The Pharma Innovation Journal 2023; 12(8): 1482-1488

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(8): 1482-1488

www.thepharmajournal.com
Received: 08-05-2023
Accepted: 13-06-2023

Katta Sreevandana
College of Horticulture,
Dr. YSR. Horticultural University,
Venkataramannagudem, West Godavari, Andhra Pradesh, India

M Ravindra Babu
Horticultural Research Station,
Dr. YSR. Horticultural University,
Venkataramannagudem, West Godavari, Andhra Pradesh, India

B Ramesh Babu
Horticultural Research Station,
Dr. YSR. Horticultural University,
Venkataramannagudem, West Godavari, Andhra Pradesh, India

P Subbaramamma
College of Horticulture,
Dr. YSR. Horticultural University,
Venkataramannagudem, West Godavari, Andhra Pradesh, India

Corresponding Author:
Katta Sreevandana
College of Horticulture,
Dr. YSR. Horticultural University,
Venkataramannagudem, West Godavari, Andhra Pradesh, India

Studies on the influence of combined application of liquid biofertilizers and inorganic fertilizers on growth and yield of water melon (*Citrullus lanatus* T.)

Katta Sreevandana, M Ravindra Babu, B Ramesh Babu and P Subbaramamma

Abstract
The present investigation "Studies on the influence of combined application of liquid biofertilizers and inorganic fertilizers on growth and yield of water melon (*Citrullus lanatus* T.)" was laid out in mixed factorial randomized block design with two factors and three replications comprising twelve treatment combinations at Horticultural Research Station, Venkataramannagudem, West Godavari District, Andhra Pradesh during *Rabi*, 2019-2020. The first factor comprise of four levels of liquid biofertilizers (without biofertilizers, application of liquid biofertilizers (Nitrogen fixing bacteria + Phosphate solubilizing bacteria + Potassium solubilizing bacteria) 100% at the time of transplanting, application of liquid biofertilizers (NFB+PSB+KSB) 50% at the time of transplanting and 50% at 15 days after transplanting, application of liquid biofertilizers (NFB+PSB+KSB) 10% at nursery + 40% at the time of transplanting and 50% at 15 days after transplanting and the second factor comprise of three levels of recommended dose of inorganic NPK fertilizers (100%, 80% and 60% of RDF). The results indicated that the application of liquid biofertilizers (NFB+PSB+KSB) 10% at nursery + 40% at the time of transplanting and 50% at 15 days after transplanting in combination with 100% RDF recorded significant increase in terms of growth parameters *viz*., vine length (107.89 cm, 227.56 cm, 396.11 cm and 424.00 cm), leaf area (109.82 cm^2, 240.01 cm^2, 326.57 cm^2 and 347.67 cm^2) at 20, 40, 60 DAT and at final harvest respectively, yield parameters *viz*., average fruit weight (3.64 kg), fruit yield per plant (4.05 kg), fruit yield per hectare (67.44 t/ha) which were on par with 10% liquid biofertilizers in the nursery + 40% at the time of transplanting and 50% at 15 days after transplanting + 80% of RDF.

Keywords: Liquid biofertilizers, inorganic fertilizers, water melon, nitrogen fixing bacteria, phosphate solubilizing bacteria and potassium

Introduction
Water melon (*Citrullus lanatus* Thumb Mansf*)* is an important warm season vegetable crop grown all over the plains of India. It belongs to the family Cucurbitaceae. Water melon contains about 6% sugars and 92% water by weight and is rich source of vitamin C (8.1 mg/100 g). Water melons with light green or pale green colour rinds are also edible. Water melon is a wonderful fruit with its high glycemic index, enormous antioxidant potential and is low in calorific value. Biofertilizers are the microbial preparations containing living cells of different microorganisms, which have the ability to fix or solubilize the plant nutrients fixed to the soil particles through biological process. Biofertilizers are environmental friendly and play a significant role in crop production Verma *et al*. (2011) [14]. Now-a-days most of the farmers are using drip irrigation system to the crops. It is difficult to apply carrier based biofertilizers through drip system and hence the liquid formulations are beneficial to use by the farmers. Keeping the above points in consideration, the present investigation entitled "Studies on the Influence of combined application of liquid biofertilizers and inorganic fertilizers on growth and yield of water melon (*Citrullus lanatus* T.)" Was planned.

Materials and Methods
The present investigation entitled " Studies on the influence of combined application of liquid biofertilizers and inorganic fertilizers on growth, yield and quality of water melon (*Citrullus lanatus* T.)" was conducted during *Rabi*, 2019-2020 and laid out in mixed factorial randomized block design with two factors and three replications at Horticultural Research Station, Venkataramannagudem, West Godavari District, Andhra Pradesh. The first factor consists of four levels of liquid biofertilizers (without biofertilizers, application of liquid

biofertilizers (Nitrogen fixing bacteria + Phosphate solubilizing bacteria + Potassium solubilizing bacteria) 100% at the time of transplanting, application of liquid biofertilizers (NFB+PSB+KSB) 50% at the time of transplanting and 50% at 15 days after transplanting, application of liquid biofertilizers (NFB+PSB+KSB) 10% at nursery + 40% at the time of transplanting and 50% at 15 days after transplanting and the second factor consists of three levels of recommended dose of inorganic NPK fertilizers (100%, 80% and 60% of RDF) comprising twelve treatment combinations. The nursery was raised at Centre of Excellence for Protected Cultivation, Dr. Y. S. R. Horticultural University, Venkataramannagudem and the seedlings were transplanted after fourteen days at a spacing of 1.2 m × 0.5 m in a single row in the main field with mulching and drip irrigation. Liquid biofertilizers were applied at nursery, at the time of transplanting and 15 days after transplanting of water melon crop. Liquid biofertilizers (Nitrogen fixing bacteria, Phosphate solubilizing bacteria and Potassium solubilizing bacteria) were applied at 1.25 l/ha each. Irrigation and intercultural operations were done as and when necessary. The observations were recorded on the effect of liquid biofertilizers in combination with different levels of inorganic NPK fertilizers on growth and yield attributes of water melon.

Results and Discussion

Vine length (cm)

Vine length in water melon crop was significantly varied by the application of different levels of liquid biofertilizers at 20, 40, 60 days after transplanting and at final harvest and the data regarding vine length is furnished in the table-1. There was no significant difference on vine length with different levels of liquid biofertilizers at 0 DAT. At 20 DAT, the maximum vine length (100.56 cm) was obtained with the application of 10% liquid biofertilizers (NFB + PSB + KSB) at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting (B_4) followed by (B_3) i.e., application of 50% liquid biofertilizers at the time of transplanting and 50% at 15 days after transplanting with 92.81 cm. Significant higher (217.06 cm, 377.48 cm and 412.86 cm) vine length were recorded in B_4 which was on par with B_3 with 208.15 cm, 360.50 cm and 395.09 cm at 40, 60 DAT and at final harvest respectively. Whereas, the lowest (87.01cm, 183.67cm and 338.21 cm and 361.31 cm) was recorded in without biofertilizers (B_1).

Inorganic fertilizers did not show significant influence on vine length at 0 DAT. At 20 DAT, the application of 100% RDF resulted significantly highest vine length (96.61 cm) which was on par with the application of 80% RDF (F_2) with 94.84 cm. Application of 100% RDF resulted in maximum vine length (218.97 cm, 380.77 cm and 409.29 cm) followed by the 80% RDF application 9201.46 cm, 361.05 cm and 390.44 cm) at 40, 60 DAT and at final harvest respectively. While the lowest vine length was obtained in the treatment 60% RDF (F_3) with 86.47cm, 188.98 cm, 332.48 cm and 367.50 cm at 20, 40, 60 DAT and at final harvest respectively.

The interaction effect of different levels of liquid biofertilizers in combination with inorganic fertilizers was found to be significant at different stages of plant growth except at 0 DAT. Among all the interactions, application of 10% liquid biofertilizers (NFB + PSB + KSB) at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting along with 100% RDF (B_4F_1) recorded maximum vine length of 107.89 cm, 227.56 cm, 396.11 cm and 424.00 cm and B_4F_2 (application of 10% liquid biofertilizers (NFB + PSB + KSB) at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting along with 80% RDF) recorded vine length of 104.00 cm, 219.30 cm, 387.67 cm and 413.26 cm at 20, 40, 60 DAT and at final harvest respectively compared to without biofertilizers + 60% RDF (B_1F_3) with 77.11 cm, 156.67 cm, 287.26 cm and 310.55 cm respectively at 20, 40, 60 DAT and at final harvest. The increase in vine length might be due to the more availability of N, P and K in the treated plot which resulted in better uptake of nutrients by the plants. The supply of nitrogen to the meristematic tissues had encouraged the cell division, cell elongation, formation of new cells from meristematic cells. The data regarding vine length was in accordance with the findings of Wange and Kale (2004) [15] in brinjal, Singaravel *et al*. (2008) [12] in okra, Holebasappa *et al*. (2017) [3] in chilli.

Number of primary branches

The data pertaining to the number of primary branches with the combined application of liquid biofertilizers and in organic fertilizers in water melon is presented in the table-2. Number of primary branches per plant at final harvest was recorded significant higher with the application of liquid biofertilizes 10% at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting (B_4) (4.64) which was on par with B_3 i.e., 50% liquid biofertilizers at the time of transplanting and 50% at 15 days after transplanting (4.62) and B_2 i.e., 100% liquid biofertilizers at the time of transplanting (4.46). Whereas, the treatment without biofertilizers (B_1) recorded lowest number of primary branches per plant (4.33).

Application of inorganic fertilizers with different levels and the effect of liquid biofertilizers and chemical fertilizers does not show significant effect on number of primary branches per plant at the time of harvest.

The supply of optimum quantities of nutrients to the meristematic tissue present in the buds of leaf axils by fixation of atmospheric nitrogen through nitrogen fixing bacteria and release of nutrients fixed to the soil particles through the release of organic acids by microorganisms helps in the activation of cell division and formation of new cells to initiate the development of more number of primary branches per plant. However, number of primary branches per plant is a genetical character and not influenced by the external factors and hence no significant difference was observed at the end. The experimental data regarding primary number of branches per plant at the time of harvest was in accordance with the findings of Thriveni *et al*. (2015) [13] in bitter gourd, Kumar *et al*. (2017b) [6] in tomato and Kumar *et al*. (2018) [5] in tomato.

Leaf chlorophyll content (SPAD units)

The data pertaining to the leaf chlorophyll content (SPAD units) with the combined application of liquid biofertilizers and in organic fertilizers in water melon is presented in the table-3. There was no significant difference on leaf chlorophyll content with the application of liquid biofertilizers at 0 DAT. Application of liquid biofertilizers of NFB, PSB and KSB 10% at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting (B_4) recorded maximum (54.18, 69.42, 74.56 SPAD units) leaf chlorophyll content in water melon plants followed by application of 50% liquid biofertilizers at the time of

transplanting and 50% at 15 days after transplanting (51.19, 64.49, 72.11 SPAD units) over control (without biofertilizers) which recorded (45.57, 61.01, 68.00 SPAD units) at 20, 40 and 60 days after transplanting respectively. At final harvest, the maximum leaf chlorophyll content was recorded in B_4 with 79.02 SPAD units which was on par with B_3 (78.26 SPAD units) compared to control (73.78 SPAD units).

There was no significant difference among treatments with inorganic fertilizers on leaf chlorophyll content at 0 DAT. The maximum leaf chlorophyll content (53.12, 66.70, 73.25 and 78.72 SPAD units) was recorded with the application of 100% RDF which was on par with the application of 80% RDF (50.74, 65.62, 73.00 and 77.57 SPAD units) whereas, the lowest (46.21, 60.38, 67.00 and 73.51 SPAD units) was recorded with the application of 60% RDF at 20, 40, 60 DAT and at final harvest.

Among the interactions, the interaction effect of different levels of liquid biofertilizers in combination with inorganic fertilizers was found to be significant at different stages of plant growth except at 0 DAT. At 20 DAT, significantly highest leaf chlorophyll content was recorded in B_4F_2 i.e., 10% liquid biofertilizers (NFB, PSB and KSB) 50% at the time of transplanting and 50% at 15 days after transplanting along with 80% RDF (57.15 SPAD units) which was on par with B_4F_1 (57.08 SPAD units) and B_3F_1 (53.12 SPAD units). At 40 DAT significantly highest leaf chlorophyll content was recorded in B_4F_2 (73.93 SPAD units) which was on par with B_4F_1 (73.67 SPAD units), at 60 DAT maximum leaf chlorophyll content was recorded in B_4F_2 (76.00 SPAD units) which was on par with B_4F_1 (74.33 SPAD units), B_1F_1 & B_4F_3 (73.33 SPAD units), B_3F_1 (73.00 SPAD units), B_3F_2 & B_2F_1 with 72.33 SPAD units, B_2F_2 (72.00 SPAD units), B_1F_2 (71.67 SPAD units) and B_3F_3 (71.00 SPAD units). Similarly, at final harvest B_4F_2 recorded significantly highest leaf chlorophyll content (79.45 SPAD units) which was on par with B_4F_1 (78.89 SPAD units), B_3F_1 (78.78 SPAD units), B_4F_3 (78.74 SPAD units), B_1F_1 (78.67 SPAD units), B_2F_1 (78.56 SPAD units), B_1F_2 (77.67 SPAD units) and B_2F_2 (74.82 SPAD units). Whereas, the combination of without biofertilizers along with 60% RDF (B_1F_3) (40.00 SPAD units, 59.00 SPAD units, 59.00 SPAD units and 65.00 SPAD units) recorded the lowest leaf chlorophyll content at 20, 40, 60 DAT and at final harvest respectively.

The reason might be due to the increased uptake of nutrients and translocation of nitrogen present in recommended dose of inorganic nitrogen fertilizers and atmospheric nitrogen fixed by liquid biofertilizer (Azotobacter). The nitrogen nutrient was present in pyrole ring structure of the chlorophyll molecule and helps in synthesis of chlorophyll molecule. Moreover, the liquid biofertilizers have produced the growth promoting substances *viz*., cytokinins by microorganisms like Azotobacter, phosphate solubilizing bacteria which helps in maintenance of greenness of the leaf for longer period of time thereby increased the photosynthetic rate in plants. Similar findings were reported by Ekinci *et al*. (2014) [2] in cauliflower and Rueda *et al*. (2016) [10] in straw berry.

Leaf area (cm^2)

The data pertaining to the leaf area (cm^2) with the combined application of liquid biofertilizers and in organic fertilizers in water melon is presented in the table-4. Application of liquid biofertilizers did not show significant effect on leaf area at 0 DAT. Significant higher leaf area (104.05 cm^2) was recorded with the application of 10% liquid biofertilizers (NFB, PSB and KSB) at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting(B_4) which was on par with B_3 (99.50) and B_2 (99.15) at 20 DAT. Maximum leaf area (216.37 cm^2, 303.63 cm^2 and 321.67 cm^2) was obtained in the treatment 10% liquid biofertilizers (NFB, PSB and KSB) at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting(B_4) followed by application of liquid biofertilizers 50% at the time of transplanting and 50% at 15 days after transplanting (B_3) with 202.64 cm^2, 275.57 cm^2 and 293.56 cm^2) at 40, 60 DAT and at final harvest respectively. Whereas, the lower leaf area was recorded in control i.e., without biofertilizers with 92.65 cm^2, 181.46 cm^2, 252.93 cm^2 and 261.87 cm^2

Application of inorganic fertilizers did not show significant response on leaf area at 0 DAT. The maximum leaf area (104.37 cm^2, 206.77 cm^2, 285.33 cm^2 and 300.68 cm^2) was recorded with the application of 100% RDF (F_1) which was on par with the application of 80% RDF (F_2) with 100.98 cm^2, 201.08 cm^2, 279.42 cm^2 and 293.73 cm^2 and the minimum leaf area (91.16 cm^2, 178.73 cm^2, 259.56 cm^2 and 267.31 cm^2) was recorded with the application of 60% RDF (F_3) at 20, 40, 60 DAT and at final harvest respectively.

The interaction effect of different levels of liquid biofertilizers in combination with inorganic fertilizers was found to be significant at different stages of plant growth except at 0 DAT. At 20 DAT, significantly maximum leaf area was recorded in B_4F_1 i.e., 10% liquid biofertilizers (NFB, PSB and KSB) at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting along with 100% RDF (109.82 cm^2) which was on par with B_4F_2 (103.75 cm^2), B_3F_1 (103.30 cm^2), B_1F_1 (102.22 cm^2), B_2F_1 (102.14 cm^2) and B_3F_2 (101.87 cm^2). At 40 DAT, significantly highest leaf area was found in B_4F_1 (240.01 cm^2), followed by B_4F_2 (220.78 cm^2). Maximum leaf area was obtained in B_4F_1 (326.57 cm^2 and 347.67 cm^2) which was on par with B_4F_2 (322.52 cm^2 and 341.67 cm^2) at 60 DAT and at final harvest respectively. Whereas, the combination of without biofertilizers along with 60% RDF (B_1F_3) (77.08 cm^2, 165.71 cm^2, 250.41 cm^2 and 253.94 cm^2) recorded the minimum leaf area at 20, 40, 60 DAT and at final harvest respectively.

Leaf area was significantly enhanced due to an increase in number of leaves as well as expansion of leaves. The initiation of new leaves and leaf expansion was possible only through the supply of optimum amounts of nutrients and growth regulators produced by biofertilizers *viz*., auxins, gibberellins and cytokinins to the meristematic tissue present in leaf primordial which induces extensive cell division and cell elongation. The fixation of atmospheric nitrogen was achieved through nitrogen fixing bacteria present in liquid biofertilizers and the release of phosphorous and potassium nutrients fixed to the soil particles through the secretion of organic acids by phosphate and potassium solubilizing bacteria present in liquid biofertilizers. The data was in accordance with the findings of Sajan *et al*. (2002) [11] in chilli, Ramana *et al*. (2011) [11] in french bean and Rather *et al*. (2018) [9] in lettuce.

Average fruit weight (kg)

The data pertaining to the average fruit weight (kg) with the combined application of liquid biofertilizers and in organic fertilizers in water melon is furnished in the table-5. There was significant difference in average fruit weight with the

application of liquid biofertilizers, inorganic fertilizers and their interactions. Liquid biofertilizers (NFB, PSB and KSB) 10% at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting (B_4) recorded highest average fruit weight of 3.52 kg followed by B_3 i.e., 50% liquid biofertilizers at the time of transplanting and 50% at 15 days after transplanting (3.35 kg) over without biofertilizers (3.20 kg). Different levels of recommended dose of fertilizers influenced the average fruit weight and it ranged from 3.21 kg to 3.44 kg. Significantly higher average fruit weight (3.44 kg) was recorded in 100% RDF (F_1) which was on par with 80% RDF (F_2) with 3.40 kg as against 60% RDF (F_3) (3.21 kg).

Among all the treatment combinations, the combination of 10% liquid biofertilizers (NFB, PSB and KSB) at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting along with 100% RDF (B_4F_1) recorded significantly higher fruit weight (3.64 kg) which was on par with 10% liquid biofertilizers at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting along with 80% RDF (B_4F_2) with 3.60 kg when compared to B_1F_3 (2.92 kg).

The possible reason for increased fruit weight at higher levels of biofertilizers and inorganic fertilizers might be due to the essential effects of biofertilizers that increased the availability of essential elements which further enhanced the uptake of nutrient and to some possible extent ability of fixation of nitrogen. Increased uptake of nutrients might have resulted in increased assimilation of photosynthates and their accumulation in the sink lead to increased fruit weight at higher levels of biofertilizers and inorganic fertilizers.

Fruit yield per plant (kg) and estimated yield per ha (t/ha)

The data pertaining to the fruit yield per plant (kg) and estimated yield per hectare (t/ha) with the combined application of liquid biofertilizers and in organic fertilizers in water melon is mentioned in the table-5. Significant higher fruit yield (3.90 kg/plant) was recorded with the application of liquid biofertilizes 10% at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting (B_4) which was on par with 50% liquid biofertilizers at the time of transplanting and 50% at 15 days after transplanting (3.83 kg/plant) and the lowest (3.54 kg/plant) fruit was recorded in control (without biofertilizers). Significant higher fruit yield (3.89 kg/plant) was obtained with the application of 100% RDF (F_1) which was on par with 80% RDF (3.86 kg/plant) while, it was lowest (3.63 kg/plant) fruit was recorded in 60% RDF. The interaction effect of 10% liquid biofertilizers at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting along with 100% RDF (B_4F_1) recorded significantly higher fruit yield (4.05 kg/plant) which was on par with B_4F_2 (3.89 kg/plant), B_3F_1 (3.89 kg/plant) and B_3F_2 (3.86 kg/plant) while, it was observed minimum in B_1F_3 i.e., without biofertilizers along with 60% RDF (3.07 kg/plant).

The water melon plants treated with liquid biofertilizers showed significant influence on yield (t/ha). Significantly maximum yield (64.95 t/ha) was recorded with the application of liquid biofertilizers 10% at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting (B_4) which was on par with B_3 i.e., 50% liquid biofertilizers at the time of transplanting and 50% at 15 days after transplanting (63.86 t/ha) over without biofertilizers (59.07 t/ha). Inorganic fertilizers with different levels influenced the estimated yield and the maximum yield (64.86 t/ha) was recorded in 100% RDF (F_1) which was on par with 80% RDF (F_2) with 63.55 t/ha and the lowest yield was noticed in 60% RDF (F_3) with 59.53 t/ha. Different levels of liquid biofertilizer and chemical fertilizer interactions showed significant influence on yield/ha. Among all the treatment combinations, the interaction of liquid biofertilizers 10% at nursery, 40% at the time of transplanting and 50% at 15 days after transplanting along with 100% RDF recorded significantly higher yield (67.44 t/ha) which was on par with B_3F_1 (64.89 t/ha), B_4F_2 (64.86 t/ha) and B_3F_2 (64.28 t/ha) while, it was recorded lowest in B_1F_3 i.e., without biofertilizers along with 60% RDF (51.11 t/ha).

The possible reason for increased yields due to the application of biofertilizers might be due to conversion of unavailable forms of nutrients to available forms in the plant rhizosphere which improved the nutrient uptake potential of the plant and further enhanced the physiological activities which promote plant growth. Increased uptake of essential elements and availability of growth promoting substances by the application of biofertilizers resulted in increased plant growth, dry matter production and synthesis of food material which ultimately resulted in increased yields. The experimental data regarding fruit yield was in accordance with the findings reported by Ingle *et al*. (2008) [4] and Singaravel *et al*. (2008) [12] in okra, Prasad *et al*. (2009) [9] in bitter gourd and Anjanappa *et al*. (2012) [1] in cucumber.

Table 1: "Effect of application of liquid biofertilizers in combination with different levels of inorganic NPK fertilizers on vine length (cm) at 0, 20, 40, 60 DAT and at final harvest of water melon (*Citrullus lanatus* T.)"

Liquid biofertilizers	Recommended dose of fertilizers											
	0 DAT				20 DAT				40 DAT			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
B_1	13.03	12.94	12.96	12.98	92.67	91.25	77.11	87.01	214.33	180.00	156.67	183.67
B_2	12.99	13.15	13.11	13.09	91.78	89.44	89.33	90.18	215.66	201.22	194.13	203.67
B_3	13.13	12.95	13.08	13.05	94.11	94.67	89.65	92.81	218.33	205.33	200.79	208.15
B_4	13.08	13.05	13.11	13.08	107.89	104.00	89.78	100.56	227.56	219.30	204.33	217.06
Mean	13.06	13.02	13.07		96.61	94.84	86.47		218.97	201.46	188.98	
Factor	B	F	B × F		B	F	B × F		B	F	B × F	
SE (m) +	0.22	0.19	0.38		1.57	1.36	2.72		3.44	2.98	5.96	
C.D at 5%	NS	NS	NS		4.61	3.99	7.98		10.10	8.74	17.49	

Liquid biofertilizers	Recommended dose of fertilizers							
	60 DAT				At final harvest			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
B_1	371.03	356.33	287.26	338.21	407.82	365.56	310.55	361.31
B_2	370.93	352.33	345.33	356.20	401.00	383.67	376.45	387.04
B_3	385.00	347.85	348.66	360.50	404.33	399.26	381.67	395.09
B_4	396.11	387.67	348.67	377.48	424.00	413.26	401.33	412.86
Mean	380.77	361.05	332.48		409.29	390.44	367.50	
Factor	B	F	B × F		B	F	B × F	
SE (m) +	6.29	5.44	10.89		6.75	5.85	11.69	
C.D at 5%	18.44	15.97	31.93		19.79	17.14	34.28	

B1 : Without biofertilizers; B2 : Application of 100% liquid biofertilizers at the time of transplanting; B3 : Application of 50% liquid biofertilizers at the time of transplanting and 50% at 15 DAT; B4 : Application of 10% liquid biofertilizers in the nursery + 40% at the time of transplanting and 50% at 15 DAT and F1 : 100% of RDF; F2 : 80% of RDF; F3 : 60% of RDF RDF : Recommended dose of fertilizers @ 100:80:60 kg NPK/ha

Table 2: "Effect of application of liquid biofertilizers in combination with different levels of inorganic NPK fertilizers on number of primary branches per plant at final harvest in water melon (*Citrullus lanatus* T.)"

Liquid biofertilizers	Recommended dose of fertilizers			
	F_1	F_2	F_3	Mean
B_1	4.43	4.33	4.23	4.33
B_2	4.57	4.50	4.30	4.46
B_3	4.70	4.67	4.50	4.62
B_4	4.73	4.70	4.50	4.64
Mean	4.61	4.55	4.38	
Factors	B	F	B × F	
SE(m) ±	0.08	0.07	0.14	
CD at 5%	0.24	NS	NS	

B1: Without biofertilizers
B2: Application of 100% liquid biofertilizers at the time of transplanting
B3: Application of 50% liquid biofertilizers at the time of transplanting and 50% at 15 days after transplanting
B4: Application of 10% liquid biofertilizers in the nursery + 40% at the time of transplanting and 50% at 15 days after transplanting
F1: 100% Recommended dose of fertilizers
F2: 80% Recommended dose of fertilizers
F3: 60% Recommended dose of fertilizers
RDF: Recommended dose of fertilizers @ 100:80:60 kg NPK/ha

Table 3: "Effect of application of liquid biofertilizers in combination with different levels of inorganic NPK fertilizers on leaf chlorophyll content (SPAD units) at 0, 20, 40, 60 DAT and at final harvest of water melon (*Citrullus lanatus* T.)"

Liquid biofertilizers	Recommended dose of fertilizers											
	0 DAT				20 DAT				40 DAT			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
B_1	32.33	32.35	32.32	32.33	51.79	44.93	40.00	45.57	61.51	61.52	59.00	60.68
B_2	32.28	32.27	32.26	32.27	50.48	48.79	48.13	49.13	65.31	62.42	59.32	62.35
B_3	32.31	32.28	32.29	32.29	53.12	52.08	48.38	51.19	66.33	64.60	62.55	64.49
B_4	32.33	32.30	32.39	32.34	57.08	57.15	48.33	54.18	73.67	73.93	60.67	69.42
Mean	32.31	32.30	32.31		53.12	50.74	46.21		66.70	65.62	60.38	
Factor	B	F	B × F		B	F	B × F		B	F	B × F	
SE (m) +	0.96	0.83	1.66		0.91	0.80	1.58		1.07	0.93	1.85	
C.D at 5%	NS	NS	NS		2.67	2.31	4.63		3.13	2.71	5.43	

Liquid biofertilizers	Recommended dose of fertilizers							
	60 DAT				At final harvest			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
B_1	73.33	71.67	59.00	68.00	78.67	77.67	65.00	73.78
B_2	72.33	72.00	64.67	69.67	78.56	74.82	72.63	75.33
B_3	73.00	72.33	71.00	72.11	78.78	78.33	77.67	78.26
B_4	74.33	76.00	73.33	74.56	78.89	79.45	78.74	79.02
Mean	73.25	73.00	67.00		78.72	77.57	73.51	
Factor	B	F	B × F		B	F	B × F	
SE (m) +	1.20	1.04	2.07		1.28	1.11	2.21	
C.D at 5%	3.51	3.04	6.08		3.75	3.24	6.49	

B1: Without biofertilizers; B2: Application of 100% liquid biofertilizers at the time of transplanting; B3 : Application of 50% liquid biofertilizers at the time of transplanting and 50% at 15 DAT; B4: Application of 10% liquid biofertilizers in the nursery + 40% at the time of transplanting and 50% at 15 DAT and F1 : 100% of RDF; F2 : 80% of RDF; F3 : 60% of RDF
RDF: Recommended dose of fertilizers @ 100:80:60 kg NPK/ha

Table 4: Effect of application of liquid biofertilizers in combination with different levels of inorganic NPK fertilizers on leaf area (cm^2) at 0, 20, 40, 60 DAT and at final harvest of water melon (*Citrullus lanatus* T.)

Liquid biofertilizers	Recommended dose of fertilizers											
	0 DAT				20 DAT				40 DAT			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
B_1	32.54	32.60	32.59	32.58	102.22	98.65	77.08	92.65	188.67	190.00	165.71	181.46
B_2	32.62	32.58	32.61	32.60	102.14	99.67	95.65	99.15	185.74	183.52	175.63	181.63
B_3	32.57	32.60	32.57	32.58	103.30	101.87	93.34	99.50	212.67	210.00	185.27	202.64
B_4	32.58	32.58	32.59	32.58	109.82	103.75	98.58	104.05	240.01	220.78	188.23	216.37
Mean	32.58	32.59	32.59		104.37	100.98	91.16		206.77	201.08	178.73	
Factor	B	F	B × F		B	F	B × F		B	F	B × F	
SE (m) +	0.68	0.59	1.18		1.72	1.49	2.98		3.28	2.84	5.67	
C.D at 5%	NS	NS	NS		5.05	4.37	8.74		9.61	8.32	16.64	

Liquid biofertilizers	Recommended dose of fertilizers							
	60 DAT				At final harvest			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
B_1	257.37	251.00	250.41	252.93	266.67	265.00	253.94	261.87
B_2	270.56	267.85	262.45	266.95	278.92	273.38	263.29	271.86
B_3	286.80	276.31	263.60	275.57	309.48	294.87	276.33	293.56
B_4	326.57	322.52	261.79	303.63	347.67	341.67	275.67	321.67
Mean	285.33	279.42	259.56		300.68	293.73	267.31	
Factor	B	F	B × F		B	F	B × F	
SE (m) +	5.72	4.95	9.91		5.68	4.92	9.84	
C.D at 5%	16.77	14.53	29.05		16.66	14.43	28.86	

B1: Without biofertilizers;
B2: Application of 100% liquid biofertilizers at the time of transplanting; B3: Application of 50% liquid biofertilizers at the time of transplanting and 50% at 15 DAT; B4: Application of 10% liquid biofertilizers in the nursery + 40% at the time of transplanting and 50% at 15 DAT and F1: 100% of RDF; F2: 80% of RDF; F3 : 60% of RDF
RDF: Recommended dose of fertilizers @ 100:80:60 kg NPK/ha

Table 5: "Effect of application of liquid biofertilizers in combination with different levels of inorganic NPK fertilizers on average fruit weight (kg), fruit yield per plant (kg) and estimated yield (t/ha) of water melon (*Citrullus lanatus* T.)

Liquid biofertilizers	Recommended dose of fertilizers											
	Average fruit weight (kg)				Fruit yield per plant (kg)				Estimated yield per hectare (t/ha)			
	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean	F_1	F_2	F_3	Mean
B_1	3.34	3.32	2.92	3.20	3.82	3.74	3.07	3.54	63.72	62.39	51.11	59.07
B_2	3.35	3.32	3.23	3.32	3.80	3.76	3.72	3.76	63.39	62.67	62.06	62.70
B_3	3.42	3.34	3.30	3.35	3.89	3.86	3.74	3.83	64.89	64.28	62.41	63.86
B_4	3.64	3.60	3.31	3.52	4.05	3.89	3.75	3.90	67.44	64.86	62.54	64.95
Mean	3.44	3.40	3.21		3.89	3.81	3.57		64.86	63.55	59.53	
Factor	B	F	B × F		B	F	B × F		B	F	B × F	
SE (m) +	0.04	0.03	0.07		0.04	0.04	0.08		0.69	0.60	1.19	
C.D at 5%	0.11	0.10	0.19		0.12	0.11	0.21		2.01	1.75	3.49	

B1: Without biofertilizers;
B2: Application of 100% liquid biofertilizers at the time of transplanting; B3: Application of 50% liquid biofertilizers at the time of transplanting and 50% at 15 DAT; B4: Application of 10% liquid biofertilizers in the nursery + 40% at the time of transplanting and 50% at 15 DAT and F1: 100% of RDF; F2: 80% of RDF; F3 : 60% of RDF
RDF: Recommended dose of fertilizers @ 100:80:60 kg NPK/ha

Conclusion

From the present investigation, it is concluded that the application of liquid biofertilizers (NFB+PSB+KSB) 10% at nursery + 40% at the time of transplanting and 50% at 15 days after transplanting in combination with 100% RDF recorded significant increase in terms of growth parameters *viz*., vine length, leaf area and yield parameters *viz*., average fruit weight, fruit yield per plant and fruit yield per hectare which were on par with 10% liquid biofertilizers in the nursery + 40% at the time of transplanting and 50% at 15 days after transplanting + 80% of RDF.

Acknowledgement

The authors are thankful to College of Horticulture, Dr. Y. S. R. Horticultural University, Venkataramannagudem, West Godavari district, Andhra Pradesh, India-534101.

References

1. Anjanappa M, Kumara BS, Indiresh KM. Growth, yield and quality attributes of cucumber (cv. Hassan Local) as influenced by integrated nutrient management grown under protected conditions. Journal of Agricultural Science. 2012;46(1):32-37.
2. Ekinci M, Turan M, Yildirim E, Gunes A, Kotan R, Dursun A. Effect of plant growth promoting rhizobacteria on growth, nutrient, organic acid, amino acid and hormone content of cauliflower (*Brassica oleracea* var. *botrytis* L.) transplants. Acta Scientiarum Polonorum. 2014;13 (6):71-85.
3. Holebasappa K, Raj AC, Hore JK. Effect of biofertilizers

and inorganic fertilizers on growth and yield of chilli (*Capsicum annum* L.) International Journal of Current Microbiology and Applied Sciences. 2017;6(7):1564-1568.
4. Ingle VG, Tatar PG, Raut UA. Effect of biofertilizer with reduced doses of nitrogen on growth of okra. Annuals of plant Physiology. 2008; 22(2):55-58.
5. Kumar DA, Sivakumar K, Mariyappan E. Comparative studies on the growth and yield of brinjal (*Solanum melongena* L.) var. PLR-2 based on bioinoculants and inorganic fertilizers. International Journal of Research and Scientific Innovation. 2018, 5(3).
6. Kumar P, Kumar S, Meena RK, Kumar R, Rawat R. Effect of integrated nutrient management on growth, yield and quality of tomato (*Lycopersicon esculentum* Mill.) cv. Pusa Ruby. Plant Archives. 2017b;17(2):1197-1200.
7. Prasad PH, Mandal AR, Sarkar A, Thapa U, Maity TK. Effect of biofertilizers and nitrogen on growth and yield attributes of bitter gourd (*Momordica charantia* L.). International Conference on Horticulture. 2009;2:47.
8. Ramana V, Ramakrishna M, Purushotam K, Reddy BK. Effect of mulching and biofertilizers on growth, yield and quality of french bean (*Phaseolus vulgaris* L.). Vegetable Science. 2011;38(1):35-38.
9. Rather A, Jabeen N, Bhat T, Parray EA, Hajam MA, Wani MA, Bhat I. Effect of organic manures and biofertilizers on growth and yield of lettuce. The Pharma Innovation Journal. 2018;7(5):75-77.
10. Rueda D, Valencia G, Soria N, Rueda BB, Manjunatha B, Kundapur RR, Selvanayagam M. Effect of *Azospirillum spp.* and *Azotobacter* spp. on the growth and yield of strawberry (*Fragaria vesca*) in hydroponic system under different nitrogen levels. Journal of Applied Pharmaceutical Science. 2016;6(1):58-54.
11. Sajan KM, Gowda KK, Kumar SN, Sreeramu BS. Effect of biofertilizers on growth and yield of chilli (*Capsicum annum* L.) cv. Byadagi Dabba at different levels of nitrogen and phosphorous. Journal of Spices and Aromatic Crops. 2002;11(1):58-61.
12. Singaravel R, Suhatiaa K, Vembu G, Kamraj S. Effect of liquid biofertilizer on the nutrient content and uptake of okra. Asian Journal of Soil Science. 2008;3(2):217-19.
13. Thriveni V, Mishra HN, Pattanayak SK, Sahoo GS, Thomson T. Effect of inorganic, organic fertilizers and biofertilizers on growth, flowering, yield and quality attributes of bitter gourd (*Momordica charantia* L.). International Journal of Farm Sciences. 2015;5(10):24-29.
14. Verma M, Sharma S, Prasad R. Liquid biofertilizers: Advantages over carrier based biofertilizers for sustainable crop production. International Society of Environmental Botanists. 2011, 17(2).
15. Wange SS, Kale RH. Effect of biofertilizers under graded nitrogen levels on brinjal crop. Journal of Soils and Crops. 2004;14(1):9-11.