AATCC Review

02 October 2024: Received
30 December 2024: Revised
28 January 2025: Accepted
01 February 2025: Available Online

https://aatcc.peerjournals.net/

Original Research Article

Open Access

Storage Quality of Onion (*Allium Cepa* L.) As Influence by Seedling Age And Biofertilizer Combinations

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ABSTRACT

The mentioned experiment was carried out at the Horticulture Nursery of the college of agriculture, Gwalior, during the rabi_seasons of 2019-20 and 2020-21 with the same treatments and the same site. The experiment was laid down in factorial randomized block design with two factors viz., Seedling age and bio fertilizers combinations along with 15 treatment combinations and three replications. The factor one have three levels viz.,S-1 6 weeks, $S_2$7 weeks and $S_3$8 weeks whereas second factor BF_1- un-inoculated (control), BF_2. Azotobecter BF_3- Azotobecter+ PSB, BF_4-Consortia (Azotobecter+ PSB + KMB) and BF_5- Arka Microbial Consortium(Azotobecter+ PSB + ZSB). Under the observations, the 7 weeks old seedlings were performed well for low physical weight loss, bulb sprouting, and bulb rotting under different stages of the storage condition. The BF_5- Arka Microbial Consortium(Azotobecter+ PSB + ZSB) has observed superior for the same observations like low physical weight loss, bulb sprouting, and bulb rotting under different stages.

Keywords: *physical weight loss, bulb sprouting and bulb rotting, storage condition and biofertilizers*

Introduction

Onion is a one of the most important kitchen vegetables used as food flavoring and salad. There is no dish is completed without onion in India. Quality onion production is very important for the prevention of so many bacterial and viral diseases.

Bio-fertilizers are a gift for modern agricultural sciences retards the nitrification for a sufficiently longer time and increases the soil fertility. Bio-fertilizers are important components of integrated nutrient management. They play a key role in the productivity and sustainability of soil while protecting the environment, being cost-effective, eco-friendly, and renewable sources of plant nutrients to supplement chemical fertilizers in sustainable agricultural systems. These are the microbial inoculants containing the living or latent cells of efficient strains used for application to seeds-, soil or composting areas with the purpose of accelerating the microbial process to augment the availability of nutrients that can easily be assimilated by plants, colonize the rhizosphere or the interior of the plant and promotes growth by converting nutritionally important elements to available form through biological process such as nitrogen fixation and solubilization of rock phosphate.

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DOI: https://doi.org/10.21276/AATCCReview.2025.13.01.185

Biofertilizers are microbial inoculants or carrier-based preparations containing living or latent cells of efficient strains of nitrogen-fixing, phosphate solubilizing and cellulose decomposing microorganisms intended for seed or soil application and designed to improve soil fertility and plant growth by increasing the number and biological activity of beneficial microorganisms in the soil. Bio-fertilizers are generally used as microbial inoculants, which may help in increasing crop productivity by enhancing the efficiency of natural biological nitrogen fixation, solubilization of insoluble forms of nutrients, and stimulating plant growth. The N fixing potential of Azotobacter varies soil to soil depending upon a number of environmental and ecological factors it inoculation also has been found effective in increasing nitrogen content in the plant`s dry matter (Badgire and Bindu 1976). Inoculation with efficient strains of Azotobacter contributes about 15-20 kg N per hectare in different crops and integrated use of P solubilizing bacteria with contributes 30-35 kg P2O5 ha-1 in natural to slightly alkaline soils. The introduction of beneficial microbes in inorganic fertilizers has received a considerable amount of attention in the last decades as the microbes are effective in promoting plant growth by secreting phyto-hormones and metabolites. The application of bio-inoculants containing N-fixing bacteria and P-solubilizing bacteria have proven to improve leaf chlorophyll, plant nutrient uptake, and yield of rice in which the use of N and P fertilizer was able to be minimized by 50%.

The indirect mechanism includes the biological control against diseases which includes antibiosis, induction of systemic resistance, and competition for nutrients and niches (Amir et al. 2005). Biofertilizers could be produced growth-promoting factors, e.g., gibberellins, cytokinins and auxins (Vessey, 2003). The addition of biological microbes from organic fertilizer can have a positive impact on plant growth and production.

Transplanting is another option in the basket of choice available to farmers, to minimize the risk of crop failure or patchy stands, so achieving better yields during years when the rain is late and providing a safety net when the rains are erratic. Generally, farmers transplant onion based on their own judgment on the age/size of seedlings which critically influences the productivity and quality of the bulb. Both late and early-age transplanting of seedlings may have a significant influence on the survival and growth performance of onion.The age of seedlings is an important consideration in transplanting. The onset of the rainy season in semi-arid tropics is highly variable.

Arka Microbial Consortium is a carrier-based product that contains N fixing, P, and Zn solubilizing and plant growth-promoting microbes as a single formulation. The novelty of this technology is that farmers need not apply N fixing, phosphorous solubilizing and growth-promoting bacterial inoculants individually. Phosphorus solubilizing bacteria and fungi play a vital role in persuading the insoluble phosphatic compounds such as rock phosphate, bone meal and basic slag and particularly the chemically fixed soil phosphorus into available form (Pindi and Satyanarayana, 2012).

Biofertilizers combined with organic manure and inorganic fertilizers influences the plant growth by enhancing root biomass, total root surface facilitates higher absorption of nutrients and increases in yield by reducing consumption of natural sources of energy (Prasad *et al.,* 2017). Many studies mentioned the positive effects of organic fertilizer with bio-fertilizer on vegetative growth, yield, and quality of onion (Singh *et al.,* 2015). But, the use of microbial consortium combined with NPK fertilizer is long-term sustainable nutrient management that can be beneficial for improving the quality of soil fertility.

Material and Methods

The present experiment entitled "Effect of bio-fertilizers on growth, yield, quality and storage of onion (*Allium cepa* L.) under different seedling age" was carried out, during two consecutive Rabi seasons of 2019 -20 and 2020-21 at the horticulture nursery, College of Agriculture, Gwalior, The research farm is situated at the of 26↼ 13' North latitude and 76↼ 14' East longitude with an altitude of 211.52 meters above Mean Sea Level. The field of research farm having homogenous fertility and uniform textural make up was selected for the field experimentation.

The region comes under a semi-arid and sub-tropical climate with extreme weather conditions having hot and dry summers and cold winters. Generally, monsoon sets in the last week of June. Annual rainfall ranges from 700 to 800 mm, most of which falls during the last week of June to the middle of September. 44 Winter rains are occasional and uncertain. The maximum temperature goes up to 47°C during summer and the minimum as low as 2.8° C during winter. Usually, the monsoon arrives in the second fortnight in June and lasts till September. An average precipitation of 700 mm is usually received from July to September with few showers during winter.

The soil of the experimental field was alluvial, sandy clay loam in texture. Representative soil samples of surface (0-20 cm depth) were collected from each plot before transplanting and after harvest of onion with the help of soil auger for determination of physic-chemical properties of soil.

Six, seven- and eight-week`s old seedlings of onion, having three to five leaves were transplanted as per treatments. The seedlings were lifted in clumps with the soil around the roots with the help of khurpi and carried to the field in a basket covered with moist gunny bags. After separating out the individual, but, sturdy seedlings from clumps', planting was done on pre-marked spacing of 15 x 10 cm in the afternoon during both the years. The onions were stored under plastic mesh partially open ground fully ventilated from all sides. Ten randomly selected onion bulbs were marked in each treatment and were tested for changes in the quality of onion bulbs for the period of three months at an intervals of 45, 60 and 90 days after harvesting.

Treatments details

Table:1

A. Main treatments (03): Seedling age	Treatment Notation
6 weeks	S_1
7 weeks	S_2
8 weeks	S_3
B. Sub treatments (05): bio fertilizers combinations	
un-inoculated (control)	BF_1
Azotobecter	BF_2
Azotobecter+ PSB	BF_3
Consortia (Azotobecter+ PSB + KMB)	BF_4
Arka Microbial Consortium (Azotobecter+ PSB + ZSB)	BF_5

Table.2. Treatments combinations

T_1: S_1BF_1	T_2: S_1BF_2	T_3: S_1BF_3	T_4: S_1BF_4	T_5: S_1BF_5
T_6: S_2BF_1	T_7: S_2BF_2	T_8: S_2BF_3	T_9: S_2BF_4	T_{10}: S_2BF_5
T_{11}: S_3BF_1	T_{12}: S_3BF_2	T_{13}: S_3BF_3	T_{14}: S_3BF_4	T_{15}: S_3BF_5

RESULT AND DISCUSSION

Effect of seedling age on storable quality of onion

The analysis of the storage quality of the onion was essential to identify the economic loss due to loss of moisture, sprouting, and rotting loss of the onion bulb during the storage condition. It is decreasing the quality of the understorability of onion, observation on physical loss of weight, sprouting, and rotting percentage were observed after 45, 60 and 90 days after harvesting (DAH) and respective data are presented in table 3 and Fig.1.

The physical loss in weight revealed from the mean of two years data, that different treatments of seedling age showed non-significant differences with each other. However, minimum physical loss in weight war recorded in treatment S_{1-} (6 weak old seedling transplanted) if stored up to 45 and 60 days after harvest respectively and when the 7 weeks old age seedlings were transplanted, the treatment S_2 show minimum (16.09%) weight loss for 90 days storage after harvest. This is might be due to the 7 days old seeding performed very well under Gwalior condition and the little bit effect of variety also shows the minimum physical loss during the storage condition. In relation to the effect of seedling age on sprouting **%,** It is revealed from two years of pooled data, that different treatments of seedling age noted only marginal differences in sprouting percentage and showed non-significant differences with each other. However, minimum sprouting percentage(11.26%) was noted with 7 weeks old seedling age during storage at 90 days after harvesting of the crop. Concerning rotting the same trends was followed at 90 DAH.

This may be ascribed to the maximum weight loss associated with the resumption of higher incidence of sprouting and rotting presumably through an increase in the rate of respiration. Similar findings on storage parameters were also reported by Bhalekar*et al.* (1987) and Dankhar and Singh (1991).

Effect of biofertilizers

The impact of biofertilizers mathematically shows a statistically significant difference value at 45, 60, and 90 days after harvest. The impact of various biofertilizers on the mean of two years of data revealed that the minimum physical loss was noted in the treatment BF_2: *Azoto* when it was stored at 45 DAH. This is might be due to the azotobacter increasing more dry matter production by better nitrogen fixation and solubilization of soil phosphate. These factors may be responsible for healthy onion bulb production and minimizes weight loss. When it was stored at 60 and 90 DAH the minimum weight loss (13.50 &15.52% respectively) was recorded in the treatment BF_5: Arka microbial consortium- (*Azoto*+PSB +ZSB) followed by other treatments. This is might be due to the Arka microbial consortium stimulating the formation of plant growth promoting microbes and these microbes increase the nitrogen fixation and solubilization of the soil phosphate and zinc. The zinc and phosphate may increase the better-quality production of proteins and amino acids and the formation of carbohydrates that is responsible for better self-life. The zink is also helps to biosynthesis of cytochrome and maintain plasma membrane integrity and this is also helps to increase the storage life of the onion bulb. The close findings are Pindi and Satyanarayana, 2012), Koli and Jayanthi (2018), Deshmukh *et al.* (2019) and Bahman *et al.*(2020).

In relation to the sprouting of onion bulb in storage condition at different stages, the bio-fertilizer inoculated treatments showed a non-significant difference at 45 DAH stage but the difference was significant at 60 and 90 DAH stages, during both the years as well as a pooled basis.

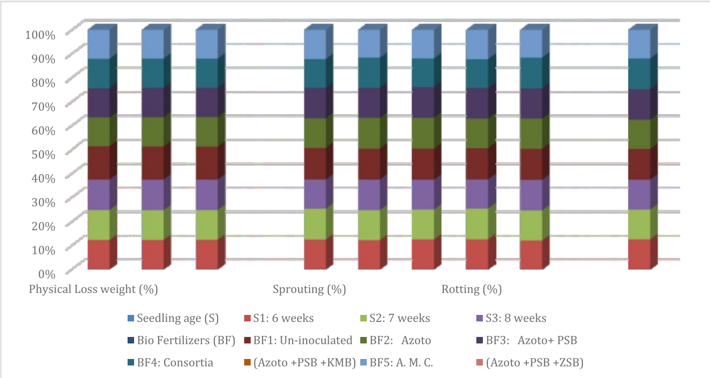
Based on two years pooled data, minimum sprouting percentage found in Arka Microbial Consortium (*Azoto*+ PSB + ZSB) was comparable with Consortia (*Azoto*+ PSB + KMB) at 90 DAH stage and significantly lower as compared to all other bio-fertilizer treatments at 60 and 90 days after harvesting stages. Whereas, the maximum sprouting percentage in onion was found in un-inoculated treatment during storage period. This is might be due to the Arka microbial consortium stimulating synthesis of bio stimulant and solubilization of phosphorus and zinc. These factors might be responsible for healthy bulb formation and synthesis of more biomass and the activation of enzymes might suppress sprouting. The results of these findings are supported by the reports of Singh and Dhankar (1989) who reported that sprouting and rotting percentage was reduced considerably during storage in the bulbs with the application of bio-fertilizers along with minerals fertilizers. Similarly, Nandi *et al*. (2002).

With respect to rotting percent,it is revealed that bio-fertilizer inoculated treatments showed a non-significant difference at 45 DAH stage but the difference was significant at **60** and 90 DAH stages, during both the years as well as pooled basis. Based on two years pooled data, the minimum rotting percentage found in Arka Microbial Consortium (*Azoto*+ PSB + ZSB) was comparable with *Azotobacter* at 90 DAH stage and significantly lower as compared to all other bio-fertilizer treatments at 60 and 90 days after harvesting stages. Whereas, the maximum rotting percentage in onion was found in un-inoculated treatment during all storage periods. The minimum rotting percent might be due to the arka microbial consortium consisting of azotobactor, PSB and ZSB, the zink solubilizing bacterial and PSB reduced the disease during the crop production and storage condition. The close findings are Barman *et al.* (2016), Koli and Jayanthi (2018)

Table 3. Storage quality of onion (allium cepa l.) as influence by seedling age and biofertilizers

Treatments	**Physical Loss weight (%)**			**Sprouting (%)**			**Rotting (%)**		
	45 DAH	**60 DAH**	**90 DAH**	**45 DAH**	**60 DAH**	**90 DAH**	**45 DAH**	**60 DAH**	**90 DAH**
Seedling age (S)									
S_1: 6 weeks	9.12	13.92	16.13	1.34	5.80	11.40	1.26	3.74	7.23
S_2: 7 weeks	9.22	14.02	16.09	1.37	5.89	11.26	1.28	3.86	7.10
S_3: 8 weeks	9.37	14.38	16.46	1.30	6.01	11.28	1.21	3.93	7.16
SEm (±)	0.13	0.16	0.18	0.02	0.07	0.08	0.02	0.06	0.05
CD (P=0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**
Bio Fertilizers (BF)									
BF_1: Un-inoculated	10.29	15.57	17.90	1.41	6.10	11.71	1.31	3.99	7.35
BF_2: *Azoto*	8.90	13.80	16.02	1.32	6.07	11.66	1.23	3.90	6.97
BF_3: *Azoto*+ PSB	8.98	13.89	15.87	1.36	5.92	11.58	1.28	3.87	7.31
BF_4: Consortia (*Azoto*+PSB +KMB)	9.10	13.77	15.83	1.28	5.96	10.85	1.20	3.97	7.34
BF_5: A. M. C. (*Azoto*+PSB +ZSB)	8.92	13.50	15.52	1.30	5.45	10.77	1.22	3.56	6.83
SEm (±)	0.15	0.21	0.25	0.04	0.09	0.13	0.04	0.06	0.09
CD (P=0.05)	**0.43**	**0.60**	**0.70**	**NS**	**0.27**	**0.36**	**NS**	**0.17**	**0.25**
Interaction (S x BF)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Fig.1.Storage quality of onion (allium cepa l.) as influence by seedling age and biofertilizers



Conclusion

This is concluded that the application or inoculation of arka microbial consortium is highly helpful for reducing the storability loss during the storage condition at different stages. It can be recommended for further work.

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