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Effect of organic nutrient management on quality parameters of late kharif onion (*Allium cepa* L.) cv. Bhima Super

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Abstract
Onion, a seasonal crop has comparatively low storability. Sometimes bulbs are to be stored for longer period due to seasonal glut in the market. Significant losses in the quality and quantity of onion occur during storage. Post-harvest losses occur mainly due to sprouting, rotting and physiological loss in weight. Therefore, an experiment was undertaken in Washim district of Maharashtra to assess the effects of integrated nutrient management on the quality parameters of late Kharif onion bulbs. The experiment consists of thirteen treatments in combination with chemical fertilizer, Biodynamic preparation, manure and combinations of different organic manure. The experiment was laid out in a randomized complete block design with three replications. Results revealed that combined application of 50% RDN through FYM (q ha^{-1}) + 50% RDN through Vermicompost (q ha^{-1}) + Azotobacter (kg ha^{-1}) + PSB (kg ha^{-1}) (T9) gives highest oleoresin content (10.61 and 10.53%), TSS (12.93 and 14.23 0brix), maximum dry matter content (14.01% and 14.57%) and Total sugars (8.22% and 8.87%) and reducing sugar (5.01 and 4.23%), non-reducing sugars content (3.21% and 4.54%) after curing of the bulbs and after 60 days of storage, respectively.

Keywords: Farmyard manure, integrated nutrient management, nitrogen, late kharif onion, vermicompost

Introduction
Onions are an important nutritive and protective food valued for their qualities, essential for a balanced diet and maintenance of physiological activities in human body. Onion (*Allium cepa* L.) is one of the important commercial bulbous crop cultivated extensively in India and it belongs to family '*Alliaceae'*. It has chromosome number of 2n=2x=16. The genus allium is very large having 500 species, which are perennial and mostly bulbous plant. Out of these, only 7 species are in cultivation (Hanlet, 1990) [5].

Onion bulb is strongly contracted subterranean shoot with thickened, fleshy leaves as food organ. The bulb is composed of carbohydrates (11.0 g), proteins (1.2 g), fibre (0.6 g), moisture (86.8 g) and energy (38 cal.). Apart from these, vitamins like 'C' (11 mg), thiamine (0.08 mg), riboflavin (0.01 mg) and niacin (0.2 mg) and minerals like phosphorus (39 mg), calcium (27 mg), sodium (1.0 mg), iron (0.7 mg) and potassium (1.57 mg) are also recorded per 100 g material (Anon., 1978) [1].

Organic agriculture is gaining momentum in India due to individual as well as group efforts to conserve the environment and avoid contamination of farm produce from the use of chemical fertilizers and pesticides. The organic vegetable industry is flourishing due to consumer preference for organically produced vegetables over traditionally grown vegetables due to their health consciousness. The problem of the high cost of chemical fertilizers which supplies only few major nutrients lead to thinking of using different sources of nutrients such as farm yard manure, vermicompost, neem cake, poultry manure and biofertilizers.

Vermicompost provides vital macronutrients (N, P, K, Ca and Mg) and micronutrients (Fe, Mo, Zn and Cu). Poultry manure is the organic waste from poultry composed of mainly feces and urine of chikens. The total N and P contents of poultry manures and litters are among the highest of all animal manures. The bio-fertilizers are alternative sources to meet the nutrient requirement of crops and to bridge future gaps. Azotobacter belongs to family *Azotobacteriaceae*, aerobic free living and heterotrophic in nature. The bacterium produces antifungal antibiotics which inhibits the growth of several pathogenic fungi in root region thereby preventing seedling mortality to a certain extent. Phosphorous solubilizers are different

species of bacteria which solubilize insoluble inorganic phosphate compound such as rock phosphate, dicalcium phosphate (Yogita and Ram, 2012) [14].

Onion a seasonal crop has comparatively low storability. Sometimes bulbs are to be stored for longer period due to seasonal glut in the market. Significant losses in the quality and quantity of onion occur during storage. Hence, keeping these facts in view the study about integrated nutrient management in late kharif onion was carried out with an objective effect of integrated nutrient management on the quality parameters of late Kharif onion bulbs.

Materials and Methods

Description of the Study Area

The study was conducted at the instructional farm, Krishi Vigyan Kendra, Karda, Washim during late kharif season of 2019-20 and 2020-21. KVK, Karda, block Risod, District Washim is situated in a subtropical region between 20.03° N, latitude and 76.77° E longitude and at an altitude of 522 m above the mean sea level. The climate of Karda is semi-arid and characterized by three distinct seasons i.e. hot and dry summer from March to May, warm humid and rainy monsoon from June to October and mid cold winter from November to February.

Treatments and experimental design

In the experimental design there were thirteen treatments and they were replicated thrice. The treatment consisting of chemical fertilizer, Biodynamic preparation, manure and combinations of different organic manure. The details about the same are given below.

The experimental design there were thirteen treatments and they were replicated thrice.

T_1	50% RDN through FYM (43.6 q ha^{-1}) + 50% RDN through Neem cake (13.1 q ha^{-1})
T_2	50% RDN through FYM (43.6 q ha^{-1}) + 50% RDN through Poultry manure (37.2 q ha^{-1})
T_3	50% RDN through FYM (43.6 q ha^{-1})+ 50% RDN through Vermicompost (31.0 q ha^{-1})
T_4	50% RDN through FYM (43.6 q ha^{-1})+ Azotobacter (5 kg ha^{-1}) + PSB (5 kg ha^{-1})
T_5	50% RDN through Neem cake (13.1 q ha^{-1}) + Azotobacter (5 kg ha^{-1}) + PSB (5 kg ha^{-1})
T_6	50% RDN through Poultry manure (37.2 q ha^{-1}) + Azotobacter (5 kg ha^{-1}) + PSB (5 kg ha^{-1})
T_7	50% RDN through FYM (43.6 q ha^{-1}) + 50% RDN through Neem cake (13.1 q ha^{-1}) + Azotobacter (5 kg ha^{-1}) + PSB (5 kg ha^{-1})
T_8	50% RDN through FYM (43.6 q ha^{-1}) + 50% RDN through Poultry manure (37.2 q ha^{-1}) + Azotobacter (5 kg ha^{-1}) + PSB (5 kg ha^{-1})
T_9	50% RDN through FYM (43.6 q ha^{-1}) + 50% RDN through Vermicompost (31.0 q ha^{-1}) + Azotobacter (5kg ha^{-1}) + PSB (5 kg ha^{-1})
T10	Biodynamic 501& 500 + solution S_9 (cow pat pit) + Biodynamic manure (91.0 q ha^{-1})
T11	Biodynamic 501& 500 + solutionS_9 (cow pat pit)
T12	Recommended dose of fertilizer (100:50:50 kg ha^{-1})
T13	Control

The experiment was laid out in a randomized block design with three replications. The gross plot size was 2.5 m x 2 m (5 m2). The distance between blocks were 2 meters whereas the distance between plots was 1m and the spacing between rows and plants were 15 cm by 10 cm.

Experimental procedure

The high yielding onion variety Bhima Super developed by ICAR-Directorate of Onion & Garlic Research (DOGR), Rajgurunagar, Pune (Maharashtra) was used. All proper agronomic practices were carried out until the seedlings were transferred to the main field. The field was ploughed followed by harrowing and to bring the soil to a fine tilth. Clods were broken with the rotavator and plot was leveled. seeds were sown on the bed during 2nd week of August and watered regularly on alternate days. Beds were prepared before transplanting the seedlings and 45 days old seedling were transplanted during the last week of September. Experimental plots of 2.5 m x 2 m were prepared. The recommended dose of nitrogen (RDN- 100 kg ha^{-1}) was applied through organic manure one month before the transplanting of plant. Chemical fertilizers were applied at the rate of 100 kg ha^{-1} N, 50 kg ha^{-1} P_2O_5 and 50 kg ha^{-1} K_2O in the form of Urea, SSP and MOP respectively. Half dose of nitrogen and full dose of P_2O_5 and K_2O was given at time of transplanting and the remaining half dose of nitrogen was applied 30 days after transplanting. The Biofertilizers, Azotobacter and PSB was mixed with small quantity of fine organic manure and applied in the required quantity per treatment before transplanting of seedling. Light irrigation was given immediately after transplanting and subsequent irrigations were given to the plots at an interval of 10-12 days as per the situation during period of experimentation. Other recommended agronomic practices like weeding, insect pest and disease control, etc., were kept uniformly for all treatments. Harvesting of onion bulbs was done when 70% plants showed neck fall.

Methods for quality parameter measurement

Measurements on the quality parameters i.e. oleoresin content (%), total soluble solids (%), dry matter content, total sugars (%), reducing sugar, non-reducing sugar and sulphur (%) were conducted. The estimation of oleoresin from the powder of oven dried onion bulbs after curing of bulb and after 60 days of storage was carried out by Soxhlet apparatus method given by Thimmaiah S.R (1999) [13]. Scales from randomly selected bulbs were macerated for juice extraction and total soluble solids of the juice was determined after curing of bulb and after 60 days of storage by using a Hand Refractometer (0 to 32% range). The values were expressed as per cent total soluble solids of the bulb. Total sugars, reducing and non-reducing sugars in percentage were estimated as per the following prescribed method. Five grams of fresh bulb obtained from random bulb sample under each treatment was preserved in 80 per cent alcohol and kept in a refrigerator. The bulb samples were taken on 20, 40 and 60 days after storage. Total sugars of the experimental bulb were determined by "Dubois method". In this method 5 per cent phenol and 96% conc. H_2SO_4 was used to carry out the chemical analysis. Absorbance of the sample was noted at 490 nm. (Anon., 1978) [1]. Reducing sugars was estimated by using Nelson-Smogyi method. In this method Dinitrosalicylic acid method reagent used and absorbance was noted at 540 mm. (Miller, 1972) [8]. Non reducing sugars were determined by subtracting the value of reducing sugars from total sugars.

The percentage of non- reducing sugars was obtained by subtracting the values of reducing sugars from that of total sugars and multiplying the same with 0.95 as given below (Somogyi, 1952) [12]. The sulphur content after curing of bulb and after 60 days of storage was determined by using barium sulphate turbiditary method given by Chesnin and Yein (1951) [2].

Data Analysis

The data of the experiment were analysed statistically following the procedure described by Gomez and Gomez (1984) [4]. The level of significance used in 'F' and 't' test was P=0.05. Critical difference values were calculated wherever the 'F' test was significant.

Results and Discussion

Oleoresin content (%)

The data regarding the oleoresin content of onion bulbs as influenced by various treatments of organic manure and bio-fertilizers is presented in Table 1. The data presented in Table 1 revealed that, an oleoresin content of onion bulbs was significantly influenced due to the different treatments during both the years of study. However, as per pooled data, maximum oleoresin content (10.61 and 10.53%) after curing of onion bulb was recorded T_9 and T_7 in and after 60 days of storage was recorded in the treatment in T_9 and T_2 (9.30 and 9.24%) respectively. Whereas, lowest oleoresin content after curing of bulb (10.22 and 8.91%) after curing and 60 days of storage was recorded in absolute control treatment.

Table 1: Effect of organic nutrient management on oleoresin content (%) in late kharif onion bulbs

Treatment	Oleoresin (%)					
	After curing of bulb			After 60 days of storage		
	2019-2020	2020-2021	Pooled	2019-2020	2020-2021	Pooled
T_1	10.27	10.29	10.28	8.92	8.96	8.94
T_2	10.30	10.35	10.32	9.25	9.23	9.24
T_3	10.34	10.36	10.35	8.96	8.86	8.91
T_4	10.38	10.40	10.39	9.08	9.15	9.12
T_5	10.39	10.45	10.42	9.10	9.23	9.17
T_6	10.25	10.41	10.33	9.18	9.24	9.21
T_7	10.49	10.58	10.53	9.13	9.30	9.21
T_8	10.43	10.48	10.45	8.91	9.06	8.98
T_9	10.53	10.69	10.61	9.26	9.35	9.30
T10	10.27	10.32	10.30	8.83	9.08	8.96
T11	10.30	10.36	10.33	9.14	9.13	9.14
T12	10.28	10.30	10.29	9.17	9.17	9.17
T13	10.20	10.24	10.22	8.77	9.05	8.91
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.04	0.05	0.03	0.06	0.05	0.04
CD at 5%	0.10	0.13	0.08	0.17	0.15	0.11
CV	0.59	0.76	0.48	1.13	0.97	0.71

TSS content in onion (^{0}Brix))

The data recorded on content of total soluble solids of onion bulb was influenced significantly due to various treatments during both years of experiment. (Table 2). The content of total soluble solids of onion bulbs were observed to be maximum after curing of bulb (12.86 ^{0}Brix) and after 60 days of storage period (14.07 ^{0}Brix) with the treatment T_9 and it is found to be at par with T_8 (12.46 ^{0}Brix), T_8 (13.80 ^{0}Brix) after curing of bulb and 60 days of storage respectively. However minimum value registered for content of total soluble solids of onion bulb after curing of bulb (11.04 ^{0}Brix) and after 60 days of storage period (12.19 ^{0}Brix) with absolute control treatment. During the year 2020-2021, the maximum content of total soluble solids was noticed after curing of bulb (12.99 ^{0}Brix) reported in T_9 and was at par with T_7 (12.50 ^{0}Brix). After 60 days of storage period, maximum content of total soluble solids was noticed (14.39 ^{0}Brix) with the treatment T_9 which was at par with T_8 (14.16 ^{0}Brix). Whereas minimum values pertaining to total soluble solids were recorded after curing of bulb (10.92 ^{0}Brix) and after 60 days of storage period (11.97 ^{0}Brix) with absolute control.

The pooled mean of two year data presented in Table 2 revealed that maximum content of total soluble solid of onion bulb were recorded after curing of bulb (12.93 ^{0}Brix) and after 60 days of storage period (14.23 ^{0}Brix) with the treatment T_9 and it was at par with T_8 (12.45 ^{0}Brix and 13.98 ^{0}Brix) before and after curing of bulb. However minimum content of total soluble solids was noticed in the absolute control treatment. This might be due to enhanced translocation of nutrient, vitamins and proteins in to the bulb, due to improved nutritional environment in the rhizosphere as well as its utilization in the plant system. This in turn helped in increased physiological functions of plants also due the increased activity of nitrate reductase, which helped in synthesis of certain amino acids and protein. Similar kind of finding were reported by Ramesh *et al.* (2006) [9], Choudhary *et al.* (2002) [3] and Sharma *et al.* (2009) [10].

Table 2: Effect of organic nutrient management on TSS (^{0}Brix) content in late kharif onion bulbs

Treatments	TSS ^{0}Brix					
	After curing of bulb			After 60 days of storage		
	2019-2020	2020-2021	Pooled	2019-2020	2020-2021	Pooled
T_1	12.25	12.48	12.36	13.52	13.61	13.57
T_2	12.37	12.18	12.27	13.67	13.39	13.53
T_3	11.10	12.25	11.67	13.60	13.93	13.77
T_4	11.71	11.88	11.79	13.30	13.45	13.38
T_5	11.65	11.56	11.61	13.05	13.25	13.15
T_6	11.91	11.58	11.74	13.57	13.70	13.63
T_7	12.22	12.50	12.36	13.78	13.48	13.63
T_8	12.46	12.45	12.45	13.80	14.16	13.98
T_9	12.86	12.99	12.93	14.07	14.39	14.23
T10	11.92	12.12	12.02	13.10	13.06	13.08
T11	11.44	11.68	11.56	13.00	13.05	13.03
T12	11.65	11.58	11.61	13.01	13.21	13.11
T13	11.04	10.92	10.98	12.19	11.97	12.08
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)+	0.09	0.09	0.06	0.09	0.10	0.06
CD@5%	0.25	0.26	0.18	0.27	0.28	0.18
CV	1.27	1.30	0.90	1.18	1.24	0.81

Dry matter content (%)

The data on dry matter yield of onion revealed that, the dry matter yield of onion was significantly influenced during both year of study. During first year (2019) it was noticed that the highest dry matter yield of onion after curing of onion bulb (14.13%) and after 60 Days of storage period (13.89%) was recorded with the treatment T_9 and it was found to be at par with T_8 (13.80 and 13.63%) after curing and after 60 days of storage (Table 3).

During second year (2020) data showed that, the highest dry matter yield of onion (14.51% after curing of onion bulb and 14.62% after 60 days of storage period) was recorded with the treatment T_9. This was found to be at par with T_8 (13.45% after curing of bulb and 13.53% after 60 days of storage) and T_7 (13.33% after curing of bulb and 13.47% after 60 days of storage) whereas lowest value pertaining to this observation was recorded T_5 treatment. The pooled mean of two year data presented in table 3 indicated that, the significantly highest dry matter yield. (14.01% after curing of onion bulb and 14.57% after 60 days of storage) were observed with the T_9 treatment and it was at par with T_8 (13.71% after curing of onion bulb and 13.49% after 60 days of storage). However lowest dry matter content recorded in T_5.

The increased accumulation of dry mater (%) and TSS (%) in the bulbs could be attributed to increased accumulation of chemical constituents like sulphur and phosphorus and also decrease in moisture content of the bulbs. These results are in agreement with the findings of Singh and Dhanakar (1995) [11], Meshram and Shende (1990) [7] and Madhan and Sandhu (1983) [6] in onion.

Table 3: Effect of organic nutrient management on dry matter (%) of onion bulbs during storage

Treatments	Dry matter (%)					
	After curing of bulb			After 60 days of storage		
	2019-2020	2020-2021	Pooled	2019-2020	2020-2021	Pooled
T_1	9.05	11.62	10.33	12.01	12.27	12.14
T_2	8.49	9.33	8.91	10.83	11.81	11.32
T_3	10.56	11.52	11.04	12.12	12.94	12.53
T_4	11.52	12.15	11.84	12.34	13.06	12.70
T_5	8.51	8.70	8.60	10.33	10.30	10.32
T_6	10.39	10.55	10.47	10.85	11.05	10.95
T_7	12.14	10.96	11.55	13.33	13.47	13.40
T_8	13.80	13.63	13.71	13.45	13.53	13.49
T_9	14.13	13.89	14.01	14.51	14.62	14.57
T10	9.89	9.80	9.84	11.72	10.88	11.30
T11	10.19	9.88	10.03	10.45	10.35	10.40
T12	10.15	10.22	10.19	11.63	11.78	11.70
T13	8.51	8.58	8.55	10.53	10.46	10.49
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)+	0.08	0.11	0.07	0.14	0.22	0.15
CD@5%	0.23	0.32	0.22	0.42	0.63	0.44
CV	1.29	1.78	1.21	2.10	3.13	2.21

Total sugars content (%)

Based on the data recorded during the first year (2019) it was observed that the total sugars content of onion was significantly influenced during both the year of study. It is evident from the data that, among the different treatment highest total sugars content was recorded with treatment T_9 with 8.19% of total sugars after curing of the bulb and 8.88% of total sugars after 60 days of storage period and it was at par with T_8 (7.34% at curing of the bulb and 7.38% after 60 days of storage period). During second year of experiment highest

total sugars content (8.26% after curing of bulb and 8.65% after 60 days of storage period) was recorded with the treatment T_9 and it was followed by the treatment T_7 with total sugars content of 7.43% after curing of bulb and 8.52% after 60 days of storage period (Table 4).

Table 4: Effect of organic nutrient management on Total sugars (%) content in late kharif onion

Total sugars (%)						
	After curing of bulb			After 60 days of storage		
Treatments	2019-2020	2020-2021	Pooled	2019-2020	2020-2021	Pooled
T_1	5.95	5.93	5.94	6.12	6.58	6.35
T_2	6.85	6.94	6.90	6.75	7.01	6.88
T_3	6.80	6.77	6.78	6.65	6.78	6.71
T_4	6.63	6.53	6.58	6.76	6.48	6.62
T_5	7.23	6.83	7.03	7.41	7.37	7.39
T_6	7.22	7.18	7.20	7.22	7.47	7.35
T_7	7.33	7.43	7.38	8.36	8.52	8.44
T_8	7.34	7.33	7.33	8.38	8.46	8.42
T_9	8.19	8.26	8.22	8.88	8.65	8.77
T10	6.89	6.79	6.84	7.00	6.93	6.97
T11	7.06	7.03	7.04	7.13	7.20	7.17
T12	6.67	7.07	6.87	7.70	7.72	7.71
T13	5.96	6.12	6.04	6.50	6.38	6.44
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.13	0.11	0.10	0.18	0.15	0.13
CD@%	0.39	0.33	0.28	0.52	0.44	0.38
CV	3.32	2.85	2.39	4.20	3.52	3.04

The pooled mean of two year data indicated the significantly highest total sugars content was recorded with the treatment T_9 with 8.22% of total sugars after curing of bulb and 8.77% of total sugars after 60 days of storage period and it was found to be at par with T_8 treatment with total sugars content 8.38% after curing and with T_7 8.44% after 60 days of storage. However, the lowest total sugars content was recorded (5.94%) after curing of bulb and (6.35%) after 60 days of storage in T_1

Reducing sugars (%)

A glance of the results presented in Table 5 revealed that the reducing sugars content of onion significantly influenced in various treatments during both the years of study. The highest reducing sugars content 4.99%) after curing of bulb and after 60 days of storage (4.17%) was recorded with T_9 treatment followed by treatment T_7 during first year (2019) of experiment.

Table 5: Effect of organic nutrient management on reducing sugars (%) content in late kharif onion

Reducing sugars (%)						
	After curing of bulb			After 60 days of storage		
Treatments	2019-2020	2020-2021	Pooled	2019-2020	2020-2021	Pooled
T_1	3.08	3.39	3.24	2.72	2.78	2.75
T_2	3.94	3.96	3.95	3.36	3.23	3.30
T_3	3.54	3.73	3.63	2.97	2.86	2.91
T_4	3.77	3.71	3.74	3.43	3.20	3.32
T_5	4.52	3.86	4.19	3.64	3.36	3.50
T_6	4.24	4.23	4.24	3.78	3.55	3.66
T_7	4.56	4.42	4.49	4.07	4.19	4.13
T_8	4.20	4.22	4.21	4.02	4.15	4.09
T_9	4.99	5.03	5.01	4.17	4.29	4.23
T10	3.76	3.84	3.80	3.53	3.29	3.41
T11	3.90	4.16	4.03	3.72	3.51	3.62
T12	3.85	3.90	3.87	3.54	3.56	3.55
T13	3.03	3.27	3.15	2.71	3.15	2.93
'F' test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.05	0.07	0.04	0.17	0.14	0.13
CD@5%	0.15	0.19	0.13	0.49	0.42	0.39
CV	2.19	2.85	1.92	8.34	7.10	6.62

During second year of experiment (2020) the highest reducing sugars content (5.03 and 4.29%) after curing of bulb and after 60 days of storage was recorded with T_9 treatment and it was at par with treatment T_7 with (4.42% and 4.19) reducing sugar after curing of bulb and after 60 days of storage.

The pooled mean of two year data indicated highest reducing sugars content (5.01 and 4.23%) after curing of bulb and after 60 days of storage was recorded with T_9 treatment and it was at par with treatment T_7 with (4.49% and 4.13) reducing sugar after curing of bulb and after 60 days of storage. However pooled mean shows lowest reducing sugars content after curing of bulb (3.15%) in T_{13} and after 60 days of storage (2.75%) with T_1 treatment.

Non-reducing sugars (%)

The data recorded on content of non-reducing sugars% in onion bulb was influenced significantly due to various treatments during both years of experiment (Table 6).

Table 6: Effect of organic nutrient management on reducing sugars (%) content in late kharif onion

Non reducing sugars (%)						
	After curing of bulb			After 60 days of storage period		
Treatments	2019-2020	2020-2021	Pooled	2019-2020	2020-2021	Pooled
T_1	2.87	2.54	2.70	3.40	3.81	3.60
T_2	2.92	2.99	2.95	3.39	3.78	3.58
T_3	3.26	3.04	3.15	3.69	3.91	3.80
T_4	2.87	2.81	2.84	3.33	3.28	3.30
T_5	2.71	2.96	2.84	3.77	4.00	3.89
T_6	2.99	2.94	2.96	3.44	3.93	3.69
T_7	2.76	3.01	2.89	4.29	4.34	4.31
T_8	3.14	3.10	3.12	4.36	4.31	4.34
T_9	3.20	3.22	3.21	4.71	4.36	4.54
T10	3.13	2.94	3.04	3.47	3.64	3.56
T11	3.15	2.86	3.01	3.41	3.69	3.55
T12	2.82	3.17	3.00	4.16	4.16	4.16
T13	2.94	2.85	2.89	3.79	3.23	3.51
'F' test	NS	Sig	Sig	Sig	Sig	Sig
SE(m)±	0.13	0.10	0.09	0.14	0.15	0.12
CD at 5%	0.37	0.28	0.27	0.41	0.43	0.34
CV	7.31	5.69	5.37	6.40	6.55	5.32

The data in Table 6 revealed that, the differences among different treatments in the year 2019-2020 regarding content of non-reducing sugars was non-significant. The maximum non reducing sugar was reported in T_3 (3.26%) after curing of bulb. While maximum was found in T_9 (4.41%). The lowest non reducing sugar was reported in T5 (2.71%) in first year and in T4 (2.81%) after curing of bulb during second year. The pooled data of both year is found significant and maximum non-reducing sugar was obtained in 3.21% and 4.54% after curing and after 60 days storage, respectively. While minimum non-reducing sugar after curing was obtained in T5 (2.84%) and after 60 days storage in T4 (4.54%).

Sulphur content (%)

The data in respect of sulphur content in onion bulb during 2019 and 2020 and its pooled result were influenced significantly by different organic manure and biofertilizers treatment are presented in Table 7. During first year of experimentation, the highest sulphur content after curing of bulb (0.43%) was observed inT_7 followed by T_9 (0.41%). The same after 60 days of storage period (0.68%) was observed in treatment T_9 and it was significantly superior over all other treatment followed by T_7 with sulphur content of 0.41% after curing and 0.65% after 60 days of storage and by T_8 with sulphur content of 0.41% after curing and 0.65% after 60 days of storage. However, lowest sulphur content after curing of bulb (0.20%) and after 60 days of storage (0.41%) was noted in absolute control.

Table 7: Effect of organic nutrient management on sulphur (%) in bulb of late kharif onion

Sulphur (%)						
Treatments	After curing of bulb			After 60 days of storage		
	2019-2020	2020-2021	Pooled	2019-2020	2020-2021	Pooled
T_1	0.30	0.38	0.34	0.55	0.57	0.56
T_2	0.33	0.33	0.33	0.60	0.60	0.60
T_3	0.32	0.36	0.34	0.59	0.59	0.59
T_4	0.26	0.31	0.28	0.48	0.49	0.48
T_5	0.23	0.40	0.32	0.45	0.48	0.47
T_6	0.26	0.38	0.32	0.52	0.53	0.53
T_7	0.43	0.40	0.41	0.65	0.64	0.65
T_8	0.36	0.39	0.37	0.63	0.63	0.63
T_9	0.41	0.44	0.42	0.68	0.69	0.68
T10	0.27	0.29	0.28	0.53	0.58	0.56
T11	0.25	0.26	0.26	0.46	0.52	0.49
T12	0.27	0.25	0.26	0.51	0.48	0.50
T13	0.20	0.21	0.21	0.41	0.46	0.44
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE(m)±	0.01	0.01	0.00	0.01	0.01	0.01
CD at 5%	0.02	0.02	0.01	0.02	0.02	0.02
CV	4.45	3.81	2.29	2.49	2.18	1.66

During second year of experimentation, significantly highest sulphur content after curing of bulb (0.44%) and after 60 days of storage recorded (0.64%) with T_9 treatment followed by T_7 (0.40%) and after 60 days of storage (0.64%), whereas lowest value pertaining to this observation noted in absolute control. The pooled mean of two year data also indicated increase in sulphur content after curing of bulb (0.42%) and after 60 days of storage (0.68%) with treatment T_9 and it was at par with T_7 (0.41%) after curing of bulb and after 60 days of storage (0.65%), however lowest sulphur content after curing of bulb (0.21%) and after 60 days of storage (0.44%) was noticed in control treatment.

Conclusions

The experiment was conducted in a randomized block design with three replications using Cv. Bhima Super, with 13 treatments, four kinds of organic manures (FYM, vermicompost, poultry manure and Neemcake) in combination with two kinds of bio-fertilizers (Azotobacter and PSB) and two kind of biodynamic preparations (BD-501 and BD 500) and 100% recommended doses of fertilizers were tested in comparison with control without any nutrient application. The pooled mean of two year data shows significantly highest oleoresin content (10.61 and 10.53%), TSS (12.93 and 14.23 ^{0}brix), maximum dry matter content (14.01% and 14.57%) and Total sugars (8.22% and 8.87%) and reducing sugar (5.01 and 4.23%), non-reducing sugars content (3.21% and 4.54%) after curing of the bulbs and after 60 days of storage respectively was recorded with T_9 treatment consisting of 50% RDN through FYM (q ha^{-1}) + 50% RDN through Vermicompost (q ha^{-1}) + Azotobacter (kg ha^{-1}) + PSB (kg ha^{-1}). Whereas, lowest value regarding oleoresin content, TSS, dry matter content was recorded in control.

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