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RESEARCH PAPER

Influence of foliar application of humic and fulvic acids on yield and nutrient uptake by Okra (*Abelmoschus esculentus* L.) under different nutrient management practices

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Abstract: A field experiment was conducted to identify the optimal nutrient management practices and levels of humic and fulvic acids for better yield and nutrient uptake in Okra. The study was laid out in a split-split plot design with three main plot treatments consisting of different nutrient management practices (inorganic farming-M_1, organic farming-M_2 and recommended nutrient practice-M_3), three subplot treatments of humic acid (0, 0.25 and 0.50%) and three sub-subplot treatments of fulvic acid (0, 0.10 and 0.25%) at college of Horticulture, UHS, Bagalkot. Observations *viz*., yield attributing parameters, yield and nutrient uptake were recorded. The results revealed that the treatment ($M_3H_3F_3$) receiving recommended nutrient practice with foliar application of humic acid @ 0.50 per cent and fulvic acid @ 0.25 per cent significantly increased yield and nutrient uptake in okra.The maximum number of fruits per plant (24.27), fruit length (14.94 cm), fruit weight per plant (314.62 g plant^{-1}) and fruit yield (111.12 q ha^{-1}) were recorded under this treatment. Similarly, the highest uptake of nitrogen (143.85 kg ha^{-1}), phosphorous (79.05 kg ha^{-1}), potassium (204.75 kg ha^{-1}) and sulphur (10.18 kg ha^{-1}) was noticed under the same treatment.Similar trends were noticed in both the seasons. The study suggests that integrating recommended nutrient practices with foliar application of humic and fulvic acids can enhance okra yield and nutrient uptake.

Key words: Fulvic acid, Humic acid, Nutrient uptake, Okra, Yield

Introduction

Soil is one of the most precious natural resource serving not only for mankind through food and shelter but also plays key role in life cycle of fauna and flora of the earth. But this precious natural entity is diminishing at an alarming rate due to man-made activities. Among them are increasing populations, unscientific way of cultivation, over exploitation of irrigation water and industrialization. Effective fertility management strategies significantly enhancing soil health for sustainable crop production. To attain sustainable enhancement in yield and better nutrient uptake, different strategies have been envisaged in recent past. One of the approaches to enhance the productivity of crops is through development of environment friendly humic substances which have beneficial effect on plants. To identify and explore the potential organics as a source of plant nutrients, an experiment was conducted treating Okra (*Abelmoschus esculentus*) with combinations of humic acid and fulvic acids along with different nutrient management practices. Hence, the study was conducted to determine suitable nutrient management practice and foliar application of humic and fulvic acid concentration for better yield and nutrient uptake by Okra.

Material and methods

The experiment was conducted at College of Horticulture, UHS, Bagalkot during *kharif* and *rabi* seasons of 2023-24 to study the effect of humic acid and fulvic acid with different nutrient management practices on growth and yield of Okra.The experiment was laid out in a split-split plot design with three replications. The main plot consists of three nutrient management practices: inorganic farming (M_1), organic farming (M_2) and recommended nutrient practice (M_3). The subplot consists of three levels of humic acid: no humic acid (H_1), 0.25 per cent humic acid (H_2) and 0.50 per cent humic acid (H_3). The sub-subplot consists of three levels of fulvic acid: no fulvic acid (F_1), 0.10 per cent fulvic acid (F_2) and 0.25 per cent fulvic acid (F_3). Foliar application of humic and fulvic acid was given at 30, 45 and 60 DAS. The observations on yield, yield attributing parameter and amount of nutrient uptake by the Okra crop were recorded.The data was subjected to statistical analysis as per Gomez and Gomez (1984).

Results and discussion

Yield: The results of the experiment revealed that the treatment receiving recommended nutrient practices with foliar application of 0.50 per cent humic acid and 0.25 per cent fulvic acid ($M_3H_3F_3$) significantly out performed other nutrient management practices with different combinations of humic and fulvic acid. The fruit yield of okra was highest (111.12 q ha^{-1}) (Table 2) (Fig.2) in the $M_3H_3F_3$ treatment, which was attributed to better nutrient availability during the crop growth period.Highest fruit yield in the $M_3H_3F_3$ treatment can be attributed to the synergistic effect of foliar application of humic and fulvic acids and integrated nutrient management. This combination likely enhanced the translocation of photosynthates from source to sink, resulting

Table 1. Effect of different treatments on number of fruits per plant and fruit length of Okra during *kharif and rabi* seasons of 2023-24

Treatments	No. of fruits / Plant			Fruit length (cm)		
	kharif	*rabi*	Pooled	*kharif*	*rabi*	Pooled
Nutrient Management Practices (M)						
Inorganic farming (M_1)	19.29	19.73	19.51	11.66	11.76	11.71
Organic Farming (M_2)	18.27	19.55	18.91	11.55	11.94	11.74
Recommended Nutrient Practice (M_3)	20.88	21.60	21.24	12.42	13.43	12.92
S.Em±	0.084	0.074	0.017	0.053	0.067	0.047
C.D.(0.05)	0.332	0.289	0.065	0.207	0.263	0.186
Humic Acid (H)						
Humic acid (0%) H_1	16.90	17.79	17.35	10.73	11.19	10.96
Humic acid (0.25%) H_2	19.40	20.11	19.76	11.83	12.28	12.05
Humic acid (0.50%) H_3	22.13	22.99	22.56	13.07	13.67	13.37
S.Em±	0.058	0.093	0.058	0.037	0.120	0.070
C.D.(0.05)	0.178	0.288	0.180	0.115	0.369	0.216
Fulvic Acid (F)						
Fulvic acid (0%) F_1	18.72	19.77	19.25	11.40	11.85	11.63
Fulvic acid (0.10%) F_2	19.55	20.29	19.92	11.89	12.37	12.13
Fulvic acid (0.25%) F_3	20.16	20.83	20.50	12.33	12.91	12.62
S.Em±	0.100	0.162	0.101	0.064	0.207	0.122
C.D. (0.05)	0.308	0.499	0.311	0.199	0.639	0.375
Interaction - M X H						
M_1H_1	16.53	17.16	16.85	10.47	10.51	10.49
M_1H_2	19.36	19.80	19.58	11.60	11.71	11.65
M_1H_3	21.99	22.24	22.11	12.93	13.06	13.00
M_2H_1	16.03	17.25	16.64	10.61	11.03	10.82
M_2H_2	17.96	18.88	18.42	11.60	11.83	11.71
M_2H_3	20.81	22.53	21.67	12.44	12.96	12.70
M_3H_1	18.14	18.96	18.55	11.12	12.01	11.56
M_3H_2	20.88	21.66	21.27	12.28	13.29	12.79
M_3H_3	23.61	24.19	23.90	13.85	14.98	14.42
S.Em±	0.066	0.069	0.050	0.048	0.058	0.035
C.D.(0.05)	0.189	0.198	0.144	0.137	NS	0.099
Interaction - M X F						
M_1F_1	18.32	18.93	18.62	11.19	11.33	11.26
M_1F_2	19.33	19.73	19.53	11.64	11.67	11.66
M_1F_3	20.23	20.54	20.38	12.16	12.29	12.22
M_2F_1	17.65	19.33	18.49	11.07	11.42	11.25
M_2F_2	18.39	19.59	18.99	11.63	12.02	11.82
M_2F_3	18.76	19.74	19.25	11.95	12.38	12.16
M_3F_1	20.20	21.04	20.62	11.95	12.80	12.37
M_3F_2	20.94	21.53	21.24	12.41	13.41	12.91
M_3F_3	21.49	22.22	21.86	12.89	14.07	13.48
S.Em±	0.114	0.119	0.087	0.082	0.101	0.060
C.D.(0.05)	0.327	0.342	0.250	NS	NS	NS
Interaction - H X F						
H_1F_1	15.88	17.35	16.61	10.03	10.42	10.22
H_1F_2	17.16	17.72	17.44	10.82	11.28	11.05
H_1F_3	17.68	18.30	17.99	11.34	11.86	11.60
H_2F_1	18.70	19.33	19.02	11.53	12.02	11.78
H_2F_2	19.37	20.04	19.71	11.80	12.26	12.03
H_2F_3	20.12	20.96	20.54	12.14	12.55	12.34
H_3F_1	21.59	22.62	22.11	12.65	13.10	12.88
H_3F_2	22.13	23.10	22.62	13.06	13.56	13.31
H_3F_3	22.68	23.24	22.96	13.51	14.33	13.92
S.Em±	0.114	0.119	0.087	0.082	0.101	0.060
C.D.(0.05)	0.327	0.342	0.250	0.237	0.290	0.172
Interaction - M X H X F						
$M_1H_1F_1$	14.89	16.19	15.54	9.75	9.91	9.83
$M_1H_1F_2$	17.00	17.30	17.15	10.48	10.40	10.44
$M_1H_1F_3$	17.70	18.00	17.85	11.17	11.23	11.20

cont....

$M_1H_2F_1$	18.53	18.77	18.65	11.38	11.51	11.45
$M_1H_2F_2$	19.05	19.50	19.28	11.61	11.74	11.68
$M_1H_2F_3$	20.48	21.13	20.81	11.79	11.89	11.84
$M_1H_3F_1$	21.53	21.83	21.68	12.43	12.57	12.50
$M_1H_3F_2$	21.93	22.40	22.17	12.84	12.87	12.85
$M_1H_3F_3$	22.50	22.47	22.49	13.52	13.75	13.63
$M_2H_1F_1$	15.63	17.29	16.46	9.88	10.20	10.04
$M_2H_1F_2$	16.03	17.28	16.66	10.75	11.37	11.06
$M_2H_1F_3$	16.43	17.17	16.80	11.20	11.52	11.36
$M_2H_2F_1$	17.30	18.47	17.88	11.35	11.60	11.48
$M_2H_2F_2$	18.17	18.93	18.55	11.63	11.84	11.74
$M_2H_2F_3$	18.42	19.25	18.83	11.82	12.05	11.93
$M_2H_3F_1$	20.02	22.23	21.13	11.99	12.46	12.22
$M_2H_3F_2$	20.97	22.57	21.77	12.50	12.85	12.68
$M_2H_3F_3$	21.43	22.80	22.12	12.83	13.56	13.20
$M_3H_1F_1$	17.10	18.57	17.83	10.46	11.14	10.80
$M_3H_1F_2$	18.43	18.57	18.50	11.23	12.07	11.65
$M_3H_1F_3$	18.90	19.73	19.32	11.67	12.82	12.24
$M_3H_2F_1$	20.28	20.77	20.52	11.86	12.97	12.41
$M_3H_2F_2$	20.90	21.70	21.30	12.17	13.20	12.69
$M_3H_2F_3$	21.47	22.50	21.98	12.82	13.70	13.26
$M_3H_3F_1$	23.23	23.80	23.52	13.53	14.28	13.91
$M_3H_3F_2$	23.50	24.33	23.92	13.84	14.97	14.40
$M_3H_3F_3$	24.10	24.43	24.27	14.18	15.69	14.94
S.Em±	0.197	0.207	0.151	0.143	0.175	0.104
C.D.(0.05)	0.566	0.593	0.433	NS	NS	NS

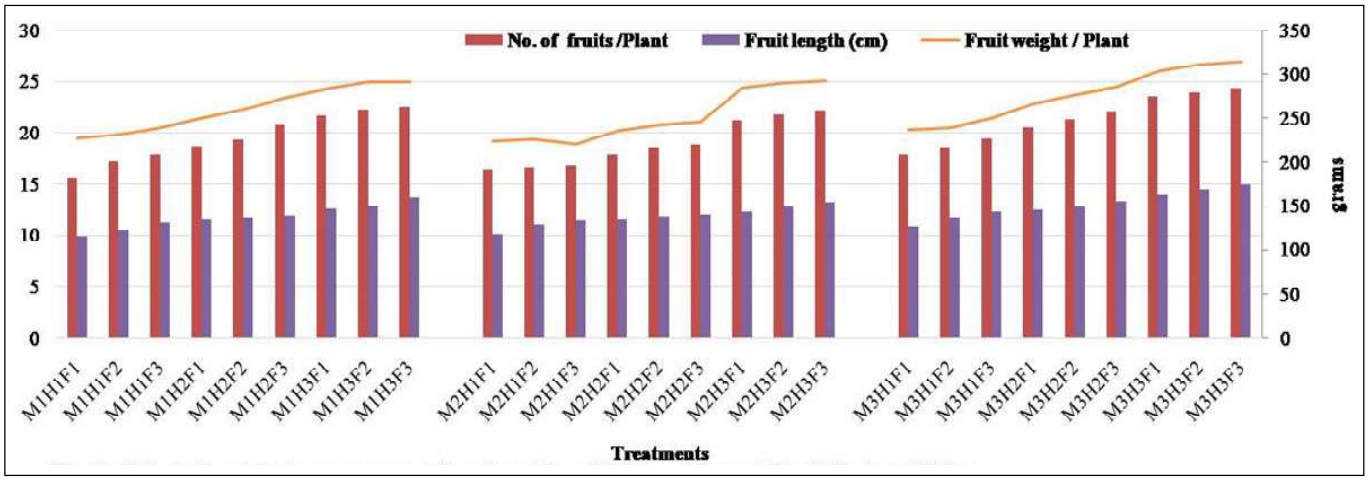

Fig1. Effect of nutrient management, humic acid and fulvic acid on yield attributes of Okra

in improved yield attributes, including increased number of fruits per plant, fruit length, fruit weight per plant and ultimately leading to higher fruit yield. (Tables 1 and 2; Fig. 1).The results are in confirmation with the findings of Manoranjitham D (2007) who reported that applying 0.05 per cent humic acid topically in the shade, boosted the majority of the coriander's growth parameters including plant height, branch, leaf counts, leaf area, leaf area index, specific leaf weight, root length, RGR, CGR and dry matter production during various growth phases. These results also corroborate with the findings of Shafeek *et al.* (2016), Pasha *et al*. (2021) and Anandakumar *et al*. (2024).

Nutrient uptake: The nutrients retained in the soil after the harvest of crop mainly depend on both supply of nutrients through various sources and uptake by the crop. In general, higher the uptake of nutrients by crop lower will be the residual soil nutrients status. Conjoint application of fertilizers and organic manures with foliar application of humic and fulvic acid significantly influenced the total nutrient uptake by Okra crop (N, P, K and S) and followed almost similar trend as that of yield.

Data for nitrogen, phosphorus, potassium and sulphur uptake by Okra crop in two seasons indicated that significantly increased nitrogen, phosphorus, potassium and sulphur uptake was recorded. The highest uptake of N, P, K and S was noticed under treatment $M_3H_3F_3$ (143.85, 79.05, 204.75 and 10.18 kg ha^{-1} respectively) (Table. 3 and 4 Fig. 3) which contains recommended nutrient practice with foliar application of humic acid @ 0.50 per

Table 2. Effect of different treatments on fruit weight (g Plant^{-1}) and fruit yield (q ha^{-1}) of Okra during *kharif* and *rabi* seasons of 2023-24

Treatments	No. of fruits / Plant			Fruit length (cm)		
	kharif	*rabi*	Pooled	*kharif*	*rabi*	Pooled
Nutrient Management Practices (M)						
Inorganic farming (M_1)	260.66	260.92	260.79	93.16	95.71	94.43
Organic Farming (M_2)	246.96	255.17	251.07	89.31	94.37	91.84
Recommended Nutrient Practice (M_3)	270.90	281.26	276.08	97.14	101.54	99.34
S. Em±	1.047	1.081	0.906	0.347	0.261	0.223
C.D. (0.05)	4.111	4.243	3.557	1.361	1.026	0.877
Humic Acid (H)						
Humic acid (0%) H_1	229.31	235.37	232.34	83.03	85.88	84.46
Humic acid (0.25%) H_2	256.70	262.70	259.70	93.19	95.89	94.54
Humic acid (0.50%) H_3	292.51	299.28	295.89	103.39	109.84	106.61
S. Em±	1.033	0.957	0.973	0.274	0.337	0.227
C.D. (0.05)	3.182	2.950	2.997	0.844	1.039	0.698
Fulvic Acid (F)						
Fulvic acid (0%) H_1	253.69	259.73	256.71	90.72	94.53	92.63
Fulvic acid (0.10%) H_2	259.67	266.10	262.88	92.99	97.05	95.02
Fulvic acid (0.25%) H_3	265.17	271.51	268.34	95.89	100.03	97.96
S. Em±	1.789	1.658	1.685	0.474	0.584	0.393
C.D. (0.05)	5.512	5.110	5.191	1.462	1.800	1.210
Interaction - M X H						
M_1H_1	232.40	232.24	232.32	82.30	84.31	83.31
M_1H_2	261.64	260.94	261.29	93.88	95.05	94.47
M_1H_3	287.93	289.56	288.75	103.30	107.75	105.53
M_2H_1	218.84	226.80	222.82	78.96	83.86	81.41
M_2H_2	237.15	245.48	241.32	87.62	90.42	89.02
M_2H_3	284.89	293.22	289.06	101.34	108.83	105.08
M_3H_1	236.70	247.06	241.88	87.82	89.48	88.65
M_3H_2	271.32	281.68	276.50	98.07	102.19	100.13
M_3H_3	304.70	315.06	309.88	105.52	112.94	109.23
S. Em±	0.585	0.658	0.550	0.241	0.332	0.219
C.D.(0.05)	1.678	1.888	1.578	0.691	0.952	0.627
Interaction - M X F						
M_1F_1	253.43	253.24	253.34	89.98	92.27	91.12
M_1F_2	260.26	260.88	260.57	92.84	95.49	94.17
M_1F_3	268.28	268.63	268.46	96.66	99.36	98.01
M_2F_1	243.95	251.91	247.93	87.03	92.37	89.70
M_2F_2	248.28	256.61	252.44	89.30	94.69	92.00
M_2F_3	248.66	256.99	252.82	91.59	96.05	93.82
M_3F_1	263.68	274.04	268.86	95.17	98.94	97.05
M_3F_2	270.46	280.82	275.64	96.83	100.98	98.91
M_3F_3	278.56	288.92	283.74	99.41	104.69	102.05
S. Em±	1.013	1.140	0.953	0.417	0.575	0.379
C.D.(0.05)	2.906	3.269	2.734	1.196	1.648	1.086
Interaction - H X F						
H_1F_1	225.61	231.82	228.72	81.08	84.13	82.60
H_1F_2	228.58	234.66	231.62	82.63	85.30	83.97
H_1F_3	233.75	239.62	236.69	85.37	88.22	86.80
H_2F_1	247.94	253.51	250.72	89.49	91.59	90.54
H_2F_2	256.76	262.46	259.61	93.00	96.00	94.50
H_2F_3	265.41	272.14	268.78	97.08	100.08	98.58
H_3F_1	287.52	293.87	290.69	101.60	107.87	104.74
H_3F_2	293.67	301.19	297.43	103.35	109.85	106.60
H_3F_3	296.33	302.78	299.56	105.21	111.80	108.51
S. Em±	1.013	1.140	0.953	0.417	0.575	0.379
C.D.(0.05)	2.906	3.269	2.734	1.196	1.648	1.086
Interaction - M X H X F						
$M_1H_1F_1$	226.11	227.17	226.64	79.31	82.65	80.98
$M_1H_1F_2$	231.00	230.57	230.78	81.91	83.62	82.76
$M_1H_1F_3$	240.10	239.00	239.55	85.68	86.67	86.17

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$M_1H_2F_1$	250.93	248.97	249.95	88.87	89.03	88.95
$M_1H_2F_2$	260.73	259.13	259.93	93.12	94.37	93.75
$M_1H_2F_3$	273.26	274.73	274.00	99.65	101.75	100.70
$M_1H_3F_1$	283.25	283.60	283.43	101.75	105.12	103.44
$M_1H_3F_2$	289.06	292.93	291.00	103.49	108.49	105.99
$M_1H_3F_3$	291.49	292.15	291.82	104.66	109.65	107.15
$M_2H_1F_1$	219.41	226.63	223.02	78.47	82.65	80.56
$M_2H_1F_2$	221.12	229.45	225.29	78.67	83.94	81.30
$M_2H_1F_3$	215.99	224.32	220.15	79.74	84.98	82.36
$M_2H_2F_1$	231.74	240.07	235.90	83.56	87.41	85.49
$M_2H_2F_2$	237.80	246.13	241.97	88.28	91.16	89.72
$M_2H_2F_3$	241.92	250.25	246.09	91.03	92.69	91.86
$M_2H_3F_1$	280.70	289.03	284.87	99.05	107.05	103.05
$M_2H_3F_2$	285.90	294.23	290.07	100.96	108.98	104.97
$M_2H_3F_3$	288.07	296.40	292.24	104.00	110.48	107.24
$M_3H_1F_1$	231.31	241.67	236.49	85.46	87.07	86.27
$M_3H_1F_2$	233.61	243.97	238.79	87.32	88.36	87.84
$M_3H_1F_3$	245.17	255.53	250.35	90.69	93.01	91.85
$M_3H_2F_1$	261.14	271.50	266.32	96.04	98.31	97.18
$M_3H_2F_2$	271.74	282.10	276.92	97.59	102.48	100.03
$M_3H_2F_3$	281.07	291.43	286.25	100.57	105.79	103.18
$M_3H_3F_1$	298.61	308.97	303.79	104.01	111.43	107.72
$M_3H_3F_2$	306.04	316.40	311.22	105.59	112.10	108.84
$M_3H_3F_3$	309.44	319.80	314.62	106.97	115.28	111.12
S.Em±	1.755	1.974	1.651	0.723	0.995	0.656
C.D.(0.05)	5.033	5.663	4.735	2.072	2.855	1.881

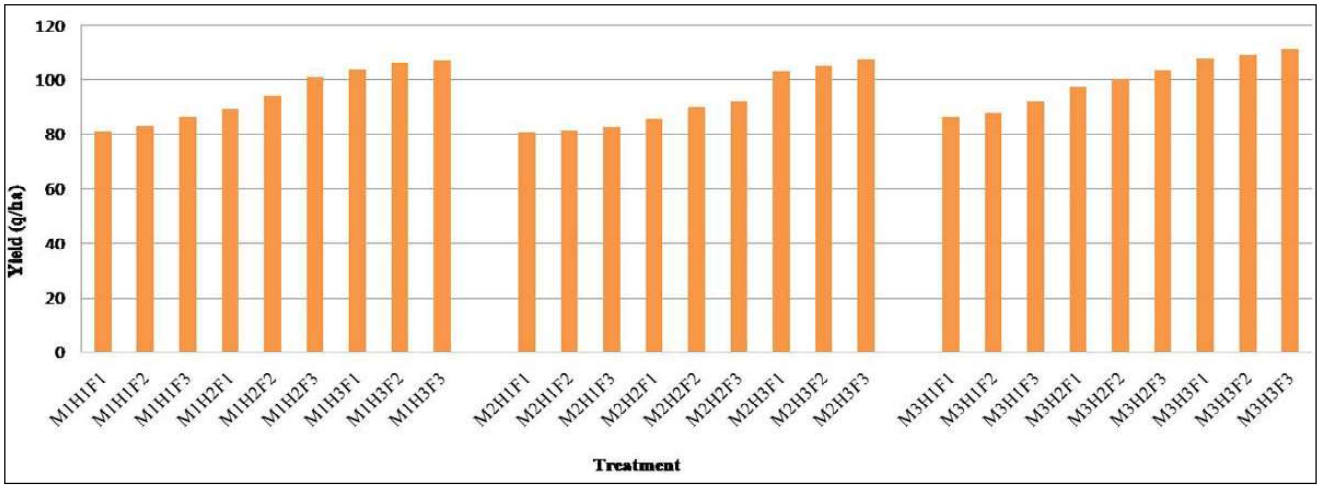

Fig. 2. Effect of nutrient management, humic acid and fulvic acid on yield of Okra

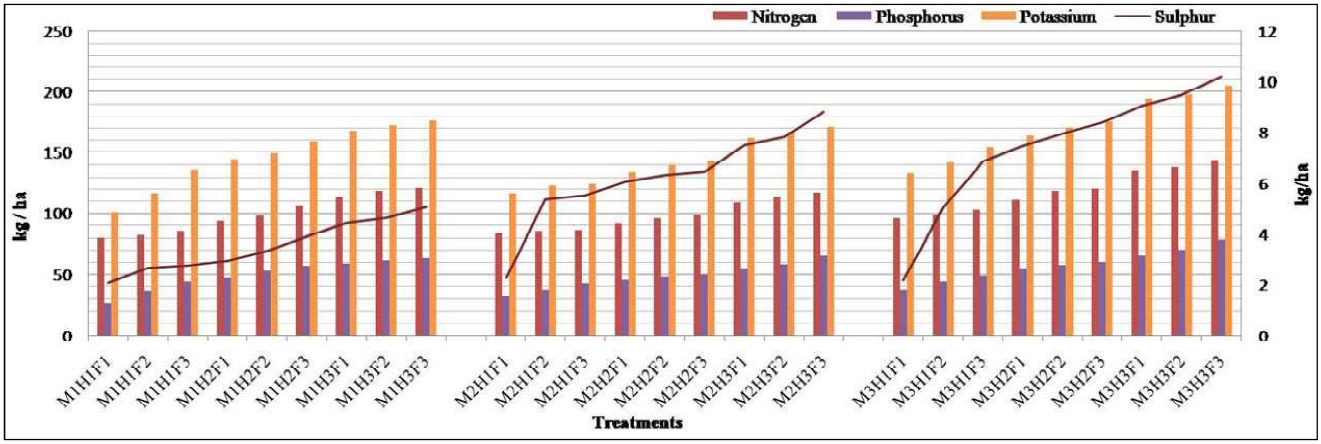

Fig. 3. Effect of nutrient management, humic acid and fulvic acid on uptake of nutrients by Okra

Table 3. Effect of different treatments on uptake nitrogen and phosphorus by Okra during *kharif* and *rabi* seasons of 2023-24.

Treatments	N uptake (kg ha^{-1})			P uptake (kg ha^{-1})		
	kharif	*rabi*	Pooled	*kharif*	*rabi*	Pooled
Nutrient Management Practices (M)						
Inorganic farming (M_1)	102.39	98.30	100.34	50.21	50.37	50.29
Organic Farming (M_2)	91.38	105.42	98.40	47.09	50.32	48.70
Recommended nutrient Practice (M_3)	115.34	122.01	118.68	57.04	58.63	57.83
S.Em±	0.451	0.356	0.130	0.815	0.551	0.678
CD(0.05)	1.769	1.399	0.509	3.200	2.165	2.662
Humic Acid (H)						
Humic acid (0%) H_1	87.24	91.79	89.52	38.58	39.90	39.24
Humic acid (0.25%) H_2	101.85	106.51	104.18	52.10	53.66	52.88
Humic acid (0.50%) H_3	120.01	127.43	123.72	63.66	65.75	64.71
S. Em±	0.674	0.510	0.451	0.433	0.516	0.469
C.D.(0.05)	2.076	1.573	1.391	1.335	1.589	1.445
Fulvic Acid (F)						
Fulvic acid (0%) F_1	99.08	104.84	101.96	46.73	48.36	47.54
Fulvic acid (0.10%) F_2	103.26	108.55	105.90	51.38	53.16	52.27
Fulvic acid (0.25%) F_3	106.78	112.34	109.56	56.23	57.80	57.02
S.Em±	1.167	0.884	0.782	0.750	0.893	0.812
C.D.(0.05)	3.595	2.724	2.409	2.312	2.752	2.502
Interaction - M X H						
M_1H_1	85.15	81.12	83.14	36.19	36.28	36.24
M_1H_2	101.23	98.13	99.68	52.61	53.05	52.83
M_1H_3	120.78	115.65	118.22	61.84	61.79	61.82
M_2H_1	80.16	91.40	85.78	36.57	39.24	37.90
M_2H_2	89.14	102.66	95.90	46.76	49.21	47.98
M_2H_3	104.83	122.21	113.52	57.93	62.51	60.22
M_3H_1	96.41	102.85	99.63	42.97	44.19	43.58
M_3H_2	115.19	118.74	116.96	56.92	58.73	57.83
M_3H_3	134.43	144.44	139.43	71.21	72.96	72.08
S.Em±	0.445	0.373	0.323	0.480	0.456	0.463
C.D.(0.05)	1.277	1.070	0.927	1.376	1.308	1.329
Interaction - M X F						
M_1F_1	98.08	94.59	96.34	45.04	45.03	45.03
M_1F_2	101.45	98.15	99.80	50.57	51.04	50.80
M_1F_3	107.63	102.16	104.89	55.03	55.06	55.04
M_2F_1	88.10	102.11	95.11	42.89	46.58	44.73
M_2F_2	91.89	105.97	98.93	46.64	49.83	48.24
M_2F_3	94.14	108.19	101.16	51.73	54.54	53.13
M_3F_1	111.04	117.81	114.43	52.25	53.46	52.86
M_3F_2	116.42	121.53	118.97	56.92	58.61	57.76
M_3F_3	118.56	126.69	122.62	61.94	63.81	62.87
S. Em±	0.771	0.646	0.560	0.831	0.790	0.803
C.D.(0.05)	2.211	1.854	1.606	2.384	2.266	2.302
Interaction - H X F						
H_1F_1	84.45	89.41	86.93	31.99	33.35	32.67
H_1F_2	87.02	91.76	89.39	38.89	40.26	39.58
H_1F_3	90.26	94.19	92.23	44.85	46.10	45.48
H_2F_1	97.00	101.48	99.24	48.87	50.21	49.54
H_2F_2	102.90	106.01	104.46	52.47	54.05	53.26
H_2F_3	105.65	112.02	108.84	54.95	56.72	55.84
H_3F_1	115.78	123.62	119.70	59.32	61.51	60.42
H_3F_2	119.85	127.87	123.86	62.77	65.17	63.97
H_3F_3	124.42	130.81	127.62	68.90	70.58	69.74
S.E m±	0.771	0.646	0.560	0.831	0.790	0.803
C.D.(0.05)	2.211	1.854	1.606	2.384	2.266	2.302
Interaction - M X H X F						
$M_1H_1F_1$	82.19	78.96	80.58	27.57	27.68	27.63
$M_1H_1F_2$	84.19	80.84	82.51	36.93	37.06	36.99
$M_1H_1F_3$	89.08	83.55	86.32	44.08	44.11	44.10
$M_1H_2F_1$	95.98	92.28	94.13	48.08	47.97	48.03

cont....

$M_1H_2F_2$	99.66	96.78	98.22	53.09	53.73	53.41
$M_1H_2F_3$	108.04	105.32	106.68	56.66	57.44	57.05
$M_1H_3F_1$	116.08	112.52	114.30	59.47	59.43	59.45
$M_1H_3F_2$	120.52	116.82	118.67	61.70	62.33	62.02
$M_1H_3F_3$	125.76	117.60	121.68	64.35	63.62	63.98
$M_2H_1F_1$	78.04	90.18	84.11	31.49	34.46	32.97
$M_2H_1F_2$	80.28	92.36	86.32	35.83	38.93	37.38
$M_2H_1F_3$	82.17	91.67	86.92	42.40	44.32	43.36
$M_2H_2F_1$	85.72	98.49	92.11	44.19	47.01	45.60
$M_2H_2F_2$	89.79	102.85	96.32	47.42	49.56	48.49
$M_2H_2F_3$	91.90	106.63	99.26	48.68	51.04	49.86
$M_2H_3F_1$	100.53	117.67	109.10	53.00	58.27	55.63
$M_2H_3F_2$	105.61	122.70	114.15	56.68	61.01	58.85
$M_2H_3F_3$	108.36	126.26	117.31	64.10	68.24	66.17
$M_3H_1F_1$	93.11	99.09	96.10	36.92	37.91	37.41
$M_3H_1F_2$	96.59	102.08	99.34	43.91	44.80	44.36
$M_3H_1F_3$	99.53	107.37	103.45	48.07	49.87	48.97
$M_3H_2F_1$	109.30	113.68	111.49	54.33	55.65	54.99
$M_3H_2F_2$	119.25	118.41	118.83	56.92	58.87	57.89
$M_3H_2F_3$	117.02	124.13	120.57	59.51	61.68	60.60
$M_3H_3F_1$	130.73	140.66	135.70	65.49	66.84	66.16
$M_3H_3F_2$	133.41	144.09	138.75	69.92	72.16	71.04
$M_3H_3F_3$	139.14	148.57	143.85	78.24	79.87	79.05
S.Em±	1.335	1.119	0.970	1.439	1.368	1.390
C.D.(0.05)	3.830	3.211	2.782	4.128	3.925	3.987

Table 4. Effect of different treatments on uptake potassium and sulphur by Okra during *kharif* and *rabi* seasons of 2023-24

Treatments	K uptake (kg ha^{-1})			S uptake (kg ha^{-1})		
	kharif	*Rabi*	Pooled	*kharif*	*Rabi*	Pooled
Nutrient Management Practices (M)						
Inorganic farming (M_1)	147.11	147.58	147.34	3.78	3.29	3.54
Organic Farming (M_2)	137.83	147.37	142.60	5.82	6.65	6.24
Recommended nutrient Practice (M_3)	168.59	173.32	170.96	7.18	7.62	7.40
S.Em±	1.495	0.720	1.077	0.166	0.118	0.103
C.D.(0.05)	5.868	2.827	4.228	0.653	0.462	0.404
Humic Acid (H)						
Humic acid (0%) H_1	125.49	129.84	127.66	3.69	4.01	3.85
Humic acid (0.25%) H_2	151.30	155.87	153.58	5.80	5.96	5.88
Humic acid (0.50%) H_3	176.75	182.56	179.66	7.29	7.59	7.44
S.Em±	1.006	1.181	1.071	0.117	0.079	0.079
C.D.(0.05)	3.101	3.640	3.301	0.360	0.245	0.242
Fulvic Acid (F)						
Fulvic acid (0%) F_1	143.97	149.05	146.51	4.77	5.00	4.88
Fulvic acid (0.10%) F_2	150.87	156.14	153.50	5.66	6.02	5.84
Fulvic acid (0.25%) F_3	158.70	163.08	160.89	6.35	6.55	6.45
S.Em±	1.743	2.046	1.856	0.203	0.138	0.136
C.D.(0.05)	5.371	6.305	5.718	0.624	0.424	0.419
Interaction - M X H						
M_1H_1	117.83	118.15	117.99	2.65	2.35	2.50
M_1H_2	150.61	151.81	151.21	3.72	3.08	3.40
M_1H_3	172.89	172.78	172.83	4.97	4.45	4.71
M_2H_1	117.34	126.11	121.72	3.96	4.78	4.37
M_2H_2	135.59	142.69	139.14	5.92	6.68	6.30
M_2H_3	160.57	173.32	166.94	7.59	8.49	8.04
M_3H_1	141.30	145.27	143.28	4.47	4.90	4.69
M_3H_2	167.70	173.09	170.40	7.76	8.12	7.94
M_3H_3	196.78	201.60	199.19	9.31	9.83	9.57
S.Em±	0.975	0.912	0.926	0.088	0.085	0.063
C.D.(0.05)	2.797	2.617	2.656	0.252	0.244	0.182

cont....

Interaction - M X F						
M_1F_1	137.86	137.88	137.87	3.41	2.89	3.15
M_1F_2	145.92	147.20	146.56	3.76	3.34	3.55
M_1F_3	157.55	157.66	157.60	4.17	3.65	3.91
M_2F_1	131.86	143.29	137.58	4.88	5.68	5.28
M_2F_2	138.85	148.43	143.64	6.04	6.96	6.50
M_2F_3	142.79	150.40	146.60	6.55	7.32	6.94
M_3F_1	162.19	165.99	164.09	6.03	6.42	6.23
M_3F_2	167.85	172.78	170.31	7.19	7.77	7.48
M_3F_3	175.74	181.19	178.47	8.32	8.67	8.49
S.Em±	1.689	1.580	1.604	0.152	0.147	0.110
C.D.(0.05)	4.845	4.532	4.601	0.436	0.422	0.314
Interaction - H X F						
H_1F_1	114.70	119.55	117.13	2.08	2.26	2.17
H_1F_2	125.19	129.65	127.42	4.09	4.59	4.34
H_1F_3	136.57	140.33	138.45	4.91	5.19	5.05
H_2F_1	145.49	149.48	147.49	5.41	5.59	5.50
H_2F_2	151.27	155.82	153.55	5.80	5.96	5.88
H_2F_3	157.14	162.29	159.72	6.19	6.34	6.27
H_3F_1	171.72	178.13	174.93	6.84	7.14	6.99
H_3F_2	176.16	182.93	179.54	7.09	7.52	7.31
H_3F_3	182.37	186.63	184.50	7.94	8.11	8.03
S.Em±	1.689	1.580	1.604	0.152	0.147	0.110
C.D.(0.05)	4.845	4.532	4.601	0.436	0.422	0.314
Interaction - M X H X F						
$M_1H_1F_1$	100.59	101.07	100.83	2.24	1.89	2.07
$M_1H_1F_2$	116.54	116.93	116.73	2.72	2.63	2.67
$M_1H_1F_3$	136.35	136.45	136.40	2.99	2.52	2.76
$M_1H_2F_1$	144.66	144.33	144.50	3.39	2.51	2.95
$M_1H_2F_2$	148.99	150.68	149.83	3.67	3.01	3.34
$M_1H_2F_3$	158.19	160.43	159.31	4.09	3.73	3.91
$M_1H_3F_1$	168.34	168.23	168.28	4.59	4.26	4.43
$M_1H_3F_2$	172.23	174.00	173.11	4.88	4.37	4.63
$M_1H_3F_3$	178.11	176.10	177.11	5.44	4.71	5.07
$M_2H_1F_1$	111.36	121.94	116.65	1.99	2.54	2.26
$M_2H_1F_2$	118.66	128.89	123.78	4.90	5.78	5.34
$M_2H_1F_3$	121.99	127.50	124.74	4.99	6.03	5.51
$M_2H_2F_1$	130.09	138.46	134.27	5.57	6.60	6.08
$M_2H_2F_2$	136.65	142.84	139.75	5.97	6.73	6.35
$M_2H_2F_3$	140.04	146.77	143.40	6.23	6.73	6.48
$M_2H_3F_1$	154.13	169.48	161.81	7.08	7.90	7.49
$M_2H_3F_2$	161.23	173.54	167.39	7.25	8.36	7.80
$M_2H_3F_3$	166.36	176.92	171.64	8.43	9.21	8.82
$M_3H_1F_1$	132.14	135.65	133.89	2.00	2.34	2.17
$M_3H_1F_2$	140.36	143.13	141.75	4.66	5.35	5.01
$M_3H_1F_3$	151.38	157.04	154.21	6.75	7.01	6.88
$M_3H_2F_1$	161.73	165.65	163.69	7.27	7.66	7.46
$M_3H_2F_2$	168.17	173.94	171.06	7.76	8.14	7.95
$M_3H_2F_3$	173.20	179.68	176.44	8.26	8.57	8.42
$M_3H_3F_1$	192.70	196.68	194.69	8.83	9.26	9.05
$M_3H_3F_2$	195.00	201.26	198.13	9.16	9.82	9.49
$M_3H_3F_3$	202.64	206.85	204.75	9.95	10.42	10.18
S.Em±	2.926	2.737	2.778	0.263	0.255	0.190
C.D.(0.05)	8.392	7.850	7.968	0.756	0.732	0.545

cent and fulvic acid @ 0.25 per cent. Similar trends were noticed in both the seasons.This might be due to the solubilization of organic acids produced during decomposition of organic manures, improved aeration and root proliferation which helped in increased uptake of nutrients (Mishra *et al*., 2109). The results are in line with the findings of Taha *et al.* (2016)

Conclusion. From the experiment it can be inferred that, the integrated approach of nutrient management with foliar application of humic acid and fulvic acid appears to be a promising strategy for improving okra productivity. The results

of this study suggest that the recommended nutrient practice with 0.50 per cent humic acid and 0.25 per cent fulvic acid can be recommended for okra cultivation to achieve higher yields and nutrient uptake.

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