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Effect of jeevamrutha on soil Physico-chemical parameters of mango var. Alphonso

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Abstract
A field study with jeevamrutha application in mango var. Alphonso at different concentrations and at different frequent intervals was carried out on 20 year old mango var. Alphonso at Regional Horticulture Research and Extension Centre, Dharwad (University of Horticultural Sciences, Bagalkot) during 2019-20 and 2020-21. The objective is to study the effect of jeevamrutha on soil Physico-chemical parameters of mango var. Alphonso. In pooled data, application of jeevamrutha at 1000 litre/ha with an interval of 15 days (D_3F_1) recorded the maximum soil moisture (13.19%). Similarly D_3F_1 recorded the maximum soil organic carbon content during flowering (1.09%) and after harvest (1.04%), available nitrogen (at flowering (339.22 kg/ha) and after harvest (304.85 kg/ha)), available phosphorous (during flowering (26.92 kg/ha) and after harvest (15.93 kg/ha)), available potassium (during flowering (228.42 kg/ha) and after harvest (204.30 kg/ha)) and highest yield (9.71 t/ha) was recorded in RPP (recommended package of practice) followed by D_3F_1 (7.04 t/ha).

Keywords: Jeevamrutha, dosage, frequency, soil moisture, nitrogen and potassium

Introduction
Mango is the most important commercially grown fruit crop of the country. It is called the king of fruits. India has the richest collection of mango cultivars. Cultivation of mango is believed to have originated in South East Asia and it is distributed in almost 110 countries of the world and Asia accounts for 77 per cent of global mango production. America and Africa account for 13 and 19 per cent, respectively (Yadav *et al*., 2014) [21]. Increase in productivity with adoption of advanced technologies also increased the use of chemical fertilizers causing serious damage to environment and health. Continuous use of chemical fertilization leads to deterioration of soil characteristics and fertility and accumulation of heavy metals in plant tissues, affecting the fruit nutritional value and edibility (Shimbo *et al*., 2001) [15]. The cost of inorganic fertilizers is increasing enormously to an extent that they are out of reach from small and marginal farmers. In addition, indiscriminate use of chemical fertilizers and pesticides destroys the beneficial soil micro flora and fauna that pollute soil and ground water. Further, in the near future, we may face severe problems in the fertilizer production as the reserves of some fertilizer components, especially phosphate is becoming limiting. Hence, there is an urgent need to tap the alternate sources for these nutrients, which have to be eco-friendly, low cost, locally adoptable, simple and sustainable. Hence, keeping these views in mind and it needs to be ascertained that the quantum of inorganic fertilizers can be substituted with natural farming (jeevamrutha, Ghana jeevamrutha and mulching) and organic farming (biofertilizers and panchagavya) practices without sacrificing the yield, quality and improving the soil nutrient status. Keeping these points in view, the present investigation was undertaken to study the effect of jeevamrutha on soil Physico-chemical parameters of mango var. Alphonso.

Material and Methods
The present investigation on effect of jeevamrutha on soil Physico-chemical properties in mango (*Mangifera indica* L.) var. Alphonso was carried out in Regional Horticulture Research and Extension Centre, Dharwad (University of Horticultural Sciences, Bagalkot) during 2019-20 and 2020-21. The experiment was laid out in two Factorial Randomized Block Design with ten treatments (3 x 3 +1) and three replications. Factor A includes D_1: 500 litre/ha (4 litre/tree), D_2:750 litre/ha (6 litre/tree) and D_3:1000 litre/ha (8 litre/tree), Factor-B includes F_1: Once in two weeks (15 days), F_2: Once in three weeks (21 days) and F_3: Once in four weeks (30 days) and RPP. Gana Jeevamrutha was applied in July month at 1000 kg/ha.

Organic mulching with sugarcane thrash (1st year) and cow pea (2nd year) was common to all the treatments except T_{10}. The tree age is almost 20 years. Soil samples collected from 0-30 cm depth. Observation on soil physical parameters like Soil moisture was determined by heated in an oven at 105^0 C with unfitted lid over-night (Chapman and Pratt, 1961) [4] and soil bulk density was determined for the oven dried sample by measuring cylinder method (Black, 1965) [2]. Soil chemical parameters like pH was determined in 1:2.5 soil to water suspension by dipping the combined electrode of a digital pH meter as described by Jackson (1973) [9] and organic carbon (%) content in the soil was determined by using Walkley and Black's wet oxidation method. For soil organic carbon analysis, the 2 mm sieved samples were subjected for further grinding and passed through 0.2 mm sieve. Major nutrients like available nitrogen in the soil samples was determined by alkaline potassium permanganate method as outlined by Subbiah and Asija (1956) [18]. Available phosphorous was extracted with 0.5 M sodium bicarbonate at pH 8.5 (Olsen's reagent) and amount of phosphorus in the extract was estimated at 660 nm using spectrophotometer. P- Content was calculated by referring to its standard curve (Jackson, 1973) [9]. Available potassium content in soil was determined by extracting with neutral normal ammonium acetate (Jackson, 1973) [9]. Fruit yield (t/ha) was recorded during fruiting period.

Results and Discussion

Soil physical properties

Soil moisture influenced significantly by dosage, frequency and interactions compared with RPP, but non-significant difference was found in interaction treatments (Table 1). Pooled data revealed that the maximum soil moisture was recorded by the application of a higher dosage of liquid jeevamrutha at 1000 litre/ha (D_3) (12.52%), the highest soil moisture was recorded due to frequency levels of 15 days once (F_1) (12.68%) so also in D_3F_1 (13.19%). The maximum soil moisture was noted due to frequent application of jeevamrutha at higher doses. Mulching material also helps to withhold the moisture content in the soil. Bulk density was not influenced significantly due to application of jeevamrutha during both the years. Bulk density was decreased significantly in second year due to application of jeevamrutha and FYM in interaction treatments and RPP respectively. Pooled data was found significant difference the minimum bulk density was recorded in D_1F_2 (1.21 g/cm^3) and it was on par with D_3F_1, D_2F_2 and RPP. These results are supported with the findings of Upperi *et al.* (2008) [19] reported that use of jeevamrutha significantly reduced the bulk density and increased the water holding capacity. Similar findings were reported by Birajadar *et al.*, 2001 [1]; Guled *et al.*, 2002 [8]; Patil *et al.*, 2003 [13].

Soil chemical properties

The soil pH was neutral (range from 6.1 to 7.5). PH was not influenced significantly due to dosage and frequency of liquid jeevamrutha at flowering and after harvest during both the years and pooled data (Table 2). Interaction treatments in pooled data was not differed significantly during flowering and after harvest. When interaction treatments compared with RPP (recommended package of practice) differed significantly in pooled data during after harvest. The maximum soil reaction was recorded in RPP (7.24) at after harvesting stage. But pH was reduced in second year (2020-21) compared to first year (2019-20) in interaction treatments. This might be due to acidic nature of jeevamrutha. Pooled data revealed that organic carbon content in the soil differed significantly at flowering and after harvest.

Table 1: Soil moisture (%) and bulk density (g cm^{-3}) of mango var. Alphonso as influenced by dosage and frequency of liquid jeevamrutha

Treatment	Soil moisture (%)			Bulk density (g/cm^3)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Dosage						
D_1	10.59	11.71	11.15	1.26	1.26	1.26
D_2	10.71	12.44	11.57	1.30	1.29	1.30
D_3	12.03	13.01	12.52	1.31	1.27	1.29
S. Em±	0.33	0.34	0.22	0.02	0.02	0.01
C. D. @ 5%	0.98	1.01	0.67	NS	NS	NS
Frequency						
F_1	11.92	13.43	12.68	1.29	1.27	1.28
F_2	10.98	12.08	11.53	1.28	1.26	1.27
F_3	10.43	11.64	11.04	1.31	1.29	1.30
S. Em±	0.33	0.34	0.22	0.02	0.02	0.01
C. D. @ 5%	0.98	1.01	0.67	NS	NS	NS
Interaction						
D_1F_1	11.78	12.42	12.10	1.30	1.28	1.29
D_1F_2	10.41	11.50	10.96	1.22	1.21	1.21
D_1F_3	9.56	11.21	10.39	1.30	1.28	1.29
D_2F_1	11.53	13.95	12.74	1.31	1.31	1.31
D_2F_2	10.18	11.87	11.03	1.27	1.25	1.26
D_2F_3	10.41	11.50	10.96	1.34	1.29	1.32
D_3F_1	12.45	13.93	13.19	1.26	1.22	1.24
D_3F_2	12.34	12.87	12.60	1.36	1.31	1.34
D_3F_3	11.30	12.23	11.77	1.31	1.27	1.29

S. Em±	0.56	0.59	0.38	0.04	0.04	0.02
C. D. @ 5%	NS	NS	NS	NS	NS	0.06
RPP	9.03	9.93	9.48	1.27	1.25	1.26
S. Em±	0.58	0.57	0.40	0.04	0.03	0.02
C. D. @ 5%	1.72	1.69	1.19	NS	NS	0.06

D_1- Jeevamrutha 500 litre/ha (4.0 litre/tree) **F_1-** Once in 15 days **F_3-** Once in 30 days
D_2- Jeevamrutha 750 litre/ha (6.0 litre/tree) **F_2-** Once in 21 days **RPP**- Recommended package of practice
D_3- Jeevamrutha 1000 litre/ha (8.0 litre/tree)

Table 2: Soil pH and Organic carbon (%) in mango *var*. Alphonso as influenced by dosage and frequency of liquid jeevamrutha

Treatment	pH						Organic Carbon (%)					
	Flowering			After harvest			Flowering			After harvest		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Dosage												
D_1	6.97	6.25	6.61	6.68	6.13	6.41	0.73	0.87	0.80	0.65	0.81	0.73
D_2	7.05	6.41	6.73	6.85	6.19	6.52	0.91	1.01	0.96	0.74	0.90	0.82
D_3	7.15	6.43	6.79	6.97	6.17	6.57	0.91	1.06	0.99	0.85	0.99	0.92
S. Em±	0.13	0.11	0.10	0.12	0.11	0.08	0.06	0.05	0.04	0.04	0.04	0.02
C. D. @ 5%	NS	NS	NS	NS	NS	NS	NS	0.14	0.12	0.13	0.12	0.07
Frequency												
F_1	7.24	6.29	6.76	6.97	6.09	6.53	0.94	1.05	1.00	0.86	1.00	0.93
F_2	6.95	6.38	6.67	6.78	6.23	6.50	0.85	0.98	0.92	0.76	0.87	0.81
F_3	6.98	6.41	6.70	6.75	6.18	6.46	0.76	0.91	0.84	0.62	0.82	0.72
S. Em±	0.13	0.11	0.10	0.12	0.11	0.08	0.06	0.05	0.04	0.04	0.04	0.02
C. D. @ 5%	NS	NS	NS	NS	NS	NS	NS	NS	0.12	0.13	0.12	0.07
Interaction												
D_1F_1	7.03	6.17	6.60	6.71	6.15	6.43	0.81	0.97	0.89	0.80	0.94	0.87
D_1F_2	6.53	6.43	6.48	6.36	6.22	6.29	0.65	0.81	0.73	0.56	0.73	0.65
D_1F_3	7.35	6.16	6.76	6.98	6.02	6.50	0.74	0.84	0.79	0.60	0.75	0.67
D_2F_1	7.41	6.08	6.74	7.22	5.98	6.60	0.98	1.04	1.01	0.80	0.96	0.88
D_2F_2	6.93	6.42	6.67	6.74	6.30	6.52	0.88	1.08	0.98	0.76	0.91	0.83
D_2F_3	6.81	6.73	6.77	6.58	6.30	6.44	0.86	0.91	0.89	0.66	0.82	0.74
D_3F_1	7.27	6.63	6.95	6.98	6.13	6.56	1.04	1.14	1.09	0.98	1.09	1.04
D_3F_2	7.41	6.30	6.86	7.24	6.16	6.70	1.02	1.06	1.04	0.96	0.97	0.97
D_3F_3	6.78	6.35	6.57	6.68	6.22	6.45	0.69	0.97	0.83	0.61	0.90	0.76
S. Em±	0.23	0.20	0.17	0.21	0.19	0.13	0.10	0.08	0.07	0.08	0.07	0.04
C. D. @ 5%	0.68	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
RPP	7.42	7.21	7.31	7.38	7.10	7.24	0.68	0.78	0.73	0.53	0.67	0.60
S. Em±	0.22	0.20	0.16	0.20	0.19	0.12	0.10	0.08	0.06	0.07	0.07	0.04
C. D. @ 5%	NS	0.59	NS	0.61	0.56	0.37	NS	0.23	0.19	0.22	0.21	0.12

D_1- Jeevamrutha 500 litre/ha (4.0 litre/tree) **F_1-** Once in 15 days **F_3-** Once in 30 days
D_2- Jeevamrutha 750 litre/ha (6.0 litre/tree) **F_2-** Once in 21 days **RPP**- Recommended package of practice
D_3- Jeevamrutha 1000 litre/ha (8.0 litre/tree)

The maximum organic carbon content was recorded by the application of jeevamrutha at higher doses (D_3) during flowering (0.99%) and after harvest (0.92%) respectively (Table 2 and Fig 1). Application of jeevamrutha 15 days once was recorded maximum organic carbon content in all the growth stages. When interaction compared with RPP, the maximum organic carbon content was noted in D_3F_1 during flowering (1.09%) and after harvest (1.04%). This significant changes might be due to the rapid decomposition of organic matter applied in the form of mulching material and also Ghana jeevamrutha. The application of jeevamrutha at frequent intervals help to increase the soil biological activity in the soil, ultimately changed the physico-chemical properties of soil. The results are supported with the findings of (Chaithra, 2018) [3] where in, higher organic carbon content was noted by the application of jeevamrutha at higher doses in combination with FYM. Other similar findings were (Upperi *et al*. 2008 [19]; Shaikh and Gachande, 2015 [14]; Kumar, 2016) [11].

Available major nutrients

The data on available nitrogen, phosphorous and potassium differed significantly at flowering and after harvest due to dosage and frequency of liquid jeevamrutha and interactions compared with RPP during 2019-20, 2020-21 and pooled data (Table 3 and 4) (Fig 1 & 2). In pooled data significantly maximum available nitrogen was recorded in D_3 (application of jeevamrutha at 1000 litre/ha) during flowering (322.47 kg/ha) and after harvest (289.50 kg/ha). Similarly F_1 (interval of 15 days) was recorded maximum nitrogen content during flowering (317.61 kg/ha) and after harvest (287.17 kg/ha) respectively and so in D_3F_1 had the highest nitrogen content was recorded during flowering (339.22 kg/ha) and after harvest (304.85 kg/ha) respectively which was on parity with D_3F_2 and D_2F_1 and minimum was recorded in D_1F_3 and D_1F_2. Available phosphorous differed significantly, the maximum phosphorous content was found in D_3 during flowering (21.37 kg/ha) and after harvest (13.09 kg/ha) respectively. Similarly, F_1 (application of jeevamrutha 15 days once) recorded the

maximum phosphorous content during flowering (23.23 kg/ha) and after harvest (15.00 kg/ha) respectively so also in D_3F_1 had the highest phosphorous content during flowering (26.92 kg/ha) and after harvest (15.93 kg/ha) respectively and minimum was recorded in D_1F_3. The data pertaining to available potassium content in soil influenced significantly by dosage, frequency and interaction treatments compared with RPP. The maximum potassium content was recorded in D_3 during flowering (202.24 kg/ha) and retained after fruit harvest (174.30 kg/ha) respectively. Similarly F_1 (application of jeevamrutha 15 days once) recorded the maximum potassium content during flowering (200.30 kg/ha) and after harvest (173.63 kg/ha) respectively so also in D_3F_1 had the highest potassium content during flowering (228.42 kg/ha) and after harvest (204.30 kg/ha) respectively and minimum was recorded in D_1F_3. The increase in available potassium in soil is due to the decomposition products of organic matter which contain various organic acids, might have aided in the release of non-exchangeable K to the water-soluble forms (Chitra and Janaki, 1999) [5].

Table 3: Available Nitrogen (kg/ha) and Available phosphorous (kg/ha) in mango *var*. Alphonso as influenced by dosage and frequency of liquid jeevamrutha.

Treatment	Available nitrogen (kg/ha)						Available phosphorous (kg/ha)					
	Flowering			After harvest			Flowering			After harvest		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Dosage												
D_1	278.67	294.55	286.61	240.10	259.78	249.94	16.65	18.72	17.68	9.03	12.33	10.68
D_2	288.34	305.13	296.74	265.09	270.10	267.60	18.72	21.31	20.01	9.83	14.02	11.93
D_3	304.96	339.99	322.47	272.29	306.71	289.50	19.10	23.65	21.37	10.33	15.85	13.09
S. Em±	5.96	5.40	4.81	4.56	3.67	3.71	0.92	0.91	0.69	0.57	0.60	0.40
C. D. @ 5%	17.87	16.17	14.41	13.66	10.99	11.11	NS	2.72	2.07	NS	1.79	1.19
Frequency												
F_1	299.47	335.75	317.61	274.76	299.57	287.17	20.55	25.92	23.23	11.01	19.00	15.00
F_2	292.34	310.59	301.47	257.31	275.82	266.57	17.32	20.99	19.15	9.66	12.98	11.32
F_3	280.16	293.33	286.74	245.41	261.19	253.30	16.60	16.77	16.68	8.54	10.22	9.38
S. Em±	5.96	5.40	4.81	4.56	3.67	3.71	0.92	0.91	0.69	0.57	0.60	0.40
C. D. @ 5%	NS	16.17	14.41	13.66	10.99	11.11	2.75	2.72	2.07	1.70	1.79	1.19
Interaction												
D_1F_1	289.56	316.75	303.15	255.26	277.64	266.45	16.43	23.35	19.89	8.87	16.84	12.85
D_1F_2	268.41	288.87	278.64	229.41	256.37	242.89	17.97	19.56	18.76	10.77	11.36	11.07
D_1F_3	278.04	278.03	278.03	235.63	245.32	240.48	15.54	13.24	14.39	7.45	8.78	8.11
D_2F_1	287.52	333.41	310.47	278.27	302.12	290.20	20.64	25.12	22.88	12.93	19.52	16.23
D_2F_2	290.28	298.37	294.33	266.57	261.72	264.15	18.67	21.18	19.93	8.48	12.33	10.41
D_2F_3	287.23	283.62	285.42	250.44	246.45	248.45	16.85	17.62	17.24	8.09	10.22	9.15
D_3F_1	321.34	357.09	339.22	290.75	318.95	304.85	24.57	29.28	26.92	11.22	20.64	15.93
D_3F_2	318.34	344.54	331.44	275.95	309.38	292.66	15.32	22.22	18.77	9.71	15.24	12.48
D_3F_3	275.20	318.33	296.76	250.16	291.80	270.98	17.41	19.45	18.43	10.07	11.65	10.86
S. Em±	10.33	9.34	8.33	7.89	6.35	6.42	1.59	1.57	1.19	0.98	1.04	0.69
C. D. @ 5%	NS	NS	NS	NS	NS	NS	4.76	NS	NS	2.95	NS	NS
RPP	283.36	293.18	288.27	237.70	243.88	240.79	19.03	21.36	20.20	8.34	10.98	9.66
S. Em±	10.73	9.36	8.72	7.93	6.76	6.28	1.53	1.52	1.14	1.02	1.03	0.65
C. D. @ 5%	31.87	27.81	25.91	23.55	20.10	18.65	4.54	4.51	3.40	3.02	3.05	1.94

D_1- Jeevamrutha 500 litre/ha (4.0 litre/tree) **D_3-** Jeevamrutha 1000 litre/ha (8.0 litre/tree) **F_2-** Once in 21 days **F_3-** Once in 30 days
D_2- Jeevamrutha 750 litre/ha (6.0 litre/tree) **F_1-** Once in 15 days **RPP-** Recommended package of practice

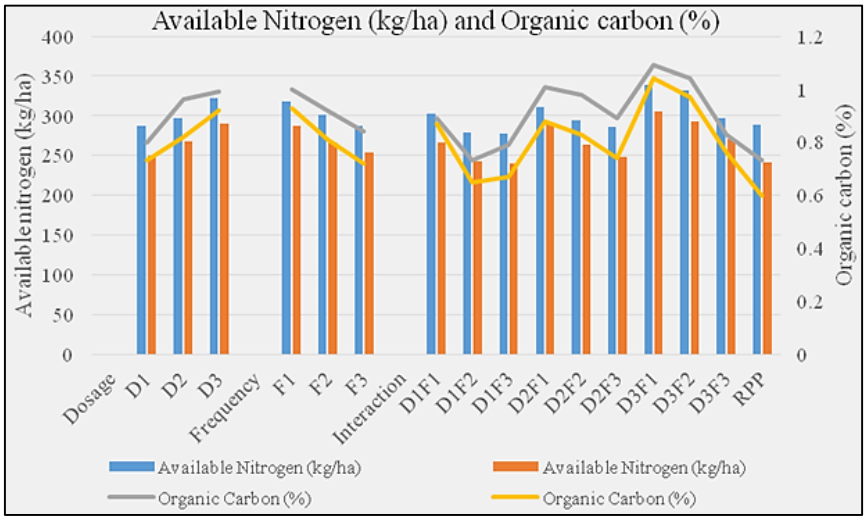
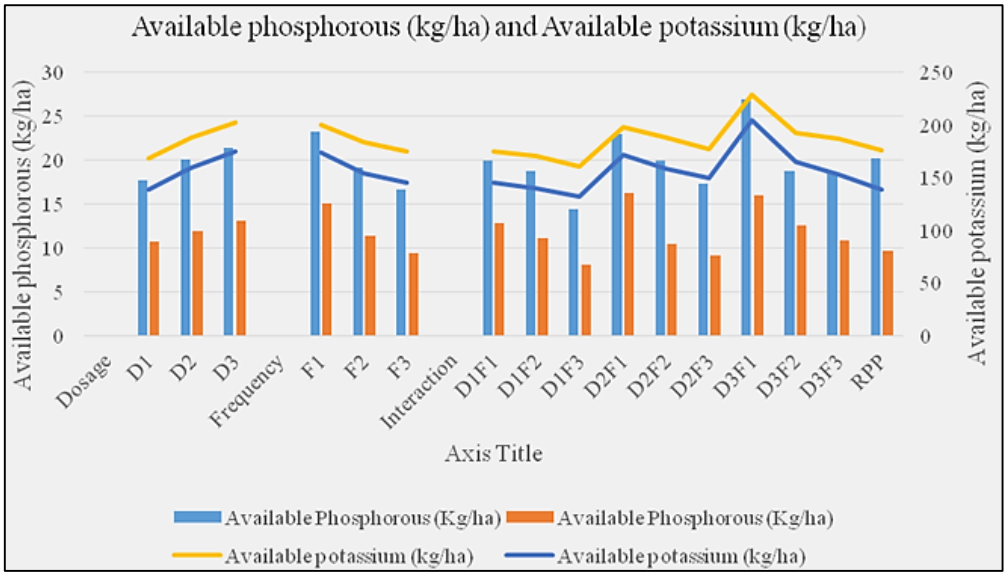


Fig 1: Available nitrogen (kg/ha) and organic carbon (%) during flowering and after harvest in 0-30 cm depth of mango var. Alphonso as influenced by dosage and frequency of liquid jeevamrutha.



Dosage of: Jeevamrutha (D) **D_1**- 500 litre/ha **D_2**- 750 litre/ha **D_3**- 1000 litre/ha **RPP**- Recommended package of practice Frequency (F): **F_1**- Once in 15 days **F_2**- Once in 21 days **F_3**- Once in 30 days

Fig 2: Available phosphorous (kg/ha) and Available potassium ((kg/ha) during flowering and after harvest in 0-30 cm depth of mango var. Alphonso as influenced by dosage and frequency of liquid jeevamrutha.

Table 4: Available Potassium (kg/ha) and Fruit yield (t/ha) in mango *var*. Alphonso as influenced by dosage and frequency of liquid jeevamrutha

Treatment	Available Potassium (kg/ha)						Fruit yield (t/ha)		
	Flowering			After harvest					
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
Dosage									
D_1	159.11	178.13	168.62	135.83	141.81	138.82	5.34	4.70	5.02
D_2	179.30	196.07	187.68	150.04	169.20	159.62	5.52	4.83	5.18
D_3	192.97	211.50	202.24	163.14	185.45	174.30	7.02	5.73	6.37
S. Em±	8.22	6.05	5.59	6.27	6.33	4.29	0.35	0.18	0.20
C. D. @ 5%	24.66	18.15	16.75	18.78	18.98	12.86	1.04	0.55	0.59
Frequency									
F_1	191.92	208.68	200.30	170.06	177.19	173.63	6.58	5.72	6.15
F_2	173.23	193.79	183.51	145.01	163.12	154.06	5.80	5.03	5.41
F_3	166.23	183.23	174.73	133.95	156.16	145.05	5.50	4.51	5.00
S. Em±	8.22	6.05	5.59	6.27	6.33	4.29	0.35	0.18	0.20
C. D. @ 5%	NS	18.15	16.75	18.78	NS	12.86	NS	0.55	0.59
Interaction									
D_1F_1	166.77	183.34	175.06	140.70	150.09	145.40	5.95	5.77	5.86
D_1F_2	160.92	179.62	170.27	136.38	141.81	139.09	5.23	4.94	5.09
D_1F_3	149.65	171.43	160.54	130.42	133.53	131.98	4.84	3.38	4.11
D_2F_1	186.69	208.17	197.43	168.54	173.82	171.18	6.14	4.97	5.55
D_2F_2	182.64	193.81	188.23	147.04	168.55	157.80	5.24	4.88	5.06
D_2F_3	168.56	186.21	177.39	134.55	165.24	149.90	5.18	4.66	4.92
D_3F_1	222.31	234.53	228.42	200.93	207.67	204.30	7.64	6.43	7.04
D_3F_2	176.12	207.92	192.02	151.61	178.99	165.30	6.92	5.28	6.10
D_3F_3	180.49	192.06	186.27	136.87	169.70	153.29	6.49	5.48	5.98
S. Em±	14.24	10.49	9.68	10.85	10.96	7.43	0.60	0.32	0.34
C. D. @ 5%	NS	NS	NS	NS	NS	NS	NS	0.96	NS
RPP	170.59	180.29	175.44	135.86	142.06	138.96	10.46	8.96	9.71
S. Em±	13.95	10.09	9.57	10.71	11.08	7.85	0.61	0.40	0.36
C. D. @ 5%	NS	29.98	28.44	31.81	32.91	23.34	1.82	1.19	1.06

D_1- Jeevamrutha 500 litre/ha (4.0 litre/tree) **F_1**- Once in 15 days **F_3**- Once in 30 days
D_2- Jeevamrutha 750 litre/ha (6.0 litre/tree) **F_2**- Once in 21 days **RPP**- Recommended package of practice
D_3- Jeevamrutha 1000 litre/ha (8.0 litre/tree)

In the present investigation, the variation in nutrient availability due to different jeevamrutha dosages and frequency levels was estimated at flowering and after fruit harveststage. The analysis revealed that in general the jeevamrutha applied at higher doses with frequent intervals of 15 days indicated more availability of nitrogen, phosphorous and potassium in soil. The increased availability of nutrients due to enhanced population of soil micro flora resulting in increased bacteria, fungi and actinomycetes population and enzyme activity in the soil and also due to increased earth

worm activity in the soil which helps faster decomposition of Organic matter (mulching material used in all the treatments except RPP) which ultimately add the nutrients to the soil. Similar results were reported by Chaithra (2018) [3] as they observed significantly higher N, P and K content in sunflower due to application of jeevamrutha 1500 l ha^{-1} recorded significantly higher available nutrient *viz.*, N, P and K in the soil compared to without jeevamrutha application (control). This is due to huge quantity of microbial load present in jeevamrutha which enhances soil bio-mass upon its application to soil even at very lesser rate as it acts as a tonic to soil besides improving soil health (Vasanthkumar, 2006) [20]. These results are in agreement with the findings of (Singh, 2008 [17]; Gore and Srinivas, 2011 [7]; Siddaram, 2012) [16].

Fruit yield

Fruit yield was recorded during both the years (2019-20 and 2020-21) and pooled data are presented in Table 4. The pooled data revealed that significantly, the maximum fruit yield (t/ha) was recorded in D_3 (6.37 t/ha) and minimum was recorded in D_1 (5.02 t/ha) due to dosage of liquid jeevamrutha application. Irrespective of frequency levels of liquid jeevamrutha had significantly, the maximum fruit yield (6.15 t/ha) was recorded in F_1 (jeevamrutha application at 15 days interval). This might be due to higher number of fruits (200.17). The higher yield was recorded in D_3 (Jeevamrutha @ 1000 litre/ha) and F_1 (15 days once) might be due to favorable effects of macro and micronutrients, which helps in better availability of nutrients throughout the crop growth which might be the result of improved microbial activity in the soil. These findings are in accordance with Kasbe *et al.* (2009) [10] where in, it is reported that higher nutrient status of jeevamrutha formulation (2500 l ha^{-1}) resulted in profused growth in the form of higher drymatter accumulation and yield parameters. Interaction treatments compared with RPP was significantly influenced. Pooled data revealed that the maximum fruit yield was recorded in RPP (9.71 t/ha) due to more number of fruits harvested per tree followed by D_3F_1 (7.04 t/ha). The increased yield in RPP (recommended package of practice) due to application of nutrients through FYM and chemical fertilizers might be attributed to the quick release and availability of nutrients in required quantity with the application of fertilizers and pest and diseases were managed through use of chemical pesticides and fungicides respectively. The results are supported with the findings of Gorabal (2020) [6] where in, it is reported that application of FYM and fertilizers resulted in higher yield and its components were recorded in groundnut compared to jeevamrutha and ghana jeevamrutha and their interactions. The results are in agreement with the findings of Gore and Sreenivasa, 2011 [7]; Mahapatra *et al.*, 2017 [12].

Conclusion

Higher dosage of jeevamrutha (1000 litre/ha) helps to increase the organic carbon content in the soil which intern increased the major nutrients like Available nitrogen, Available phosphorous and Available potassium. This increase in nutrient status also due to more frequent intervals (once in 15 days) of jeevamrutha application. Finally this results into maximum nutrient uptake and gives higher yield.

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