treatments comprised of three fertigation levels *viz.*, F_1: 50% RDF, F_2: 75% RDF and F_3:100% RDF whereas subplot treatments comprised of five microbial consortium *viz.*, C_0: Control, C_1: MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*), C_2 : VNMKV Biomix, C_3 : Arka microbial consortium, C_4 : IFFCO NPK Liquid Biofertilizer Consortium. Biofertigation of microbial consortium was done at transplanting, 15 DAT, 30 DAT and 45 DAT. The seedlings of broccoli, variety Saki was obtained from Vishwa Hightek Nursery, Virgaon, Akole.Dist. Ahmednagar. The transplanting of seedling was done at a spacing of 45-75 cm × 45 cm in paired row on 11th January 2023. Curds were harvested in four intervals according to treatment and physiological development. First harvesting was done on 19th March 2023, followed by 23th, 25th and 29th March 2023.

RESULTS AND DISCUSSION

A. Growth Character

The data pertaining to growth parameters *viz.*, plant height, plant spread and dry matter of broccoli as affected by different fertigation levels are presented in Table 1. The mean plant height, plant spread and dry matter $plant^{-1}$ were (46.35cm, 62.14 cm, 68.54 g, respectively) at harvest of broccoli.

Table 1: Growth attributing characters as influenced by different fertigation levels and microbial consortia.

Tr. No.	Treatment	Growth characters		
		Plant height (cm)	Plant spread (cm)	Dry matter $plant^{-1}$ (g)
A.	**Fertigation Levels**			
F_1 :	50 % RDF	43.61	57.32	65.55
F_2 :	75 % RDF	45.00	58.05	69.93
F_3 :	100 % RDF	49.36	63.75	70.27
	S.Em. ±	1.04	1.15	2.01
	C.D. (P = 0.05)	4.08	4.50	7.90
B.	**Microbial Consortium**			
C_0 :	Control	42.61	59.31	65.90
C_1 :	MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*)	49.77	64.77	71.11
C_2 :	VNMKV Biomix	47.12	62.14	70.00
C_3 :	Arka Microbial Consortium	47.07	61.59	68.78
C_4 :	IFFCO NPK Liquid Biofertilizer Consortium	44.61	60.90	67.13
	S.Em. ±	0.89	0.72	0.80
	C.D. (P = 0.05)	2.59	2.12	2.35
C.	**Interaction**			
	A × B	N.S.	N.S.	N.S.
	General mean	46.35	62.14	68.54

Application of fertigation at 100% RDF fertigation level registered maximum and significantly higher growth contributing characters *viz.*, plant height (49.36 cm), plant spread (63.75cm) and dry matter content plant^{-1} (70.27g) at last harvesting stage, as compared to rest of fertigation levels. It was at par (45.00 cm, 58.05 cm and 69.93 g) with 75% RDF fertigation level. The minimum values of all the growth attributes plant height (43.61 cm), plant spread (57.32cm) and dry mattercontentplant^{-1} (65.55g) were registered at 50% RDF fertigation level. Fertigation provides all essential nutrients for growth and quality of crop. It maintains an adequate amount of nutrients as required by the crop which results in increase in crop plant height, plant spread and dry matter plant^{-1}. However, when fertigation was reduced, there was a considerable reduction in plant height, plant spread and dry matter plant^{-1} at 50 %RDF at all crop growth stages. The decrease in plant height, plant spread and dry matter plant^{-1} was caused by less nutrient supply, which had a negative impact on plant growth and plant spread. In this fertigation schedule, there were less growth activities. These results are in accordance with those reported by Singh *et al*. (2017); Gadhavi *et al.* (2015) ; Chand and Singh (2017).

Scheduling of biofertigation of microbial consortium of MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*) proved its superiority by recording significantly higher growth contributing characters *viz*., plant height (49.77 cm), plant spread (64.77 cm), dry matter content plant^{-1} (71.11 g) at time of harvest of crop as compared to rest of biofertigation of microbial consortium. Whereas the significantly minimum plant height (42.61 cm), plant spread (59.31 cm), and dry matter content plant^{-1} (65.90 g) were registered with control. The applied nutrients atMPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*) was helped to plant at all the growth stages and increasing the biomass of plant. Higher biomass found in the MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*). Whereas significantly minimum dry matter plant^{-1}, was observed at control. The similar findings were reported by Pawde *et al*. (2019); Kumar *et al*. (2017); Singh *et al*. (2014).

B. Yield characters

The data pertaining to yield parameters affected by different fertigation levels are presented in Table 2. The mean diameter of curd, weight of curd and curd yield (18.26 cm, 1845.33 g, and 70.13 t ha^{-1}, respectively) of broccoli was obtained during investigation.

Table 2: Yield attributing characters and total yield of broccoli as influenced by different fertigation levels and microbial consortia.

Tr. No.	Treatment	Yield attributing characters		
		Diameter of curd (cm)	Weight of curd plant^{-1} (g)	Total Yield (t ha^{-1})
A.	**Fertigation Levels**			
F_1 :	50 % RDF	15.97	1626	61.47
F_2 :	75 % RDF	18.82	1896	69.38
F_3 :	100 % RDF	19.99	2023	74.62
	S.Em. ±	0.70	32.77	1.77
	C.D. (P = 0.05)	2.76	128.69	6.94
B.	**Microbial Consortium**			
C_0 :	Control	14.40	1677	56.57
C_1 :	MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*)	23.06	1983	75.73
C_2 :	VNMKV Biomix	18.92	1898	61.06
C_3 :	Arka Microbial Consortium	17.97	1787	58.83
C_4 :	IFFCO NPK Liquid Biofertilizer Consortium	16.96	1778	57.96
	S.Em. ±	1.03	26.83	1.05
	C.D. (P = 0.05)	3.00	78.31	3.06
C.	**Interaction**			
	A × B	N.S.	Sig.	Sig.
	General mean	18.26	1845	61.07

The yield attributing characters *viz*., diameter of curd (19.99 cm), weight of curd plant^{-1} (2023.47 g), and total curd yield (74.62 t ha^{-1}) was maximum and significantly higher in application of fertigation at 100% RDF fertigation level. However, 75% RDF fertigation level was at par (18.82 cm, 1896 g, 69.38 t ha^{-1}) with it. Whereas the significantly minimum diameter of curd (15.97 cm), weight of curd plant^{-1} (1626 g), and total curd yield (61.47 t ha^{-1}) were registered at 50% RDF fertigation level. This could be due to a higher amount of nutrients being applied; the cell division increases and the cell elongation process accelerates, resulted in a increase in diameter of curd, weight of curd and curd yield. Due to application of all macro and micro nutrients in required quantity directly in the vicinity of root zone, they are easily available to plant. Then the plant grows without any deficiency with high leaf area. Which increase in luxurious crop development throughout the growing season by increasing the water usage efficiency of applied water. It creates a conducive environment for promoting physiological processes like as photosynthesis, which resulted in increased curd width and average weight of curd plant^{-1}, resulting in increased curd yield. Similar findings have been reported by Chand and Singh (2017); Singh *et al*. (2017); Biradar *et al*. (2018); Sohail

et al. (2018); Yanglem and Tumbare (2014); Chand *et al*. (2017).

Scheduling of biofertigation of microbial consortium of MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*) obtained significantly higher yield attributing characters of broccoli *viz*., diameter of curd (23.06 cm) and weight of curd plant^{-1} (1983 g) and total curd yield (75.73 t ha^{-1}) was noticed due to scheduling of biofertigation of microbial consortium of MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*). Whereas the significantly minimum diameter of curd (14.40 cm), weight of curd plant^{-1} (1677 g), and total curd yield (56.57 t ha^{-1}) were registered with control. This could be due to extended activities of microorganisms helps to make unavailable nutrients in available form, which met the crop's nutrient requirements, the vegetative growth and biomass production increased, resulting in a higher curd output. Significantly lower curd yield was observed with control. Significantly lower diameter of curd, weight of curd and curd yield was observed with control These findings are consistent with those reported by Pawde *et al*. (2019), Kumar *et al*. (2017); Singh *et al*. (2014).

CONCLUSIONS

It could be concluded that, application of fertigation at 75% RDF fertigation level coupled with biofertigation of MPKV Consortium (*Azotobacter* + PSB + KSB + *Trichoderma*) found suitable to broccoli for maximum growth characters, yield attributes and curd yield.

REFERENCES

Aires, A., Fernandes, C., Carvalho, R., Bennett, R. N., Saavedra, M. J. and Rosa, E. A. (2006). Seasonal effects on bioactive compounds and antioxidant capacity of six economically important Brassica vegetables. *Molecules, 16*(8), 6816-6832.

Bar-Yosef, B. (1999). Advances in fertigation. *Advances in Agronomy, 65*, 1-77.

Biradar, M. S., Mantur, S. M. and Dhotre, M. (2018). Influence of fertigation on growth and yield of broccoli and red cabbage under nethouse conditions. *Acta Hoticulturae, 1227*, 1261.

Brahma, S., Borbora, P. D., Kachari, M., Hazarika, T.K. and Das, K. (2005). Effect of different levels of nitrogen fertigation on growth, yield and economics of the broccoli crop. *Indian Journal of Horticulture, 67*(3), 279-282.

Chand, P., Mukherjee, S. and Kumar, V. (2017). Effect of various levels of drip irrigation on growth and yield attributes of sprouting broccoli (*Brassica oleracea* var. *italica*) Cultivar Fiesta. *International Journal of Pure and Applied Bioscience, 5*(4), 139-143.

Chand, T. and Singh, M. K. (2017). Effect of different does of NPK and boron application on growth and yield of Broccoli (*Brassica oleracea* L. var. *italica*) under western Uttar Pradesh India. *Bulletin of Environment. Pharmacol and Life Science, 7*(1), 69-74.

Gadhavi, B. K., Patel, J. M. and Choudhari, S. (2015). Influence of various sources and levels of fertilizer application through fertigation on growth and yield of cauliflower on clay soils. *The Bioscan: An International Quarterly Journal of Life Sciences, 12*(4), 1809 -1812.

Jucilene, A. S., Andrade, A. P. and Azevedo, C. V. (2009). Characteristics of bell pepper fruits cultivated in greenhouse under doses of nitrogen via fertigation. *Journal of the Brazilian Association of Agricultural Engineering, 13*(2), 152-157.

Kumar, P., Kumar, S., Kumar, M.R., Kumar R. and Rawat R. (2017). Efficacy of biofertilizers on growth, yield and quality of sprouting broccoli (*Brassica oleracea* var. *italica*), cv. pusa broccoli kts^{-1}. *Plant Archives, 17*(2), 1647-1650.

Pawde, M.V., Bhosale, A.M. and Syed, S. J. (2019). Effect of liquid biofertilizers and inorganic fertilizers on yield and quality attributes of broccoli (*Brassica oleracea* L. var. *italica*). *International Journal of Current Microbiology and Applied Sciences*, *8*(10), 374-379.

Rangkadilok, N., Nicolas, M. E., Bennett, R. N., Premier, R. R., Eagling, D. R. and Taylor, P. W. (2000). Determination of sinigrin and glucoraphanin in Brassica species using a simple extraction method combined with ion-pair HPLC analysis. *Scientia Horticulturae, 96*(14), 27-41.

Selim, E. M., El-Fattah, A. A., Abouel-Magd, M. M .and Khalafallah, M. A. (2009). Efficiency of bio-fertigation on nutrients uptake by broccoli and soil microbial biomass under sandy soil conditions. *Journal of Agricultural and Environmental Science, 6*(3), 280-286.

Singh, A., Sharma, S. K. and Chopra, R. (2017). Effect of drip fertigation scheduling on yield and economics of cauliflower (*Brassica oleracea* var. *botrytis*) and chili (*Capsicum annum* L.). *Annuals of Plant and Soil Research, 19*(2), 137-142.

Singh, B., Pathak, K., Boopathi, T., and Deka, B. (2014). Vermicompost and NPK fertilizer effects on morpho-physiological traits of plants, yield and quality of tomato fruits (*Solanum lycopersicum* L.). *Vegetable Crops Research Bulletin, 73*(77).

Sohail, K., Nangial, K., Ullah, Z., Ahmad, J., Abdullah, K., Nawaz, F. and Khan, Riaz (2018). Effect of deficit irrigation and nitrogen levels on growth and yield of cauliflower under drip irrigation. *Pure and Applied Biology, 7*(2), 910-921.

Solaimalai, A., Baskar, M., Sadasakthi, A. and Subburamu, K. (2005). Fertigation in high value crops. *Agricultural Reviews, 26*, 1-33.

Talalay, P. and Fahey, J. W. (2001). Phytochemicals from Cruciferous plants protect against cancer by modulating carcinogen metabolism. *Journal of Nutrition, 13*(1), 3027-3033.

How to cite this article: Saste D.N., Danawale N.J., Mane M.S., Khedkar D.D., Kale K.D. and Jamdade S.S. (2024). Response of Broccoli (*Brassica oleracea* L. Var. *italica*) to different Fertigation Levels and Microbial Consortia under Drip Irrigation and Plastic Mulch. *Biological Forum – An International Journal, 16*(6): 68-71.