Int.J.Curr.Microbiol.App.Sci (2023) *12*(01): 224-231

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 12 Number 1 (2023)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2023.1201.026

Effect of Organic Manures, Bio fertilizers and Bio stimulants on the Growth and Yield of Multiplier Onion (*Allium cepa* L. *var. aggregatum* Don) CO (On) 5

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Keywords

Multiplier onion, Organic manure, vermicompost, Bio fertilizer, bio stimulant, bulblets

Article Info

Received:
05 December 2022
Accepted:
30 December 2022
Available Online:
10 January 2023

A B S T R A C T

Multiplier onion (*Allium cepa* L. *var. Aggregatum* Don.) is an important commercial vegetable crop grown in Ariyalur and Perambalur districts of Tamil Nadu. Inorganic fertilizer inputs are proven to be harmful in long-term impacts. Use of organic manures to meet the nutrient requirement of crop would be an inevitable practice in future as organic manures gradually improve the soil physical, chemical and biological properties along with conserving the moisture holding capacity of soil. Although organic fertilizers are lesser amount of nutrient than that of inorganic fertilizers, presence of growth promoting substances like enzymes and hormones make organic manure vital for improvement of soil fertility and productivity. Present study was carried out to evaluate the response of different organic source of nutrients to multiplier onion CO (On) 5 during 2017-18. The observations were recorded on five randomly selected plants and bulb yield on plot basis in each replication on growth, yield parameters and BCR. The experiment was laid out in a Factorial Randomized Block Design which included 15 treatments each of which was replicated thrice. Among the different levels of treatments, significant increase in yield parameters was found in treatment T_9, application of vermicompost 5 t ha^{-1} along with bio fertilizer (*Azospirillum*, *phosphobacteria*, Potash mobilizing bacteria and Sulphur oxidizing bacteria each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1}) and spraying of bio stimulant seaweed extract (0.1%) gave the maximum Bulb weight/ clump (14.22 g), plant height (25.73cm), Number of leaves/plant (11.46 Nos.), equatorial diameter of the bulblet (1.80 cm), polar diameter of the bulblet (2.48cm), bulb yield (9.40 t ha^{-1}). The next best treatment was T_{14} treatment application of vermicompost 5 t ha^{-1} along with bio fertilizer (*Azospirillum*, *phosphobacteria*, Potash mobilizing bacteria and Sulphur oxidizing bacteria each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1}) and spraying of bio stimulant Panchagavya (3%). The results revealed that the overall performance of Treatment T_9 was superior to all the other Treatments and this organic cultivation package is recommended in Ariyalur district, Tamil Nadu.

Introduction

Multiplier onion (*Allium cepa* L. var.*aggregatum* Don.*)* is one of the most important commercial vegetable crops in Ariyalur and Perambalur Districts of Tamil Nadu. It belongs to family *Amaryllidaceae*. On global scale multiplier onion is a minor bulb crop however in South East Asia especially in India it is a highly remunerative crop. India stands first with the contribution of 8 % to the global onion production in the world and occupies 1.65 million ha area with an average annual production of 26.64 million tonnes and productivity of 16.48 t ha^{-1} (NHB, 2020-21). The major onion producing states are Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka, Rajasthan, Gujarat, Haryana, Bihar, Uttar Pradesh, West Bengal and Tamil Nadu. These States account for almost 90% of the total onion production of the country. The major share is from Dindugal, Perambalur, Ariyalur and Trichy Districts. The total area and production of onion in Ariyalur District is 107 ha and 910 t, respectively.

It is also known as small onion, potato onion, underground onion, shallots, multiplier onion, nesting onions, ever-ready onion and Egyptian ground onion noted for its hardiness and early maturity than the common onion. All the varieties of multiplier onion do not produce seeds but CO (On) 5 propagated through seeds as well as bulblets. Multiplier onion is a unique vegetable that is used throughout the year in the form of salad or for cooking with other vegetables. Small onions are widely used in the south Indian kitchen mainly for seasoning of curries and preparation of different types of sambar, a lentil-based dish. As found in large onion, bulbs of this crop are also rich in carbohydrates, protein and minerals like phosphorus and calcium. It also contains Vitamin 'C'. It possesses anti-microbial properties. Several antioxidant compounds, mainly polyphenols such as flavonoids and sulphur-containing compounds have also been identified in this crop.

In modern agriculture, fertilizers constitute major portion of cost of production of onion. The consumer demand for organically grown vegetables is markedly increasing all over the world for both domestic and export markets. This drastic change is due to human's concern over health, which made him to produce free from harmful chemical residues. Organic farming reduces the cost of production by utilization of organic wastes as fertilizers which are said to be potential source for pollution unless they are used in productive and efficient way. In recent years, it has been realized that judicious application of organic nutrients can help in obtaining stable yield. It has been established that organic materials such as poultry manure, green manure and farmyard manure can substitute inorganic fertilizers to maintain productivity and environmental quality (Choudhary *et al.,* 2002).

This is because; nutrients contained in organic manures are released more slowly and are stored for a longer time in the soil, thereby ensuring an extended residual effect. Bio fertilizers and bio stimulants are known to supplement and promote the available nutrients for crop growth. The bulb of onion consists of swollen bases of green foliage leaves and fleshy scales. This crop is highly responsive to several Arbuscular Mycorrhiza fungi, which tend to associate with onion roots leading to improved plant growth and nutrient uptake (Mahaveer and Alok, 2000). Besides, use of bio stimulants like panchagavya and vermiwash are considered as a good input in production strategy for obtaining high yields of nutritionally valuable vegetables with lower impact on the environment.

Foliar spraying of seaweed extract on the onion gives better growth, yield and quality. The three months from November - December (or) March to April is the best season for onion cultivation in Tamil Nadu. There is a general concept that multiplier onion cultivated by seed through nursery raising and transplanting is cheaper than the onion cultivated by bulb methods. The onion crop raised by seeds comes to harvest at 120 DAS and by bulb method it comes to harvest at 90 DAS. Onion can be grown under a wide range of climatic conditions but it succeeds best in mild season without extremes of

heat and cold.. Further indigenous organic additives are integrated and response was assessed in terms of yield and quality of onion. We should emphasize on using different sources of nutrients such as farm yard manure, vermicompost, organic growth stimulants and bio fertilizers. Hence, the present experiment was conducted to study the effect of organic nutrient management on the yield and quality of multiplier onion.

Materials and Methods

A field experiment was carried out to study the effect of organic manures, bio fertilizers and bio stimulants on the growth and yield of multiplier onion (*Allium cepa* L. *var. aggregatum* Don.) in farm field of ICAR Krishi Vigyan Kendra at cholamadevi village located in Ariyalur district during the year 2017-18.

Except FYM and vermicompost no other inorganic materials were incorporated in the identified field for last 12 years. The site is located at 11º.140858' North latitude; 79º.405854' East longitude. The area usually receives annual rainfall of 954 mm, average maximum temperature of 39 ºC, average minimum temperature of 18ºC and 66% Relative humidity. Texture of soil is sandy clay loam having 7.8 pH and 0.14 µmho/cm EC. Seedlings of CO (On) 5 varieties are used for cultivation.

The experiment was laid out in a Factorial Randomized Block Design. Factor 1 was five levels of organic manures including basal soil application of FYM -25 t ha^{-1}, Vermicompost -5 t ha^{-1}, FYM -25 t ha^{-1} along with bio fertilizers (*Azospirillum*, *phosphobacteria*, Potash mobilizing bacteria and Sulphur oxidizing bacteria each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1}), Vermicompost -5 t ha^{-1} along with bio fertilizers (*Azospirillum*, *phosphobacteria*, Potash mobilizing bacteria and Sulphur oxidizing bacteria each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1}) and Control. Factor II was three levels of bio stimulants comprising humic acid @ 0.2%, sea weed extract @ 0.1 % and Panchagavya @ 3 %. All 15 treatments were replicated thrice. The organic manures-Vermicompost and FYM were applied in required quantities, Bio fertilizers viz., *Azospirillum*, phosphobacteria, Potash mobilizing bacteria and Sulphur oxidizing bacteria each @ 2 kg ha^{-1} and carrier material with VAM @ 12 kg ha^{-1} were basally applied in the main field.

The experimental field was ploughed three times by tractor and levelled to get fine tilth. Ridges and furrows were prepared at a distance of 20 cm. The preparation of plots and allocation of treatments were carried out according to the treatment schedule which were randomized. The main field was divided into 45 plots; each measuring 4m × 3m. Bulbs were planted along both the sides of the ridges at a spacing of 10 cm. Organic manures like FYM and Vermicompost were incorporated after the last ploughing in soil with spade. Before planting, bio fertilizers like *Azospirillum*, *phosphobacteria*, Potash mobilizing bacteria and Sulphur oxidizing bacteria each @ 2 kg ha^{-1} and VAM inoculum @ 12 kg ha^{-1} were incorporated at the time of planting. Humic acid, Sea weed extract and Panchagavya all prepared as 0.2%, 0.1%, & 3% solution was sprayed twice on 20^{th} and 40^{th} days after transplanting in respective treatments. Five randomly selected plants in individual plot were tagged for recording observations and were statistically analyzed.

Multiplier onion seed varieties were sown in nursery during the second fortnight of September, 2017 and 45 DAS healthy seedlings of CO (On) 5 variety were transplanted at a spacing of 20cm x10 cm during the first week of November, 2017. Recommended cultural practices like seed treatment with *Pseudomonas fluorescence* @ 10g kg^{-1} of seed, Soil application of *T.Viride* @ 2.5 kg ha^{-1}, seedling root dipping and basal manure application along with farm yard manure 25 t $ha^{-1}$and vermicompost 5 t ha^{-1}, Organic pest and disease management like spraying of *Pseudomonas fluorescens* (5 g/lit) + *Beauveria bassiana* (10 g/lit) on 30 DAP and Spraying of Azadiractin 1% (2 ml/lit) on 40 DAP, irrigation etc., were followed to raise the crop successfully. The observations recorded were plant height, number of leaves/plant, Equatorial and polar

diameter of the bulblet, weight of bulb, No. of bulblets/clump and bulb yield.

Treatment Details

T_1 - Soil application of FYM @ 25 t ha^{-1} + foliar spraying of humic acid (0.3%) on 20 & 40 DAP

T_2 - Soil application of Vermicompost @ 5 t ha^{-1} + foliar spraying of humic acid (0.3%)

T_3 - Soil application of FYM @ 25 t ha^{-1} + *Azospirillum*, *phosphobacteria*, PMB and SOB each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1} + foliar spraying of humic acid (0.3%)

T_4 - Soil application of Vermicompost @ 5 t ha^{-1} + *Azospirillum*, *phosphobacteria*, PMB and SOB each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1} + foliar spraying of humic acid (0.3%)

T_5 - No manure (control) + foliar spraying of humic acid (0.3%)

T_6 - Soil application of FYM @ 25 t ha^{-1} + foliar spraying of Seaweed extract (0.1%)

T_7 - Soil application of Vermicompost @ 5 t ha^{-1} + foliar spraying of Seaweed extract (0.1%)

T_8 - Soil application of FYM @ 25 t ha^{-1} + *Azospirillum*, *phosphobacteria*, PMB and SOB each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1} + foliar spraying of Seaweed extract (0.1%)

T_9 - Soil application of Vermicompost @ 5 t ha^{-1} + *Azospirillum*, *phosphobacteria*, PMB and SOB each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1} + foliar spraying of Seaweed extract (0.1%)

T_{10} - No manure (control) + foliar spraying of Seaweed extract (0.1%)

T_{11} - Soil application of FYM @ 25 t ha^{-1} + foliar spraying of Panchagavya (3.0%)

T_{12} - Soil application of Vermicompost @ 5 t ha^{-1} + foliar spraying of Panchagavya (3.0%)

T_{13} - Soil application of FYM @ 25 t ha^{-1} + *Azospirillum*, *phosphobacteria*, PMB and SOB each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1} + foliar spraying of Panchagavya (3.0%)

T_{14} - Soil application of Vermicompost @ 5 t ha^{-1} + *Azospirillum*, *phosphobacteria*, PMB and SOB each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1} + foliar spraying of Panchagavya (3.0%)

T_{15} - No manure (control) + foliar spraying of Panchagavya (3.0%)

Common practices for all treatments

Seed treatment with *Pseudomonas fluorescens* @10 g kg^{-1} of seed

Soil application of *T.Viride* @ 2.5 kg ha^{-1}

Spraying of *Pseudomonas fluorescens* (5 g $litre^{-1}$) + *Beauveria bassiana* (10 g $litre^{-1}$) on 30 DAP

Spraying of Azadiractin 1% (2 ml/lit.) on 40 DAP

Results and Discussion

Onions is among miraculous vegetable consume green and bulb as well as for many medicinal properties. It is a good source of vitamins, minerals, polyphenols and antioxidants to lower blood pressure and prevent some kinds of cancer. Organic farming or organic foods are becoming symbol of healthy living and common people are getting more and more aware about what they are consuming. Recent trends in agriculture are to shift to old time cultivation practice with proper management system with help of modern tool and technology. Our findings suggested (table 1) positive impact on onion and increase in production with combination of different manures, bio fertilizers and bio stimulants. The data recorded on number of bulbs per plant, bulb diameter, individual bulb weight, bulb yield per plant and bulb yield per hectare as

influenced by different organic manures, bio fertilizer, bio stimulants and their interaction effects are presented in the table-1. In aggregatum onion, the formation of bulblets starts from 40 DAP and the bulblet number varies based on the nutrient management in the land. In onion, the important yield contributing characters are mean weight of bulblets and bulb diameter. The treatment T_9, application of vermicompost along with bio fertilizer and spraying of bio stimulant seaweed extract (0.1%) gave the maximum clump weight (14.22 g). Increase in bulb yield was mainly attributed to positive association between yield and yield contributing parameters like bulb weight and size in terms of equatorial and polar diameters of the bulb. The findings of Deen and Mosleh (2008) supported that increased yield may be because of difference in yield components as bulb volume, average weight of the bulbs and crop stand. Clump weight is the most important component that contributes directly to the yield of aggregatum onion (Shoba Thingalmaniyan *et al.,* 2017). Onion is a crop of green harvest as well as bulb yield. Length of leaves have it importance not only as photo-synthetically active site but also as economic point.

The average maximum plant height was observed in T_9 (25.73cm) followed by T_{14} (25.63 cm) and T_8 (25.39 cm). Application of FYM significantly enhanced the plant height (55.83 cm) and No. of leaves (15) in Soya bean as compare to control (9.2) and higher plant height (76.10 cm) over control (70.60 cm) in wheat (Singh and Agarwal, 2001). The average number of leaves was noted maximum in the T_9 (11.85), followed by T_{14} (11.67). The average bulb equatorial diameter was observed maximum in T_9 (1.80 cm) cm followed by T_{14} (1.78 cm) and T_8 (1.76 cm). Similar result was recorded for garlic bulb diameter (3.95cm) over control (3.53cm) (Zakari *et al.,* 2014) and for onion (Fisseha, 1983). Above description suggests that application of Vermicompost along with combinations of bio fertilizers and bio stimulants increases the growth and yield parameter.

Among the different levels of Treatments, T_9 treatment application of vermicompost along with bio fertilizer and spraying of bio stimulant seaweed extract (0.1%) recorded the highest values for all traits observed. The next best treatment was T_{14} treatment application of vermicompost along with bio fertilizer and spraying of bio stimulant Panchagavya (3%). Foliar application of bio stimulants (Factor 2) also had significant influence on yield per plant. Seaweed extract @ 0.1% registered best results. Combined application of organic manures, bio fertilizer and bio stimulants also showed significant differences for yield parameters.

This was followed by T_8. Next better treatment was T_{13} which was on par with T_4. The minimum was observed in control (T_5). Application of vermicompost and bio-fertilizers improved the bulb dimension significantly. Increase in porosity and water holding capacity of the soil due to organic manures might have contributed in keeping the land favourable for accumulation of photosynthesis in underground organs, which ultimately would have resulted in increased bulb length and diameter. Further, there may be improved solubilisation of plant nutrients due to combined application of vermicompost, farmyard manure and bio-fertilizers leading to increased uptake of NPK. Comparatively increased yield was also obtained due to application of farmyard manure. This may be attributed to the high amount of macro nutrients and other essential nutrients required for plant growth (Dekisissa *et al.,* 2008). The use of such manure positively influences vegetative growth of plants due to better mineralization as stated by Elbehri *et al.,* (1993) in grain amaranth and by Ojeniyi and Sanni (2000) in okra. Higher yield was also realized due to application of Vermicompost. This may be attributed to the high level of nutrients along with growth stimulating substances excreted by earthworms into their casts. The findings of Mohamed Rafi *et al.,* (2002) revealed that application of FYM 12.5 t ha^{-1} + Vermicompost 2.5 t ha^{-1} + Panchagavya 3% foliar spray improved the yield of tomato.

Table.1 Effect of organic manures, bio fertilizers and bio stimulants on yield characteristics of multiplier onion

Treatments	Plant height (cm)	Number of leaves/plant (Nos.)	Equatorial diameter of the bulblet (cm)	Polar diameter of the bulblet (cm)	Bulb weight/ clump (g)	No. of Bulblets /clump (Nos.)	bulb yield (t ha^{-1})
T_1	22.99	10.34	1.65	2.37	12.69	3.33	8.55
T_2	23.83	10.39	1.69	2.40	12.93	3.41	8.75
T_3	24.57	10.14	1.72	2.43	13.10	3.41	9.02
T_4	25.24	11.29	1.77	2.45	13.19	3.43	9.32
T_5	18.33	7.37	1.58	2.24	11.48	2.23	6.16
T_6	23.48	10.69	1.67	2.39	13.02	3.32	8.68
T_7	24.29	10.21	1.71	2.42	13.14	3.46	8.96
T_8	25.39	11.24	1.76	2.47	13.86	3.47	9.28
T_9	25.73	11.46	1.80	2.48	14.22	3.48	9.40
T_{10}	18.60	7.44	1.59	2.27	11.70	2.37	6.45
T_{11}	23.16	9.14	1.66	2.38	12.33	3.24	8.59
T_{12}	24.03	10.16	1.71	2.42	13.05	3.43	8.85
T_{13}	24.95	10.39	1.73	2.45	13.01	3.43	9.07
T_{14}	25.63	11.32	1.78	2.48	13.47	3.44	9.35
T_{15}	18.43	7.50	1.58	2.26	12.26	3.24	6.40
Mean	23.24	9.94	1.69	2.40	12.90	3.25	8.46
SEd	0.32	0.24	0.01	0.01	0.21	0.09	0.18
CD (0.05)	0.66	0.50	0.03	0.02	0.44	0.18	0.38

Further, bulking after 40 days would have been supported by continuous supply of nutrients by the way of sprays (bio stimulants) that are linked to the increased bulb diameter as reported in large onion by Velu, (2002) and in shallot onion by Yoldas *et al.*, (2011). Such results of increased bulb weight, bulb yield per plant and bulb yield per hectare due to vermicompost and farmyard manure application could be attributed to easy solubilisation effect of released plant nutrients leading to improved nutrient status and water holding capacity of the soil. VAM are wide spread group of soil fungi that enhance yield of crops (Thanuja, 2002). Nagaraju *et al.*, (2000) reported that, the bulb diameter of onion significantly increased with the application of VAM in combination with 50% SSP as compared to 100% SSP and no inoculation. In this experiment yield increase in seaweed treated plants are thought to be associated with the hormonal substances present in the extracts especially Cytokinin. Similar findings were reported by Dogra and Mandradia (2012) in onion plants. The study can be concluded stating that yield of this specific ecotype of aggregatum (*Allium cepa* L. *var. aggregatum* Don.) grown by farmers of Ariyalur District can be significantly improved by application of Soil application of Vermicompost @ 5 t ha^{-1} + *Azospirillum*, *phosphobacteria*, PMB and SOB each @ 2 kg ha^{-1} + VAM @ 12 kg ha^{-1} + foliar spraying of Seaweed extract (0.1%). Repeated usage of such inputs over a few years would establish the merits of using organic nutrients in terms of sustainability.

Present study concludes that vermicompost along with bio fertilizer and bio stimulant seaweed extract (0.1%) significantly influenced on various observed growth and yield parameters in comparison to Farmyard Manure, FYM + bio fertilizer,

vermicompost and control. Among all treatments T_9 (9.40 t ha^{-1}) showed optimum results. Even treatment T_{14} and T_8 showed better result over control. The results revealed that the overall performance of Treatment T_9 was superior to all the other Treatments and this organic cultivation package is recommended in Ariyalur district.

References

Choudhary, B. R., M. S. Fageria and R. S. Dhaka (2002). Effect of different sources of organic amendments on growth and yield of onion in mine spoil. *Madras Agric. J.*, 84(7): 382- 384.

Deen, U D & M D. Mosleh, (2008). Effect of mother bulb size and planting time on growth, bulb and seed yield of onion. *Bangladesh Journal of Agricultural Research* 33(3):531-537. https://doi.org/10.3329/bjar.v33i4.2285

Dekisissa, T., I. Short and J. Allen (2008). Effect of soil amendment with compost on growth and water use efficiency of amaranth. In: Proc. of UCOWR/NIWR Annual conf. Intl. Water Resources: challenges for the 21st century and water resources education: 22-24, Durham, NC.

Dogra, B. S. and R. K. Manradia (2012). Effect of seaweed extract on growth and yield of onion. *Intl. J. Farm Sci*., 2(1): 59-64.

Elbehri, A., D. H. Putman and M. Schmitt (1993). Nitrogen fertilizer and cultivar effects on yield and nitrogen-use efficiency of grain amaranth. *Agron. J*., 85: 120-128. https://doi.org/10.2134/agronj1993.00021962008500010023x

Fisseha G. The effect of alternative source of organic fertilizer in increasing the yield of onion (*Allium cepa* L.). (Published MSc. thesis), Addis Ababa University, Addis Ababa, Ethiopia, 1983

Mahaveer and Alok, (2000). Enhanced Growth and Productivity following Inoculation with Indigenous AM Fungi in Four Varieties of Onion (*Allium cepa* L.) in an Alfisol**.** *Biological Agriculture and Horticulture* 18(1):1-14 https://doi.org/10.1080/01448765.2000.9754860

Mohamed Rafi, P., R. Narwadkar, T. Prabu and A. K. Sajindranath (2002). Effect of organic and inorganic fertilizers on growth and yield of tomato (*Lycopersicon esculentum* Mill.). *South Indian Hort*., 50 (4-6): 522-526.

Nagaraju, R., K. Haripriya, G. V. Rajalingam, V. Sriamachandrasekarn and M. K. Mohideen (2000). Effect of VAM on growth and yield of aggregatum onion (*Allium cepa* L. var. *aggregatum* Don). *South Indian Horti*., 48: 40-45.

Ojeniyi, S. O. and T. S. Sanni (2000). Response of soil and okra nutrient contents, growth and yield to application of neem fruit powder. *J. Sustainable Agrc. and Environ.*, 2(2): 269- 274.

Shoba Thingalmaniyan., N. Rohini and T. Arumugam (2017). Performance Evaluation of Aggregatum Onion Genotypes (*Allium cepa Var. Aggregatum*) for Yield, Quality and Resistance Characters. *Int.J.Curr.Microbiol.App.Sci* (2017) 6(6): 634-642. https://doi.org/10.20546/ijcmas.2017.606.075

Singh R, Agrawal P K (2001). Growth and yield of wheat (*Triticum aestivum*) as influenced by level of farm yard manure and nitrogen. *Indian Journal of Agronomy*. 2001; 46(3):462-467.

Thanuja, T. V. (2002). Induction of rooting and root growth in black pepper cuttings (*Piper nigrum* L.) with the inoculation of arbuscular mycorrhizae. *J. Sci. Hort*., 92(3- 4): 339-346. https://doi.org/10.1016/S0304-4238(01)00299-0

Velu, G. (2002). Effect of nutrients and plant growth regulators on yield of sunflower. *Madras Agrl. J*., 89(4-6): 307-09.

Yoldas, F., S. Ceylan, N. Mordogan and B. C. Esetlili (2011). Effect of organic and inorganic fertilizers on yield and mineral content of onion (*Allium cepa* L.). *African J.Biotechno*., 10(55): 11488-11492. https://doi.org/10.5897/AJB10.2535

Zakari S M, Miko S, Aliyu B S. Effect of different types and levels of organic manures on yield and yield components of garlic (*Allium sativum*) at Kadawa, Kano, Nigeria. *Bayero Journal of Pure and Applied Sciences*. 2014; 7(1):121-126. https://doi.org/10.4314/bajopas.v7i1.22

How to cite this article:

Yesuretnaraj Raja Joslin, P. Irene Vethamoni, K. Rajappan, L. Chithra and Jeeva, S. 2023. Effect of Organic Manures, Bio fertilizers and Bio stimulants on the Growth and Yield of Multiplier Onion (*Allium cepa* L. *var. aggregatum* Don) CO (On) 5. *Int.J.Curr.Microbiol.App.Sci.* 12(01): 224-231.
doi: https://doi.org/10.20546/ijcmas.2023.1201.026