



Effects of Vermicompost and PSB on the Vegetative Growth and Yield of Onion (*Allium cepa* L.)

Manvendra Singh Solanki ^{a*}, Kshitij Parmar ^b,
Dalveer Singh ^a and Roshan Kushwah ^a

^a Department of Horticulture, RBS College, Bichpuri, Agra (U.P)-283105, India.

^b Amity Institute of Organic Agriculture, Amity University Noida, U.P., India.

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/IJPSS/2023/v35i193726

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/104734>

Original Research Article

Received: 18/06/2023

Accepted: 24/08/2023

Published: 09/09/2023

ABSTRACT

A field experiment was conducted during rabi season of 2020-21 at research farm R.B.S. College, Bichpuri, Agra (U.P) to study the "effects of Vermicompost and PSB on the vegetative growth and yield of onion (*Allium cepa* L.)". In this experiment 7 treatment were applied with three replications and laid out in randomized block design (RBD). Treatments were (T₁) 100% recommended dose of fertilizer (NPK) (Control), (T₂) 80% RDF + Phosphate Solubilizing Bacteria (PSB) (5kg/ha.), (T₃) 80% RDF + VC, (T₄) 80% RDF+VC + PSB (5kg/ha.), (T₅) 100 %RDF + PSB (5kg/ha.), (T₆) 100% RDF + VC (5kg/ha.) and (T₇) 100% RDF + VC + PSB (5kg/ha.). On the basis of experiment conducted that the treatment T₇ i.e., application 100% RDF+VC+ PSB (5kg/ha.) was found superior among the treatments for growth and yield of onion, the maximum bulb yield (332.64 q/ha) was obtained by application of treatment T₇ 100% RDF+VC+ PSB (5kg/ha.).

*Corresponding author: E-mail: solankimanvendra1993@gmail.com;

Keywords: Nitrogen; phosphorus; potassium; growth; vermicompost; PSB; onion and yield.

1. INTRODUCTION

Onion (*Allium cepa* L.) a herbaceous biennial plant in the amaryllis family (Amaryllidaceae) grown for its edible bulb is one of the most important vegetable crop commercially grown in the world. The word "onion" is derived from Latin language meaning "large pearl". It probably originated from Central Asia [1]. The crop onion is a popular vegetable and its bulb is used raw, sliced for seasoning salads, and cooked with other vegetables and meat. Onion bulbs are essential ingredients in many African sauces and dishes. The leaves, whole immature plants called 'salad onion' or leafy sprouts from germinating bulbs are used in the same way. Onion contains carbohydrates (11.0 g), fiber (0.6 g), moisture (86.8 g) and several vitamin like vitamin C (11 mg), thiamin (0.08 mg) and niacin (0.2 mg) and also some minerals like phosphorus (39 mg), calcium (27 mg), sodium (1.0 mg), iron (0.7 mg) and potassium (157 mg) per 100 g [2].

Amongst bio-fertilizers, PSB strains play a key role in harnessing the atmospheric phosphorus through its fixation in the roots [3]. They have ability to solubilize inorganic phosphorus from insoluble compounds. P-solubilization ability of rhizosphere microorganisms is considered to be one of the most important channels of plant phosphate nutrition.

Vermicompost is a peat-like organic fertilizer with high nutritional contents, aeration, porosity, and water-holding capacity, prepared by the joint action of earthworms and microbes [4,5]. In addition to organic waste management, Vermicompost is recognized as an effective plant growth promoter [6,7]. Vermicompost has large particulate surface area that provides many micro sites for the microbial activity and strong retention of nutrients [8,9]. Vermicompost also contains large amounts of humus substances and some of the effects of these substances on plant growth have been shown to be very similar to those of soil applied plant growth regulators or hormones [10]. As a result, most nutrients are easily available such as; nitrates, phosphates, and exchangeable calcium and soluble potassium, which are responsible for increased plant growth and crop yield [11]. Maharashtra is the leading onion growing state of India while, other important states are Gujarat, Karnataka, Bihar, Madhya Pradesh, Andhra Pradesh, Rajasthan, Haryana, Uttar Pradesh and Tamil Nadu.

2. METHODS AND MATERIALS

The field experiment was conducted at the RBS College, Agricultural Research Farm, Bichpuri (Agra), which is situated at an elevation (altitude) of 168 m above mean sea level, 27.2° N latitude and 77.9° E longitude. Bichpuri farm is located at about 11 km. away from Agra city on Agra-Bharatpur Road, in semi-arid region IV (AESR 4.1) and Agro-climatic Zone 'NWPZ' (North Western Plains Zone)

Agra enjoys semi-arid, sub-tropical climate with extremes of temperature both in winter and summer. The winter (December to January) is severe cold with minimum temperature at two degree Celsius (1-2°C) and in summer (May-June) the temperature often goes up to 46°-48°C accompanied with hot desiccating winds. Treatments were (T1) 100% recommended dose of fertilizer (NPK) (Control), (T2) 80% RDF + Phosphate Solubilizing Bacteria (PSB) (5kg/ha.), (T3) 80% RDF + VC, (T4) 80% RDF+VC + PSB (5kg/ha.), (T5) 100 %RDF + PSB (5kg/ha.), (T6) 100% RDF + VC (5kg/ha.) and (T7) 100% RDF + VC + PSB (5kg/ha.). The 7 treatments were replicated three times in randomized block design in 1.50m x 1.50 size plots. The recommended dose of nitrogen, phosphorus and potash were applied at the time of transplanting. The half dose of nitrogen was applied as basal and in two part after 30 day transplanting and 45 day. Vermicompost, Phumdi and the PSB were applied as per treatment on each unit plot. Five randomly selected equally competitive plants from each row in each replication were tagged for the purpose of recording the observations on 7 characters viz. plant height (cm). number of leaves, number of clumps per plant, total yield per plant (g) and total weight of root per plant (g). The observations were recorded at 30, 60, 90 and 120 days after sowing. All the required cultural operations along with the irrigation was done as per requirement of the crop. The bulb was harvested at the mature stage.

3. RESULTS AND DISCUSSION

The pooled data regarding vegetative growth and yield of onion were presented in Table-1 and Table-2 respectively. The data in Table-1 indicated that treatment T₇ (100%RDF+VC+PSB) had the maximum fresh weight of tops (22.78 g) at harvest which was significantly at par with T₆ treatment where as minimum fresh weight of

tops (18.43gm) was recorded with T₁ (100% RDF) treatment in this parameter. The data also indicated that T₇ (100%RDF+VC+PSB) treatment had the maximum fresh weight of bulb (80.71 g) at harvest which was superior to all other treatments however, treatment T₆ was statistically at par with T₇ while minimum fresh weight of bulb (65.78 gm) was obtained with T₁ (100% RDF). Diameter of bulb at harvest presented in Table 1 showed that the treatment T₇ (100%RDF+VC+PSB) produced a significantly maximum diameter of bulb (6.43cm) followed by T₆ which was statistically at par to each other. However, rest of all treatments are statistically less than T₇. The results are in agreement with the work of Yogita et al. [12,13] and Kumar et al. [14]. The significantly maximum Plant height at 30, 60 and 90 DAT was recorded with the treatment T₇ [100%RDF+VC+PSB (each 5kg/ha.)]. which was closely followed by T₅ and T₆ at 30, 60 and 90 DAT. However the minimum

plant height was noted under the treatment T₁ (100% RDF) at 30, 60 and 90 DAT. Possible reason for increased height of plant may be due to the improvement in growth related attributes because of certain growth promoting substances secreted by bio-fertilizers, better uptake of water, nutrients and their transportation. Similar studies were also conducted by Mandal et. al. [15] and Bringham et. al. [16] in onion crop. The maximum bulb yield per plot and per hectare (6.28kg and 332.64 q/ha, respectively) was recorded in treatment [100%RDF+VC+PSB (each 5kg/ha.)] T₇ which was statistically at par with T₅ and T₆. Whereas, the minimum bulb yield (3.59 kg/plot) and (190.56q/ha) was obtained in T₁. This increase may be due to more number of bulbs per plot, bulb size and average weight of bulbs. Number of leaves per plant and diameter of pseudo-stem (cm) were appreciably higher with treatment T₇ [100%RDF+VC+PSB (each 5kg/ha.)] over all

Table 1. Fresh weight of tops (g), Fresh weight of bulb and Diameter of bulb (cm) of Onion as influenced by various treatments

Treatment	Plant height (cm)	No. of green leaves per plant	Fresh weight of tops (g)	Fresh weight of bulb (g)	Diameter of bulb (cm)
100% RDF(control)	39.76	5.97	18.43	65.78	4.96
80% RDF+PSB	44.11	6.32	20.45	76.03	5.76
80% RDF+VC	44.11	6.50	20.91	76.35	5.83
80% RDF+VC +PSB (each 5kg/ha.)	41.29	6.10	19.2	75.20	5.27
100% RDF +PSB	42.1	6.30	20.17	75.35	5.67
100% RDF+VC	46.82	6.93	22.6	77.83	6.09
100%RDF+VC+PSB (each 5kg/ha.)	48.14	7.40	22.78	80.71	6.43
S.Em±	0.78	0.21	0.48	1.13	0.13
C.D.(P=0.05)	2.35	0.64	1.15	3.39	0.39

Table 2. Fresh weight of bulb (kg/plot), Dry matter content of bulb (%) and Total bulb yield (q/ha) of Onion as influenced by various treatments

Treatment	Fresh weight of bulb (kg/plot)	Dry matter content of bulb (%)	Total bulb yield (q/ha)
100% RDF(control)	3.59	9.78	190.56
80% RDF+PSB	4.30	10.45	228.12
80% RDF+VC	4.43	10.67	234.64
80% RDF+VC +PSB (each 5kg/ha.)	3.76	10.12	199.23
100% RDF +PSB	3.91	10.47	207.23
100% RDF+VC	5.96	10.91	315.94
100%RDF+VC+PSB (each 5kg/ha.)	6.28	11.05	332.64
S.Em±	0.26	1.01	8.06
C.D.(P=0.05)	0.78	NS	24.17

other treatments. Significantly maximum diameter of Onion bulb was found in treatment T₇ [100%RDF+VC+PSB (each 5kg/ha.)] while the minimum was noted with T₁ at 90 DAT and harvest stage.

The maximum fresh weight of bulb was obtained with the application of treatment T₇ [100%RDF+VC+PSB (each 5 kg/ha.)], which was significantly higher than all other treatments. Application of treatment T₇ [100%RDF+VC+PSB (each 5kg/ha.)] gave maximum Dry matter content of bulb (8.97%) which was significantly higher than all other treatments.

4. CONCLUSION

On the basis of this investigation, it could be concluded that treatment T₇ i.e., application of [100%RDF+VC+PSB (each 5kg/ha.)] was found superior to all other treatments for growth and yield characters of onion in the study site.

CONFERENCE DISCLAIMER

Some part of this manuscript was previously presented in the conference: 6th International Conference on Strategies and Challenges in Agricultural and Life Science for Food Security and Sustainable Environment (SCALFE-2023) on April 28-30, 2023 in Himachal Pradesh University, Summer Hill, Shimla, HP, India. Web Link of the proceeding: <https://www.shobhituniversity.ac.in/pdf/Souvenir-Abstract%20Book-Shimla-HPU-SCALFE-2023.pdf>

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Vavilov, NI. The Origin, Variation, Immunity and Breeding of Cultivated Plants (Translated by SK Chestitee). *Chronica Botanica*. 1951;13:1-366.
2. Sharma SK, Garhwal OP, Mahala P, Yadav TV. Influence of integrated nutrient management on yield attributes and economics of Kharif onion (*Allium cepa* L.) under loamy sand soils. *International Journal of Current Microbiology and Applied Sciences*.: 2018;7(6):806-811.
3. Balemi T. Onion for PSB in culation in integrated soil nutria manage agri Topia. 2003;18(1/2):1-2
4. Aswani G, Paliwal R, Sarolia DK. Effect of nitrogen and biofertilizer on yield and quality of rabi onion (*Allium cepa* L.) cv. Puna Red. *Agricultural Science Digest* 2005;25(2):124-126
5. Ghanti S, Sharangi AB. Effect of biofertilizers on growth, yield and quality of onion cv. Sukhsagar. *Journal of Crop and Weed* 2009;5(1):120-123.
6. Rehman SU, De Castro F, Aprile A, Benedetti M, Fanizzi FP. Vermicompost: Enhancing plant growth and combating abiotic and biotic stress. *Agronomy*. Apr 16 2023;13(4):1134.
7. Ruiz JL, Salas Sanjuan MD. The use of plant growth promoting bacteria for biofertilization; effects on concentrations of nutrients in inoculated aqueous vermicompost extract and on the yield and quality of tomatoes. *Biological Agriculture & Horticulture*. Jul 3 2022;38(3):145-61.
8. Khang VT, Patil HM, Gudedhe NN. Effect of integrated nutrient management on onion yield and soil properties in soybean-onion cropping sequence. *Omonrice* 2019;18:112-120.
9. Rabari KV, Patel MV, Kadu SP, Umale A A. Combined effect of organic and inorganic fertilizers on growth, yield attributes, bulb yield and soil nutrient status after harvest of onion (*Allium cepa* L.). *Trends in Biosciences*. 2014;7(23): 3861-3864.
10. Maji S, Das BC. Quality improvement of guava: an organic approach. *J. Asian Hort*. 2008;4:191-95.
11. Anonymous. *Indian Horticulture Database* 2013. National Horticulture Board, Ministry of Agriculture, Govt. of India, Guragaon. 2013;267.
12. Yogita, Ram RB. Effect of chemical and biofertilizers on quality of onion. *Hort Flora Research Spectrum* 2012;1(4):367-370.
13. Yogita, Ram RB, Babu M. Effect of inorganic and biofertilizers on growth and yield of onion (*Allium cepa* L.) cv. Pusa Madhavi. *Plant Archives*. 2012;12(2):645-648.
14. Kumar J, Singh O, Krishan P. Response of biofertilizers and chemical fertilizers in

- onion (*Allium cepa* L.). Progressive Agriculture. 2010;10(1): 170-172.
15. Mandal J., Ghosh C and Chattopadhyay G N. Proportional substitution of Chemical fertilizers with Vermicompost on growth and production potential of onion (*Allium cepa* L.). International Journal of Bio-resource and Stress Management 2013; 4(2):356-357.
16. Brinjh S, Kumar S, Kumar D and Kumar M. Effect of integrated nutrient management on growth, yield and quality in onion cv. Pusa Madhvi. Plant Archives. 2014;14(1): 557-559.

© 2023 Solanki et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/104734>