



Effect of fertility levels and *jeevamrut* application on growth and yield of onion (*Allium cepa* L.)

S. K. Acharya¹, Mukesh Kumar² A. R. Patel³ and M.V. Patel⁴

^{1&3}College of Horticulture, S. D. Agricultural University, Jagudan, Mehsana 384460, Gujarat, India

ABSTRACT

The investigation was carried out during *Rabi* season of 2022-23 and 2023-24 at College Farm, College of Horticulture, S. D. Agricultural University, Jagudan. The treatments comprised of three fertility levels and seven levels of *jeevamrut* application having total 21 number of treatment combinations. Standard package of practices were followed during entire period of experimentation. The experiment was laid out in a randomized block design (factorial) with three replications. The results showed that the maximum plant height (56.39 cm) at 75 DAT & (90.66 cm) at harvest, number of leaves at 75 days after transplanting (DAT) (7.58) & at harvest (11.04), weight of bulb (85.13 g), yield per plot (5.25 kg), marketable bulb yield (347.95 q/ha), total yield (350.45 q/ha) and equatorial diameter of bulb (5.89 cm) were recorded in F₁ (100% RDF) which was at par with F₂ (80% RDF). Minimum unmarketable bulb yield (2.13 q/ha) was recorded with the application of 60 per cent RDF (F₃). Among *jeevamrut* application, J₆ (basal application of ghan *jeevamrut* 750 kg/ha + spray of *jeevamrut* @ 5%) gave maximum weight of bulb (94.99 g), yield per plot (5.64 kg), marketable bulb yield (380.68 q/ha), total yield (383.30 q/ha) and equatorial diameter of bulb (5.91 cm). Minimum unmarketable bulb (2.19 q/ha) yield was obtained under treatment J₄ (spray of *jeevamrut* @ 5%). Interaction effect between fertility levels and *jeevamrut* application the maximum plant height (64.57 cm) at 75 DAT was recorded in the treatment combination F₂J₆ (80% RDF + basal application of ghan *jeevamrut* 750 kg/ha + spray of *jeevamrut* @ 5%). Minimum unmarketable bulb yield (1.94 q/ha) was noted in the treatment combination F₃J₇ (60% RDF+drenching of *jeevamrut* @ 10% +spray of *jeevamrut* @5%). It can be concluded that maximum yield/ha was noted in the treatment receiving 80 per cent RDF (80, 40, 40 kg/ha NPK, respectively) + basal application of *jeevamrut* @ 750 kg/ha + spray of *jeevamrut* @ 5% i.e. treatment combination F₂J₆.

Key words: Onion, growth, *jeevamrut*, RDF, combination treatment, yield attributing traits.

INTRODUCTION

Onion (*Allium cepa* L.) is a "Queen of the kitchen" and one of the most important bulbous vegetable crops grown in India from ancient time. The edible portion is an underground modified stem which is known as 'bulb'. Onion is preferred mainly because of its green leaves; immature and mature bulbs are either eaten raw or cooked as vegetables. It is popular as salad crop and mature onion bulbs are widely used as a cooked vegetable in soups stews and casseroles in addition to a flavoring agent in many additional dishes (Ahamad *et al.*, 1). It is one of the few versatile vegetable crops that can be kept for a fairly long period and can safely withstand the hazards of rough handling including long distance transportation. Onion belongs to family *Alliaceae* and original from Central Asia. The *Allium* genus comprises of 300 to 500 species, which are widely distributed in Northern temperate region (Thompson

and Kelley, 21). India is prominent in the production and export of onion in the world and stand at second position. Onion production in 2022-23 was estimated about 302.08 lakh tonne compared to 316.87 lakh tonne in 2021-22. (Anonymous, 3). In India onion is widely cultivated in Maharashtra, Karnataka, Madhya Pradesh, Gujarat, Bihar, Andhra Pradesh, Rajasthan, Haryana and Tamil Nadu. Maharashtra ranks first in onion production with a share of 27.72%. The major onion growing districts of Gujarat are Bhavnagar, Rajkot, Amreli, Junagadh, Jamnagar, Porbandar, Kutch, Mehsana, Surat and Anand. Onion is considered as an exhaustive crop and looking to nutrient requirement, it looks essential to standing it in view of soil health. As a matter of fact, since last few decades, nutritional and quality aspect of crops have become of prime importance. Though production is important but at the same time, soil, plant and consumer health is also important. Hence, attempts must be made to reduce the RDF and supplements it with organic substances.

Jeevamrut is a fermented liquid product prepared by mixing up cow dung (10 kg) with cow urine (10 litre), jaggery (2 kg), legume flour (2 kg) and handful

*Correspondence author Email: sanjay.acharyahort@gmail.com

²Bio Science Research Center Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar 385506, Dist.- Banaskantha, Gujarat, India

⁴C.P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar 385506, Gujarat, India

of gochar or forest soil. *Jeevamrut* also contains enormous amount of microbial load which multiply and enhance N fixation and nutrient mobilization and utilization increase the soil fertility (Kumar *et al.*, 8). *Jeevamrut* contains small amount of macro and micro nutrients as well as growth hormones which is helpful to enhancing the growth and yield of crops. Due to availability of easy energy source particularly jeggary multiply the organisms enormously and during fermentative process produce beneficial metabolites such as organic acids and antibiotics which are effective against other pathogenic. Formulations used in organic agriculture like *jeevamrut* are the fermented products which are used as plant growth enhancing substances prepared with material available with farmers. They are rich sources of beneficial micro- flora, macro nutrients, essential micro nutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms which stimulate the plant growth and help in getting better vegetative growth and also good quality yield while improving soil health (Kurubetta *et al.*, 9). As regard with the productivity, the combined application of fertilizers and *jeevamrut* and increase yield ameliorating the soil. Use of inorganic fertilizers now a day is costly affair and increases cost of cultivation. Secondly the sole application of inorganic fertilizers deteriorates soil fertility level day by day, which affect the production, economics of production and human health, while organic manure and bio-fertilizers are cheap, easily available and eco-friendly, giving quality produce, improving keeping quality, T.S.S. and pungency. It improves the physiochemical properties like soil structure, infiltration rate, porosity, water holding capacity, bulk density, etc. and also very useful for the sustainable crop production as well as soil fertility and productivity (Vaghela *et al.*, 23). In view of the importance of onion as a major vegetable crop and the growing need for sustainable nutrient management practices, the present study was conducted to assess the influence of varying NPK fertilizer levels and *jeevamrut* application on the growth, yield, and quality attributes of onion while promoting soil health and environmental sustainability.

MATERIALS AND METHODS

The experiment was carried out during *rabi* season of 2022-23 and 2023-24 at College Farm, College of Horticulture, S. D. Agricultural University, Jagudan. The treatments comprised of three fertility levels *viz.* 100 per cent RDF (100, 50, 50 kg/ha NPK, respectively), 80 per cent RDF and 60 per cent RDF and seven *jeevamrut* levels *i.e.* J₁-basal application of ghan/*jeevamrut* @ 500 kg/ha, J₂-basal application

of ghan *jeevamrut* @ 750 kg/ha, J₃-drenching of *jeevamrut* @ 10 %, J₄-spary of *jeevamrut* @ 5%, J₅-basal application of ghan *jeevamrut* @ 500 kg/ha + Spary of *jeevamrut* @ 5%, J₆- basal application of ghan *jeevamrut* 750 kg/ha + Spary of *jeevamrut* @ 5% and J₇-drenching of 10% *jeevamrut* +Spary of *Jeevamrut* @ 5%. Seeds of onion variety Agrifound Light Red were sown during October 2022 and 2023 for raising seedlings and six weeks old seedlings were transplanted at a spacing of 15 cm × 10 cm in November 2022 and 2023 in a plot having dimensions of 1.80 m × 1.20 m. The experiment was laid out in a randomized block design (factorial) with three replications. Well decomposed FYM @ 20 t/ha was applied at the time of field preparation along with 20 kg sulphur per hectare as common dose and recommended dose of fertilizer was applied as per treatments. The 20 per cent N, 100 per cent P & K was applied before the transplanting in the form of urea, SSP and MOP, respectively whereas, remaining dose of nitrogen was applied as top dressing in four equal splits at 30, 50, 70 and 90 DAT, respectively. Ghan *jeevamrut* was applied before the transplanting of seedlings. *Jeevamrut* was drenched @ 10% at every 30 days' interval and foliar spray of *jeevamrut* @ 5% was done at fortnightly interval as per the treatment. Preparation of ghan *jeevamrut* and *Jeevamrut* were done as per the method given by Acharya (2).

The observations were recorded on ten randomly selected plants on plant height (cm) at 75 DAT and at harvest, number of leaves per plant at 75 DAT and at harvest, days taken to bulb maturity, bolting percentage, weight of bulb at harvest (g), yield/plot (kg), marketable bulb yield (q/ha), unmarketable bulb yield (q/ha), total yield (q/ha) and equatorial diameter of bulb (cm) and were subjected to statistical analysis.

RESULTS AND DISCUSSION

Among fertility levels, perusal of data revealed that effect of fertility levels on plant height at 75 DAT and at harvest was found significant (Table 1). Results depicted that maximum plant height at 75 DAT *i.e.* 56.55 cm, 56.23 cm and 56.39 cm and at harvest *i.e.* 89.92cm, 91.40 cm and 90.66 cm was recorded in F₁ (100% fertility level) during 2022-23, 2023-24 and pooled data, respectively, which were at par with F₂ (80% fertility level). The minimum plant height at 75 DAT was 53.27 cm, 53.25 cm and 53.26 cm and at harvest 84.58 cm, 83.34 cm and 83.96 cm was recorded with 60 % fertility level (F₃) during both the years *i.e.*, 2022-23, 2023-24 and in pooled, respectively.

The data presented in Table 1 with respect to effect of *jeevamrut* level showed non significant differences on plant height (cm) at 75 DAT and at harvest. However, maximum value 57.68 cm at 75

Table 1: Effect of fertility levels and *jeevamrut* application on plant height (cm) at 75 DAT and at harvest.

Treatment	Plant height (cm) at 75 DAT			Plant height (cm) at harvest		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Fertility level (F)						
F ₁	56.55	56.23	56.39	89.92	91.40	90.66
F ₂	55.78	56.15	55.96	89.76	91.62	90.69
F ₃	53.27	53.25	53.26	84.58	83.34	83.96
S.Em.±	0.95	0.94	0.67	1.60	1.70	01.16
C.D. at 5%	2.73	2.67	1.88	4.56	4.85	3.28
Jeevamrut level (J)						
J ₁	54.59	53.66	54.12	86.23	90.21	88.22
J ₂	54.80	56.43	55.62	90.07	86.83	88.45
J ₃	53.44	53.69	53.57	87.81	87.67	87.74
J ₄	55.52	55.30	55.41	89.94	88.50	89.22
J ₅	55.47	55.14	55.31	85.47	89.67	87.57
J ₆	57.23	58.13	57.68	91.00	90.21	90.61
J ₇	55.33	54.11	54.72	86.09	88.44	87.27
S.Em.±	1.46	1.43	1.02	2.44	2.59	1.78
C.D. at 5%	NS	NS	NS	NS	NS	NS
F×J Interaction						
S.Em.±	2.53	2.47	3.12	4.22	4.49	4.11
C.D. at 5%	7.22	NS	8.78	NS	NS	NS
CV%	7.92	7.76	7.84	8.30	8.76	8.53
Y × T Interaction						
	S.Em.±	C.D. at 5%	CV%	S.Em.±	C.D. at 5%	CV%
Y × F	0.94	NS	7.84	1.65	NS	8.33
Y × J	1.44	NS		2.52	NS	
Y × F × J	2.50	NS		4.36	NS	

DAT and 90.61 cm at harvest during individual year as well as pooled data, respectively was observed under J₆ (basal application of ghan *jeevamrut* 750 kg/ha + spray of *jeevamrut* @ 5 %) in the pooled data. Table 2 showed that interaction effect between fertility levels (F) and *jeevamrut* application (J) were found significant with respect to plant height at 75 DAT in pooled, analysis. The interaction of fertility levels and *jeevamrut* application found significant for pooled basis with respect to plant height at 75 DAT. The maximum plant height (64.57 cm) was recorded in treatment combination F₂J₆ (80% RDF + basal application of ghan *jeevamrut* 750 kg/ha + spray of *jeevamrut* @ 5 %) which was at par with F₁J₂ (59.27 cm), F₁J₁ (57.30 cm), F₂J₆ (56.67 cm) and F₃J₅ (56.93 cm). However, minimum plant height (50.45 cm) was noticed in F₃J₁ (60% RDF+basal application of *jeevamrut* @ 500 kg/ha). An increase

in plant height might be due to enhanced availability of nutrients and production of growth promoting substances that might have caused cell elongation and cell multiplication (Dhakad *et al.*, 6). These results are in conformity with the finding of Singh *et al.* (16) in onion and Farooqui *et al.* (7) in garlic. *Jeevamrut* promotes immense biological activity in soil and makes the nutrients available to crop. Optimum growth and development might be due to the increase in cell size and enhancement of cell division, which ultimately resulted in increased plant height (Patel, 13). Similar findings were also reported by Pall and Padda (12) and Nehra *et al.* (11). Combined application of nutrients and *jeevamrut* a liquid manure contains many of the nutrients and good microbial load which stimulates growth through biosynthesis of endogenous hormones which is responsible for plant growth, enhanced photosynthesis and other

Table 2: Interaction effect of fertility levels (F) and *jeevamrut* application (J) on plant height (cm) at 75 DAT of pooled data.

Treatment	Plant height (cm) at 75 DAT		
	F ₁	F ₂	F ₃
J ₁	57.30	54.62	50.45
J ₂	59.27	56.20	51.38
J ₃	55.65	52.70	52.35
J ₄	58.02	53.60	54.62
J ₅	55.58	53.40	56.93
J ₆	54.45	64.57	54.03
J ₇	54.45	56.67	53.05
	S.Em. ±	C.D. at 5%	CV %
F	0.67	1.88	7.84
J	1.02	NS	
F × J	3.12	8.78	

metabolic activity and increase height of the plant reported by Singh *et al.* (18) and Singh *et al.* (19). These results are agreement with the results reported by Smriti *et al.* (20) and Kurubetta *et al.* (9) in onion.

Significant differences on number of leaves/plant at 75 DAT among different treatments with respect to fertility levels were observed for number of leaves per plant during both the years as well as pooled at 75 DAT and except in 2023-24 at harvest (Table 3). Number of leaves were found to be maximum (7.79) with 100 per cent fertility levels (F₁) which was statistically superior over F₃ (6.66) during 2022-23. Similar trends were observed during 2023-24 and pooled data also with maximum values 7.38 & 7.58 was recorded in F₁ (100% fertility level) respectively, which was at par with F₂ (7.24 & 7.30). Number of leaves per plant at harvest were significant in 2022-23 and pooled data with maximum values are 11.43 and 11.18 was recorded in 80 per cent fertility levels

Table 3: Effect of fertility levels and *jeevamrut* application on number of leaves per plant at 75 DAT and at harvest.

Treatment	Number of leaves per plant at 75 DAT			Number of leaves per plant at harvest		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Fertility level (F)						
F ₁	7.79	7.38	7.58	11.07	11.00	11.04
F ₂	7.35	7.24	7.30	11.43	10.93	11.18
F ₃	6.66	6.48	6.57	10.13	10.33	10.23
S.Em.±	0.30	0.25	0.20	0.37	0.35	0.24
C.D. at 5%	0.86	0.75	0.55	0.97	NS	0.68
Jeevamrut level (J)						
J ₁	7.12	7.14	7.13	10.89	10.00	10.44
J ₂	7.30	6.87	7.08	10.78	10.50	10.64
J ₃	6.82	6.93	6.88	10.67	11.11	10.89
J ₄	7.29	7.31	7.30	10.61	11.11	10.86
J ₅	7.33	7.09	7.21	11.26	10.78	11.02
J ₆	7.30	7.07	7.18	11.28	11.50	11.39
J ₇	7.71	6.81	7.26	10.67	10.28	10.47
S.Em.±	0.46	0.38	0.30	0.52	0.53	1.78
C.D. at 5%	NS	NS	NS	NS	NS	NS
F × J Interaction						
S.Em.±	0.80	0.65	0.25	0.90	0.92	4.10
C.D. at 5%	NS	NS	NS	NS	NS	NS
CV%	19.07	16.04	17.67	14.27	14.75	14.51
Y × T Interaction						
	S.Em.±	C.D. at 5%	CV%	S.Em.±	C.D. at 5%	CV%
Y × F	0.28	NS	17.67	0.34	NS	14.51
Y × J	0.42	NS		0.52	NS	
Y × F × J	0.73	NS		0.91	NS	

(F₁) respectively, which was at par with F₁ (100% fertility level). However, non-significant results have been reported during 2023-24 with highest value of 11.00 under the treatment 100 per cent fertility levels (F₁). Effect of *jeevamrut* level showed non significant differences on number of leaves per plant at 75 DAT and at harvest. However, maximum value 7.30 was noticed in J₄ (spray of *jeevamrut* @ 5%) at 75 DAT and 11.39 at harvest was observed under J₆ (basal application of ghan *jeevamrut* 750 kg/ha + spray of *jeevamrut* @ 5 %) in the pooled data (Table 3).

Increase in number of leaves per plant which directly contributes to the accumulation of biosynthates. It due to nitrogen, phosphorus, potassium of which phosphorus involved in cell division, photosynthesis and metabolism of carbohydrates where potash regulated proper translocation of photosynthesis and stimulated enzyme activity which increased the rate of growth and positive development which is resulted in

higher number of leaves in onion (Patel, 13). Similar finding was also reported by Sankar *et al.* (14) and Vani *et al.* (24) in onion. The beneficial effects of *Jeevamrut* were attributed to higher microbial load and growth hormones which might have enhanced the soil biomass thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately resulted in better growth of crop (Vasanthkumar, 25). Similar findings also reported by Devakumar *et al.* (5) in capsicum. Days to bulb maturity have been narated in Table 4 and showed non significant effect of fertility levels, *jeevamrut* application and its interaction on days taken to bulb maturity during both the years *i.e.*, 2022-23 and 2023-24 and in pooled data. The effects of fertility levels on bolting percentage plant were found significant. Results depicted that minimum bolting 3.19, 3.24 & 3.21 per cent was recorded in F₁ (100% fertility level) during 2022-23, 2023-24 and pooled data,

Table 4: Effect of fertility levels and *jeevamrut* application on days taken to bulb maturity and bolting percentage.

Treatment	Days taken to bulb maturity			Bolting percentage		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Fertility level (F)						
F ₁	137.14	137.10	137.12	3.19	3.24	3.21
F ₂	136.33	135.67	136.00	3.38	3.62	3.50
F ₃	136.19	135.29	135.74	3.86	3.86	3.86
S.Em.±	2.02	2.00	1.42	0.18	0.15	0.11
C.D. at 5%	NS	NS	NS	0.51	0.41	0.32
Jeevamrut level (J)						
J ₁	136.00	135.11	135.56	3.89	3.56	3.72
J ₂	137.22	136.44	136.83	3.67	3.78	3.72
J ₃	136.56	136.22	136.39	3.44	3.33	3.39
J ₄	136.33	135.33	135.83	3.44	3.78	3.61
J ₅	137.22	137.44	137.33	3.44	3.78	3.61
J ₆	136.33	135.67	136.00	3.22	3.22	3.22
J ₇	136.22	135.89	136.06	3.22	3.56	3.39
S.Em.±	3.09	3.05	2.17	0.27	0.22	0.17
C.D. at 5%	NS	NS	NS	NS	NS	NS
F × J Interaction						
S.Em.±	5.36	5.30	0.91	0.46	0.38	0.23
C.D. at 5%	NS	NS	NS	NS	NS	NS
CV%	6.79	6.74	6.77	23.15	18.58	20.93
Y × T Interaction						
	S.Em.±	C.D. at 5%	CV%	S.Em.±	C.D. at 5%	CV%
Y × F	2.01	NS	6.77	0.16	NS	20.93
Y × J	3.07	NS		0.25	NS	
Y × F × J	5.33	NS		0.43	NS	

respectively, which were at par with F₂ (80% fertility level). However, the maximum bolting percentage *i.e.* 3.86 per cent in pooled data was observed when 60 per cent RDF was applied (F₃).

Weight of bulb is significantly influenced by the fertility levels during individual years as well as in pooled data (Table 5). Significantly highest weight of bulb 84.50 g, 85.76 g and 85.13 g was observed under treatment F₁ (100 % RDF) during the year 2022-23, 2023-24 and in pooled data, respectively which was at par with F₂ (80 % RDF). The lowest weight of bulb was 77.83 g, 77.86 g and 77.84 g recorded with treatment F₃ (60 % RDF) during both the years *i.e.*, 2022-23, 2023-24 and in pooled data, respectively. Effect of *jeevamrut* application on weight of bulb during both the years of experiment and in pooled data. The results showed that significantly maximum weight of bulb 93.98 g, 96.00 g and 94.99 g was obtained under treatment J₆ (Basal application

of *jeevamrut* @ 750 kg/ha + spray of *jeevamrut* @5%) during the year 2022-23, 2023-24 and in pooled data, respectively. While, minimum weight of bulb 76.24 g, 76.33 g and 76.29 g was noticed under treatment J₄ (spray of *jeevamrut* @ 5%) during both the years *i.e.*, 2022-23, 2023-24 and in pooled data, respectively. Yield per plot significantly influenced by effect of fertility levels. Maximum yield per plot 5.23 kg, 5.28 kg and 5.25 kg was recorded under treatment F₁ (Fertility levels *i.e.*, 100 % RDF) during the year 2022-23, 2023-24 and in pooled data, respectively which was at par with F₂ (80% RDF fertility level). The minimum yield per plot 4.89 kg, 4.89 kg and 4.89 kg was obtained under treatment F₃ (Fertility levels *i.e.*, 60 % RDF) during the individual year as well as pooled data, respectively (Table 5). *Jeevamrut* application on yield per plot during both the years of experiment and in pooled data. The results showed that significantly maximum yield per plot 5.70 kg,

Table 5: Effect of fertility levels and *jeevamrut* application on weight of bulb (g) at harvest and yield per plot (kg).

Treatment	Weight of bulb (g) at harvest			Yield per plot (kg)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Fertility level (F)						
F ₁	84.50	85.76	85.13	5.23	5.28	5.25
F ₂	84.29	84.76	85.02	5.21	5.19	5.20
F ₃	77.83	77.86	77.84	4.89	4.89	4.89
S.Em.±	1.79	1.47	1.16	0.10	0.09	0.07
C.D. at 5%	5.11	4.19	3.26	0.29	0.26	0.20
Jeevamrut level (J)						
J ₁	81.49	83.33	82.41	5.07	5.15	5.11
J ₂	80.62	80.67	80.64	5.03	5.03	5.03
J ₃	83.02	84.56	83.79	5.15	5.23	5.19
J ₄	76.24	76.33	76.29	4.81	4.82	4.81
J ₅	78.87	79.56	79.21	4.94	4.98	4.96
J ₆	93.98	96.00	94.99	5.70	5.58	5.64
J ₇	81.22	81.44	81.33	5.06	5.07	5.07
S.Em.±	2.73	2.24	1.77	0.16	0.14	0.11
C.D. at 5%	7.81	6.39	4.98	0.45	0.40	0.30
F × J Interaction						
S.Em.±	4.73	3.88	8.36	0.27	0.24	0.39
C.D. at 5%	13.52	11.08	23.57	0.78	0.70	1.10
CV%	9.97	8.07	9.07	9.19	8.24	8.73
Y × T Interaction						
	S.Em.±	C.D. at 5%	CV%	S.Em.±	C.D. at 5%	CV%
Y × F	1.63	NS	9.07	0.10	NS	8.73
Y × J	2.50	NS		0.15	NS	
Y × F × J	4.32	NS		0.26	NS	

5.58 kg and 5.64 kg was obtained under treatment J₆ (Basal application of *jeevamrut* @ 750 kg/ha + spray of *jeevamrut* @ 5%) during the year 2022-23, 2023-24 and in pooled data, respectively. While, minimum yield per plot 4.81 kg, 4.82 kg and 4.81 kg was observed in the treatment J₄ (spray of *jeevamrut* @ 5%) during both the years *i.e.*, 2022-23, 2023-24 and in pooled data, respectively.

Marketable bulb yield (q/ha) significantly influenced by effect of fertility levels. Maximum marketable bulb yield (q/ha) 345.87 q, 350.02 q and 347.95 q was recorded with the application of 100 per cent fertility level of RDF (F₁) during the individual year as well as pooled data, respectively which was at par with F₂ (80% RDF fertility level). The minimum marketable bulb yields 323.95 q, 324.04 q, and 324.00 was obtained under treatment F₃ (Fertility levels *i.e.*, 60 % RDF) during the individual year as

well as pooled data, respectively (Table 6). Effect of *jeevamrut* application on marketable bulb yield (q/ha) during both the years of experiment and in pooled data. The results showed that significantly maximum marketable bulb yield 377.33 q, 384.03 q and 380.68 q was obtained under treatment J₆ (Basal application of *jeevamrut* @ 750 kg/ha + spray of *jeevamrut* @ 5%) during 2022-23, 2023-24 and in pooled data, respectively. While, minimum marketable bulb yield 318.63 q, 318.92 q, and 318.78 q, were observed in the treatment J₄ (spray of *jeevamrut* @ 5%) during both the years *i.e.*, 2022-23, 2023-24 and in pooled data, respectively. Unmarketable bulb yield (q/ha) significantly influenced by effect of fertility levels. Minimum unmarketable bulb yield (q/ha) 2.15 q, 2.12 q and 2.13 q were recorded with the application of 60 per cent fertility level of RDF (F₃) during the individual year as well as pooled data. The maximum

Table 6: Effect of fertility levels and *jeevamrut* application on marketable bulb yield (q/ha) and unmarketable bulb yield (q/ha).

Treatment	Marketable bulb yield (q/ha)			Unmarketable bulb yield (q/ha)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Fertility level (F)						
F ₁	345.87	350.02	347.95	2.48	2.54	2.51
F ₂	345.29	350.18	347.74	2.33	2.34	2.34
F ₃	323.95	324.04	324.00	2.15	2.12	2.13
S.Em.±	4.99	5.12	3.58	0.04	0.04	0.03
C.D. at 5%	14.29	14.64	10.09	0.11	0.12	0.08
Jeevamrut level (J)						
J ₁	336.03	342.13	339.08	2.27	2.37	2.32
J ₂	333.09	333.23	333.16	2.32	2.32	2.32
J ₃	341.06	346.14	343.60	2.34	2.37	2.36
J ₄	318.63	318.92	318.78	2.18	2.19	2.19
J ₅	327.31	329.59	328.45	2.24	2.26	2.25
J ₆	377.33	384.03	380.68	2.59	2.59	2.59
J ₇	335.12	335.86	335.49	2.28	2.29	2.29
S.Em.±	7.64	7.83	5.47	0.06	0.06	0.04
C.D. at 5%	21.82	22.37	15.41	0.17	0.18	0.12
F × J Interaction						
S.Em.±	13.23	13.56	27.67	0.10	0.11	0.19
C.D. at 5%	37.80	38.74	77.99	0.29	0.30	0.54
CV%	6.77	6.88	6.82	7.65	7.97	7.82
Y × T Interaction						
	S.Em.±	C.D. at 5%	CV%	S.Em.±	C.D. at 5%	CV%
Y × F	5.06	NS	6.82	0.04	NS	7.82
Y × J	7.73	NS		0.06	NS	
Y × F × J	13.39	NS		0.11	NS	

unmarketable bulb yield 2.48 q, 2.54 q, and 2.51 q was noticed under treatment F₁ (Fertility levels *i.e.*, 100 % RDF) during the individual year as well as pooled data, respectively (Table 6). Effect of *jeevamrut* application on unmarketable bulb yield (q/ha) during both the years of experiment and in pooled data. The results showed that significantly minimum unmarketable bulb yield 2.18 q, 2.19 q and 2.19 q was obtained under treatment J₄ (spray of *jeevamrut* @ 5%) during 2022-23, 2023-24 and in pooled data, respectively. While, maximum unmarketable bulb yield 2.59 q was observed in the treatment J₆ (Basal application of *jeevamrut* @ 750 kg/ha + spray of *jeevamrut* @ 5%) in both the year and pooled analysis.

Data related to effect of fertility levels on total yield (q/ha) was presented in Table 7 and showed that yield per hectare was significantly influenced by fertility levels. The maximum total yield per hectare

348.35 q, 352.54 q and 350.45 q were noted under treatment F₁ (100 % RDF) during 2022-23, 2023-24 and in pooled data, respectively which was at par with F₁ (80 % RDF). The minimum yield per hectare 326.09 q, 326.19 q and 326.14 q were recorded under treatment F₃ (60 % RDF) during individual year as well as pooled data, respectively. Effect of *jeevamrut* application on total yield (q/ha) was found significant during both the years of experimentation. Treatment J₆ (Basal application of *jeevamrut* @ 750 kg/ha + spray of *jeevamrut* @ 5%) showed maximum total yield q/ha *i.e.* 379.93 q/ha, 386.67 q/ha and 383.30 q/ha during the year 2022-23, 2023-24 and in pooled data, respectively. Whereas, minimum total yield as 320.82 q/ha, 321.11 q/ha and 320.96 q/ha were noted under treatment J₄ (spray of *jeevamrut* @ 5 %) during the individual year as well as pooled data, respectively. Yield attributes significantly affect by the application of nutrients

Table 7: Effect of fertility levels and *jeevamrut* application on total yield (q/ha) and equatorial diameter (cm) of bulb.

Treatment	Total yield (q/ha)			Equatorial diameter (cm) of bulb		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Fertility level (F)						
F ₁	348.35	352.54	350.45	5.92	5.86	5.89
F ₂	347.62	352.50	350.08	5.78	5.70	5.74
F ₃	326.09	326.19	326.14	5.53	5.52	5.52
S.Em.±	5.13	5.63	3.81	0.04	0.04	0.07
C.D. at 5%	14.66	16.10	10.74	0.12	0.12	0.20
Jeevamrut level (J)						
J ₁	338.30	344.45	341.37	5.80	5.73	5.77
J ₂	335.41	335.56	335.48	5.69	5.64	5.67
J ₃	343.41	348.52	345.96	5.65	5.64	5.65
J ₄	320.82	321.11	320.96	5.60	5.70	5.65
J ₅	329.56	331.85	330.71	5.87	5.87	5.87
J ₆	379.93	386.67	383.30	5.89	5.94	5.91
J ₇	337.41	338.15	337.78	5.59	5.53	5.56
S.Em.±	7.84	8.60	5.82	0.06	0.06	0.04
C.D. at 5%	22.40	24.59	16.40	0.17	0.18	0.12
F × J Interaction						
S.Em.±	13.57	14.90	27.87	0.11	0.11	0.16
C.D. at 5%	38.80	42.58	78.55	0.30	0.NS	0.45
CV%	6.90	7.51	7.21	3.21	3.25	3.23
Y × T Interaction						
	S.Em.±	C.D. at 5%	CV%	S.Em.±	C.D. at 5%	CV%
Y × F	5.39	NS	7.21	0.04	NS	3.23
Y × J	8.23	NS		0.06	NS	
Y × F × J	14.25	NS		0.11	NS	

and *jeevamrut*. An increase in weight of bulb might be due to increased bulb diameter. This might be due to efficient translocation of photosynthates to bulbs which was resulted in increase in dry matter accumulation of bulbs; hence, it increased bulb weight and ultimately bulb yield (Singh *et al.*, 17). These results are in conformity with the findings of Warade *et al.* (27), Tiwari *et al.* (22), Vedpathak and Chavan (26) and Sharma *et al.* (15) in onion and Nasreen *et al.* (10) in garlic. The effects of *Jeevamrut* were associated to higher microbial load and growth hormones which might have enhanced the soil biomass thereby sustaining the availability and uptake of applied as well as native soil nutrients which ultimately resulted in better yield of crop. These findings are also reported by Vasanthkumar (25), Devakumar *et al.* (5) and Boraiah *et al.* (4).

It can be concluded that the application of 80% of the recommended dose of fertilizers (RDF; 80:40:40 kg N₂O₅₂O ha⁻¹) through chemical fertilizers, combined with basal application of *jeevamrut* at 750 kg ha⁻¹ and foliar sprays of *jeevamrut* at 5% concentration at fortnightly intervals up to four months after transplanting, along with 20 t ha⁻¹ farmyard manure (FYM) and 20 kg S ha⁻¹, proved to be the most effective nutrient management strategy. This treatment significantly enhanced growth, yield, bulb quality, and shelf life of rabi onion, while also generating the highest economic returns.

AUTHOR'S CONTRIBUTION

Conceptualization of research (SKA); Designing of the experiment (MK); Contribution of experimental material (ARP); Analysis of data and interpretation (MVP); Preparation of manuscript (SKA, MK); Supervision and critical review (SKA, MVP).

DECLARATION

The authors declare no competing interests.

ACKNOWLEDGMENT

The authors acknowledge the College of Horticulture, S.D. Agriculture University, Jagudan, Mehsana, Gujarat, India for providing necessary facilities to carry out the research work.

REFERENCES

- Ahamad, S., Sagar, V. R., Asrey, R., Islam, S., Tomar, B. S., Vinod, B. R. and Kumar, A. 2024. Nutritional retention and browning minimisation in dehydrated onion slices through potassium metabisulphite and sodium chloride pre-treatments. *Int. J. Food Sci. Technol.*, **59**(8): 5794-805.
- Acharya, D. 2020. *Prakrutik Krushi*. Department of Agriculture, Farmers Welfare and Cooperation. *Govt. of Gujarat*, 42-43.
- Anonymous 2022-23. Final estimates of 2022-23 and first advance estimates of 2023-24 of area and production of horticultural crops. *Ministry of Agriculture and Farmers Welfare, Govt. of India*.
- Boraiah, B., Devakumar, N., Shubha, S. and Palanna, K. B. 2017. Effect of *panchgavya*, *jeevamrutha* and cow urine on beneficial microorganisms and yield of capsicum (*Capsicum annuum* L. var. *grossum*). *Int. J. Curr. Microbiol. Appl. Sci.* **6**: 3226-34.
- Devakumar, N., Rao, G. G., Shubha, S., Khan, I., Nagaraj and Gowda, S. B. 2008. Activities of Organic Farming Research Centre. Navile, Shimoga. *Univ. Agri. Sci., Bangalore*. 12
- Dhakad, R., Chudasama, V. R., Verma, J., Gosae, J. and Dhaked, M. 2019. Effect of INM in onion (*Allium cepa* L.) with respect to growth and yield under North Gujarat condition. *Int. J. Curr. Microbiol. Appl. Sci.*, **8**: 1618-22.
- Farooqui, M. A., Naruka, I. S., Rathore, S. S., Singh, P. P. and Shaktawat, R. P. S. 2009. Effect of nitrogen and sulphur levels on growth and yield of garlic (*Allium sativum* L.). *Asian J. Food Agro-Ind.*, **15**: 18-23.
- Kumar, A., Avasthe, R.K., Babu, S., Singh, R., Verma, G., Dhaka, A.K., Kumar, S., Saha, S., Devi, E.L., Bhupenchandra, Gudade, B.A. and Hasanain, M. 2021. *Jeevamrut*: A low cost organic liquid manure in organic farming for sustainable crop production. *Kerala Karsh*, **9**: 32-34.
- Kurubetta, K. D., Shivaprasad, M., Tatagar, M. H., Kareem, A. M. and Sweta, K. 2017. Response of garlic (*Allium sativum* L.) for graded levels of fertilizers and *jeevamruta* application. *Res. J. Chem. Environ. Sci.* **5**: 16-18.
- Nasreen, S., Yousuf, M.N. and Mamun, A.N. 2009. Response of garlic to zinc, boron and poultry manure application. *Bangladesh J. Agric. Res.*, **34**: 239-45.
- Nehra, B. K., Malik, Y. S. and Yadav, A. C. 1988. Seed production in onion as influenced by time on bulb planting and cut treatments. *Haryana Agric. Univ. J. Res.*, **19**: 225-29.

12. Pall, R. and Padda, D.S. 1972. Effect of nitrogen, plant spacing and size of mother bulb on growth and yield of seed crop of onion. *Indian J. Hortic.* **9**: 185-89.
13. Patel, U. 2020. Studies on effect of integrated nutrient management and bio enhancer on productivity of onion (*Allium cepa* L.). *Pharma Innov. J.*, **9**: 172-81.
14. Sankar, V., Veeraragavathatham, D. and Kannan, M. 2009. Studies on organic farming in onion (*Allium cepa* L.) for the production of export quality bulbs. *Asian J. Hort.*, **4**: 65-69.
15. Sharma, S.S., Yadav, K.K., Singh, D.P., Meena, R.H., Lakhawat, S.S., Jain, H.K. and Choudhary, R.S. 2019. Effect of integrated nutrient management on the growth and productivity of onion (*Allium cepa* L.). *Int. J. Chem. Stud*, **7**: 143-45.
16. Singh, D.K., Singh, L. and Pandey, U.B. 2004. Nutritional and medicinal values of onion and garlic. *NHRDF, News Letter*, **25**: 4-10.
17. Singh, L., Bhonde, S. R. and Mishra, V. K. 1997. Effect of different organic manures and inorganic fertilizers on yield and quality of *rabi* onion. *News Letter NHRDF*, **17**: 1-3.
18. Singh, P., Sengupta, S.K., Jain, P.K. and Verma, B.K. 2015. Effect of micronutrients and biofertilizer application on growth and yield contributing characters in onion. *JNKVV Res. J.*, **49**: 193-99.
19. Singh, P., Sengupta, S.K., Verma, B.K. and Jain, P.K. 2015. Effect of micronutrients complex and biofertilizer application on growth and yield contributing characters in onion. *JNKVV Res. J.*, **4**: 200-04.
20. Smriti, S., Kumar, S. K. and Singh, R. 2002. Effect of sulphur and boron nutrition on growth, yield, and quality of onion (*Allium cepa* L.). *J. Appl. Biol. Biotechnol.*, **12**: 40-46.
21. Thompson, H.C. and Kelly, W.C. 1957. "Vegetable crops" Tata Mc Graw Hill Publishing Company Ltd., Mumbai: pp. 347-68.
22. Tiwari, R. S., Ankur, A. and Sengar, S. C. 2002. Effect of doses and methods of nitrogen application on growth, bulb yield and quality of Pusa Red onion (*Allium cepa* L.). *Indian J. Agric. Sci.*, **72**: 23-25.
23. Vaghela, K. S., Patel, K. M. and Nadoda, S. R. 2019. Effect of organic, inorganic and biofertilizer on growth and yield of onion (*Allium cepa* L.) cv. GJRO-11. *Int. J. Chem. Stud.*, **7**: 2358-61.
24. Vani, F. B., Joshi, P. C., Verma, P., Rathod, P.J. and Tejaswini, T. 2018. Effect of integrated nutrient management on growth and soil status of onion (*Allium cepa* L.) under North Gujarat condition. *Green Farm*, **9**: 459-63.
25. Vasanthkumar, H. R. 2006. *Jeevamrut* slurry preparation. *Siri Samruddhi*, **1**: 4-5.
26. Vedpathak, M. M. and Chavan, B. L. 2016. Effects of organic and chemical fertilizers on growth and yield of onion (*Allium cepa* L.). *Int. J. Environ. Agric. Biotechnol*, **1**: 1033-37.
27. Warade, S. D., Desale, S. B. and Shinde, K. G. 1996. Effects of organic, inorganic and biofertilizers on yield of onion bulbs cv. B780. *J. Maharashtra Agric. Univ.*, **20**: 467-68.

(Received : October, 2024; Revised : May, 2026;
Accepted : June, 2026)