

Original Research Article

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Effect of Organic Nutrients and Bio-mulches on Growth, Physiology and Yield of Okra (*Abelmoschus esculentus* L. Moench)

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ABSTRACT

Field experiments were conducted at Instructional farm of Department of Vegetable Science, UBK, West Bengal. The study was aimed to evaluate about the effect of different combinations of organic nutrient sources and bio mulches on growth, physiology and yield of okra (cv. Arka Anamika) in the year 2017 and 2018. The experiment was carried out in Randomized Block Design (RBD) with three replications. There were two factors of the experiment such as factor N- Organic nutrient sources and factor M – Bio-mulches, each having four levels. The different levels were under factor N were (N₁ –Farmyard manure (25 t/ha) + *Azophos* biofertiliser +Humic Acid; N₂ –Farmyard manure (25 t/ha) + *Azophos* biofertiliser + Seaweed extract; N₃–Vermicompost (5 t/ha) + *Azophos* biofertiliser + Humic acid; N₄ - Vermicompost (5 t/ha) + *Azophos* biofertiliser +Seaweed extract) and under factor M (M₁ - Rice Straw; M₂- Dry water hyacinth (*Eichhornia crassipes*); M₃- Dry local weed (*Polygonum persicaria*); M₄- Dry vegetable legume plant residues) which in total comprises of 16 treatment and combinations. Random samples were collected and analysed at various growth phases. The results of the experiment revealed that application of biofertiliser enriched vermicompost with three time foliar spray of seaweed extract @ 2ml/lit at 30, 40 and 50 days after sowing along with dry vegetable legume plant residue (N₄M₄) exhibited maximum height (65.85 cm at 60 DAS), leaf chlorophyll content (41.91 SPAD value), total yield per hectare (16.65 t/ hectare) in pooled. However there was significant effect of different treatment combinations in growth, yield and physiological attributes of okra.

Keywords

Organic nutrients, Bio-mulch, Bio-fertilizers, Bio-stimulants

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Introduction

Okra, popularly known as Bhindi is one of the leading vegetable in the country. India is the leading producer of okra. It is rich source of protein vitamins and minerals. Medicinal properties of okra include control of goitre

(Yawalkar, 1965), useful against genitor-urinary disorders, spermatorrhoea and chronic dysentery (Nandakarni, 1927) and relief from haemorrhoids (Adams, 1975) etc. Okra mucilage has potential for use as food, non-food products, and medicine. Dried stems and roots of okra are used for cleaning sugarcane

juice from which molasses is prepared. The dry seeds are rich source of oil (18-20%) and crude protein (20-23%). It has occupied a prominent position among the export oriented vegetables in India because of high nutritive value, palatability and good post-harvest life. It has an enormous potential as one of the foreign exchange earner crops and accounts for 70% of the export of fresh vegetables (Dhankhar and Mishra, 2005). At present, it is being exported to the neighboring countries in the Gulf and South-East Asia, particularly Singapore, Mauritius, Malaysia, Sri Lanka and Bangladesh.

Being a heavy manuring crop it requires optimum nutrient for its growth and development. But indiscriminate uses of chemical fertilizers adversely affect the plant growth, disease pest infestation and residual toxicity of fruit and in long run decreases the soil fertility. Application of nutrient through the organic source is the only way to overcome all these obstacles. Another barrier in the conventional crop production is the growing public concern about the ill effect of chemical fertilizers.

The new emerging organic supplements like seaweed extract and humic acid along with farm yard manure and vermi compost modify the soil physical, chemical and biological properties and facilitate a sustainable crop growth. These nutrient source promote plant physiology and mechanism (Aydin *et al.*, 2012), disease resistance and plant hormone activities (Zodape *et al.*, 2011).

Maintenance of root micro-climate during the plant growth is very essential. Covering of the soil surface is known as mulching. This practice maintains soil temperature, inhibits weed growth, retains optimum moisture in soil and favors quality and early harvest. In general polythene sheets of various micron sizes are used as mulch material. But it has several disadvantages like difficulty of

removal, cost of disposal, increased soil erosion and increased agricultural chemical runoff (Lamont, 1993; Hochmuth, 1998; Brown and Channell-Butcher, 2001; Rice *et al.*, 2001). In a fully organic crop production system this can be replaced by organic mulches such as straw, dry leaves etc. which are easily available and degradable. However there is lack of application of locally available mulch materials like dry water hyacinth, dry weeds and legume plant residue which can be fully exploited.

Keeping all these aspects on view a research work was framed to study the combined effect of organic nutrient and organic mulch on okra growth, yield and physiology.

Materials and Methods

The field experiments were conducted at Instructional farm of Department of Vegetable Science, UBKV, Pundibari, Coochbehar, West Bengal, India. The place is situated at Terai Zone of West Bengal. Experiment was laid out in Randomized block Design with three replications. There were two factors of the experiment. Factor 'N' Organic Nutrient Sources and Factor M – Bio mulches, each factor having four levels each. The levels under organic nutrient sources N were N₁ – Farmyard manure (25 t/ha) + *Azophos* biofertiliser + Humic Acid; N₂ – Farmyard manure (25 t/ha) + *Azophos* biofertiliser + Seaweed extract; N₃ – Vermicompost (5 t/ha) + *Azophos* biofertiliser + Humic acid; N₄ – Vermicompost (5 t/ha) + *Azophos* biofertiliser + Seaweed extract and levels of bio-mulches namely M₁ - Rice Straw; M₂ - Dry water hyacinth (*Eichhornia crassipes*); M₃ - Dry local weed (*Polygonum persicaria*); M₄ - Dry vegetable legume plant residues which comprises of 16 treatment and combination in total. Okra (cv. Arka Anamika) seeds (@20 Kg/ha) were sown for both the year with spacing of 45cmX45cm. To prepare enriched organic manure, the *Azophos* biofertiliser

(*Azotobacter* + Phosphate Solubilizing Bacteria) was mixed with vermicompost and farmyard manure and kept in moist and dark condition for 15 days before field application. Humic acid and seaweed extract (*Ascophyllum nodosum*) were sprayed on standing crop at 30, 40 and 50 days after sowing (DAS) at the rate of 2 ml/l (Kumari *et al.*, 2011). Mulching (10 t/ha) was done just after thinning of seedlings. All the standard cultural practices were adopted during the crop growth period. Harvesting of the pods was done after 6 days of anthesis and was continued up to 7th picking depending upon marketable stage. Random samples were collected from each treatment for the assessment of several parameters like growth, physiology and yield. Two years data collected were pooled and statistically analyzed by using INDOSTAT statistical package (version 7.00, Hyderabad, India).

Results and Discussion

Effect of organic nutrient sources

The data relating to growth parameter of okra has been presented in the table 1 and 2. The data depicted that among all the nutrient sources, biofertiliser enriched vermicompost with foliar application of seaweed extract showed highest plant height at 60 days after sowing in both the year with pooled value 65.85 cm.

Similarly for the same treatment N₄ maximum stem girth at the time of last harvest was observed in both years with pooled value 20.05 mm. There was no significance of nutrient sources on node no. to first flowering and number of branches per plant.

However the same treatment N₄ exhibited minimum days to 50% flowering (48.18 days in pooled analysis) and days to first harvest, that is 54.19 days. In case of days to last

harvest N₄ showed maximum days 86.24 in pooled followed by N₂ (bio fertiliser enriched farm yard manure with foliar spray of seaweed extract).

The nutrient source biofertiliser enriched vermi compost with 3 time foliar spray of seaweed extract emerged better in relation to the physiological attributes of the okra plant. Leaf chlorophyll content was more at 60 DAS for the treatment N₄ 39.88 SPAD value in pooled. Highest crop growth rate at 45-60 DAS (4.59 gram/m²/day in pooled) was recorded by the same treatment followed by N₂ (4.26 gram/m²/day in pooled). Subsequently greater accumulation of dry matter (23.85%) was observed at 60 DAS for the same treatment.

The pooled data revealed that the yield attributing character varied significantly with the different organic nutrient sources. The okra plant, where biofertiliser enriched vermicompost with three time foliar spray of seaweed extract was applied resulted maximum no. of fruit per plant (19.94) , yield per plant (322.15 g) and highest total yield per hectare (14.39 t/ha).

Vermicompost has high mineralization rate than farmyard manure and assured slow releases of major plant nutrients like N, P and K and when combined with bio-stimulant like seaweed extract promoted the high plant growth due to certain hormonal content like auxin, gibberellic acid and cytokinin. All these might have induced the plant metabolism and exhibited better plant vigor and subsequently resulted increase yield in okra.

Zodape *et al.*, (2011) pointed that application of 5% seaweed extract as foliar spray and *Azotobacter* biofertiliser enriched vermicompost (Gopinathan and Prakash, 2004) indicated greater plant height as well as yield in tomato.

Table.1 Effect of organic nutrients and bio-mulches on growth parameters of okra

Treatment*	Plant height at 60 Days after sowing (cm)			Stem girth at the time of last harvest (mm)			No. of branches per plant			Node number to first flowering		
	2017	2018	pooled	2017	2018	pooled	2017	2018	pooled	2017	2018	Pooled
Nutrient sources												
N ₁	63.23	64.37	63.80	18.57	18.63	18.60	2.75	2.50	2.63	4.00	3.99	4.00
N ₂	64.43	64.25	64.34	17.95	18.92	18.44	2.97	2.81	2.89	3.65	3.92	3.79
N ₃	65.27	65.17	65.22	17.98	17.70	17.84	2.69	2.70	2.70	4.21	3.91	4.06
N ₄	65.58	66.12	65.85	19.73	20.37	20.05	2.86	2.84	2.85	3.56	3.53	3.54
CD at 5 %	2.208	2.111	2.034	N.S	0.782	0.631	N.S	N.S	N.S	N.S	N.S	N.S
Bio-mulches												
M ₁	63.92	64.46	64.19	17.50	18.23	17.86	2.82	2.73	2.77	3.82	3.73	3.78
M ₂	64.54	64.46	64.50	19.63	19.97	19.80	2.92	2.69	2.81	3.73	3.80	3.77
M ₃	62.71	63.21	62.96	17.39	17.91	17.65	2.57	2.51	2.54	4.04	4.00	4.02
M ₄	67.34	67.78	67.56	19.72	19.51	19.61	2.97	2.91	2.94	3.82	3.81	3.82
CD at 5 %	2.208	2.11	4.064	N.S	0.782	0.631	N.S	N.S	N.S	N.S	N.S	N.S
Interactions												
N ₁ M ₁	61.81	63.72	62.77	18.20	17.21	17.71	2.78	2.56	2.67	4.00	3.89	3.95
N ₁ M ₂	62.49	63.81	63.15	21.94	19.99	20.97	2.89	2.44	2.66	3.78	4.00	3.89
N ₁ M ₃	60.01	61.96	60.99	16.28	18.78	17.53	2.56	2.22	2.39	4.40	4.13	4.27
N ₁ M ₄	68.60	67.98	68.29	17.84	18.54	18.19	2.78	2.78	2.78	3.84	3.94	3.89
N ₂ M ₁	62.03	61.97	62.00	15.79	18.68	17.24	2.94	2.67	2.80	3.56	3.73	3.65
N ₂ M ₂	68.61	65.29	66.95	17.82	20.50	19.16	2.94	2.78	2.86	3.78	3.96	3.87
N ₂ M ₃	61.98	62.98	62.48	17.66	17.03	17.35	2.67	2.56	2.61	3.67	4.02	3.85
N ₂ M ₄	65.10	66.77	65.94	20.53	19.48	20.01	3.33	3.22	3.27	3.59	3.98	3.79
N ₃ M ₁	66.88	67.52	67.20	16.68	17.20	16.94	2.66	2.81	2.73	4.11	3.86	3.99
N ₃ M ₂	62.04	61.68	61.86	18.72	17.95	18.34	3.00	2.78	2.89	3.96	3.67	3.82
N ₃ M ₃	65.91	65.57	65.74	17.10	17.51	17.31	2.44	2.67	2.55	4.22	4.00	4.11
N ₃ M ₄	66.24	65.90	66.07	19.43	18.14	18.79	2.67	2.56	2.61	4.56	4.11	4.34
N ₄ M ₁	64.97	64.63	64.80	19.31	19.84	19.57	2.89	2.89	2.89	3.62	3.44	3.53
N ₄ M ₂	65.00	67.06	66.03	20.03	21.44	20.74	2.86	2.78	2.82	3.42	3.59	3.51
N ₄ M ₃	62.93	62.32	62.63	18.51	18.32	18.42	2.60	2.60	2.60	3.89	3.86	3.88
N ₄ M ₄	69.40	70.45	69.93	21.07	21.87	21.47	3.11	3.10	3.10	3.31	3.22	3.27
CD at 5 %	4.416	4.22	4.064	2.102	1.565	1.785	N.S	N.S	N.S	N.S	N.S	N.S

*Treatment details are in materials and methods

Table.2 Effect of organic nutrients and bio-mulches on growth parameters of okra

Treatment*	Days to 50% flowering			Days to first harvest			Days to last harvest		
	2017	2018	pooled	2017	2018	pooled	2017	2018	pooled
Nutrient sources									
N ₁	49.31	49.87	49.59	56.50	56.43	56.47	82.66	80.66	81.66
N ₂	49.57	50.37	49.97	56.49	56.96	56.73	85.73	84.18	84.95
N ₃	50.15	49.64	49.89	57.84	57.68	57.76	83.73	80.70	82.21
N ₄	48.19	48.18	48.18	54.19	56.20	55.19	86.20	86.28	86.24
CD at 5 %	1.232	0.793	0.713	1.039	1.078	0.717	0.686	0.663	0.462
Bio-mulches									
M ₁	48.69	49.42	49.05	56.38	56.16	56.27	84.34	84.32	84.33
M ₂	48.69	48.88	48.79	55.10	56.55	.82	84.81	84.24	84.52
M ₃	51.05	50.14	50.60	58.01	58.10	58.06	81.96	79.01	80.49
M ₄	48.78	49.61	49.19	55.54	56.46	56.00	87.21	84.26	85.73
CD at 5 %	N.S	N.S	N.S	1.039	1.078	0.717	0.686	0.663	0.462
Interactions									
N ₁ M ₁	48.50	48.30	48.40	55.93	54.23	55.08	81.87	82.60	82.23
N ₁ M ₂	49.50	49.53	49.52	56.83	56.20	56.52	84.03	83.10	83.56
N ₁ M ₃	50.00	51.53	50.77	58.67	58.87	58.77	80.43	76.43	78.43
N ₁ M ₄	49.23	50.10	49.67	54.57	56.43	55.50	84.30	80.53	82.41
N ₂ M ₁	48.43	49.37	48.90	56.80	56.42	56.61	86.43	85.80	86.11
N ₂ M ₂	48.80	49.30	49.05	53.80	56.30	55.05	86.17	84.77	85.47
N ₂ M ₃	51.90	52.40	52.15	58.90	58.40	58.65	81.20	80.37	80.78
N ₂ M ₄	49.13	50.40	49.77	56.47	56.73	56.60	89.13	85.80	87.46
N ₃ M ₁	49.17	50.46	49.82	57.10	57.47	57.29	85.40	84.40	84.90
N ₃ M ₂	49.38	49.27	49.33	56.33	56.30	56.32	84.70	80.53	82.61
N ₃ M ₃	51.67	48.48	50.08	59.60	59.53	59.57	80.20	76.70	78.45
N ₃ M ₄	50.38	50.33	50.36	58.33	57.40	57.87	84.63	81.17	82.90
N ₄ M ₁	48.67	49.53	49.10	55.70	56.50	56.10	83.67	84.47	84.07
N ₄ M ₂	47.08	47.43	47.26	53.43	57.40	55.42	84.33	88.57	86.45
N ₄ M ₃	50.62	48.16	49.39	54.87	55.62	55.24	86.03	82.57	84.30
N ₄ M ₄	46.39	47.59	46.99	52.77	55.27	54.02	90.77	89.53	90.15
CD at 5 %	2.463	1.585	N.S	2.077	2.155	2.028	1.371	1.326	1.307

*Treatment details are in materials and methods

Table.3 Effect of organic nutrients and bio-mulches physiological parameters of okra

Treatment*	Leaf chlorophyll content at 60 DAS (SPAD valuer)			Crop growth rate at 45-60 DAS (gram/m ² /day)			Dry matter accumulation at 60 DAS (%)		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	pooled
Nutrient sources									
N ₁	32.30	33.90	33.10	3.84	3.84	3.84	18.41	19.03	18.72
N ₂	37.81	38.83	38.32	4.25	4.27	4.26	18.69	18.95	18.82
N ₃	30.58	31.48	31.03	3.66	3.84	3.75	16.99	17.61	17.30
N ₄	39.02	40.75	39.88	4.61	4.58	4.59	24.07	23.64	23.85
CD at 5 %	2.392	1.176	1.318	0.371	0.264	0.221	2.044	2.094	1.458
Bio-mulches									
M ₁	34.90	37.14	36.02	4.30	4.29	4.29	19.39	19.51	19.45
M ₂	36.10	36.16	36.13	4.09	4.13	4.11	19.99	19.81	19.90
M ₃	32.17	33.68	32.93	3.32	3.49	3.41	17.06	18.14	17.60
M ₄	36.54	37.97	37.25	4.65	4.63	4.64	21.70	21.78	21.74
CD at 5 %	2.392	1.176	1.318	0.371	0.264	0.221	2.044	2.094	1.458
Interactions									
N ₁ M ₁	32.82	34.14	33.48	3.96	3.89	3.93	16.23	16.89	16.56
N ₁ M ₂	32.13	33.81	32.97	4.12	4.09	4.11	18.60	19.13	18.87
N ₁ M ₃	30.03	31.84	30.94	3.12	3.21	3.17	19.20	19.78	19.49
N ₁ M ₄	34.20	35.81	35.01	4.16	4.18	4.17	19.59	20.32	19.96
N ₂ M ₁	37.78	40.91	39.35	4.31	4.34	4.33	18.01	18.23	18.12
N ₂ M ₂	40.97	39.13	40.05	4.27	4.29	4.28	20.51	20.21	20.36
N ₂ M ₃	34.17	35.10	34.64	3.53	3.66	3.60	17.19	18.01	17.60
N ₂ M ₄	38.33	40.16	39.25	4.87	4.78	4.83	19.03	19.34	19.19
N ₃ M ₁	30.33	32.13	31.23	4.12	4.14	4.13	17.23	17.14	17.19
N ₃ M ₂	31.51	31.38	31.45	3.40	3.69	3.55	17.85	18.13	17.99
N ₃ M ₃	28.21	28.94	28.58	2.79	3.12	2.96	14.33	16.73	15.53
N ₃ M ₄	32.26	33.45	32.86	4.34	4.41	4.38	18.55	18.43	18.49
N ₄ M ₁	38.67	41.39	40.03	4.81	4.78	4.80	26.10	25.76	25.93
N ₄ M ₂	39.77	40.31	40.04	4.57	4.43	4.50	22.99	21.78	22.39
N ₄ M ₃	36.26	38.85	37.56	3.85	3.96	3.91	17.53	18.02	17.78
N ₄ M ₄	41.36	42.46	41.91	5.21	5.13	5.17	29.64	29.01	29.33
CD at 5 %	4.784	2.353	3.728	0.742	0.528	0.442	4.088	4.189	2.916

*Treatment details are in materials and methods

Table.4 Effect of organic nutrients and bio-mulches on yield parameters of okra

Treatment*	No. of fruit per plant			Yield per plant (gram)			Total yield per ha (ton)		
	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
Nutrient sources									
N ₁	17.86	18.13	17.99	305.03	300.37	302.70	12.97	13.62	13.30
N ₂	18.99	19.21	19.10	315.92	320.50	318.21	13.74	14.04	13.90
N ₃	16.79	18.28	17.53	288.92	280.32	284.62	12.87	12.96	12.92
N ₄	19.40	20.49	19.94	319.41	324.90	322.15	13.99	14.80	14.39
CD at 5 %	0.719	0.741	0.498	5.206	5.532	3.826	2.447	2.308	1.644
Bio-mulches									
M ₁	18.25	17.99	18.12	308.27	305.66	306.96	13.61	13.56	13.59
M ₂	18.65	19.32	18.99	310.06	298.36	304.21	13.89	13.75	13.82
M ₃	15.87	17.49	16.68	281.95	301.37	291.66	11.95	12.64	12.30
M ₄	20.27	21.30	20.79	329.01	320.70	324.86	14.12	15.46	14.79
CD at 5 %	0.719	0.741	0.498	5.206	5.532	3.826	2.447	2.308	1.644
Interactions									
N ₁ M ₁	16.78	16.67	16.73	304.05	301.47	302.76	13.30	13.41	13.35
N ₁ M ₂	18.22	18.17	18.20	310.41	277.47	293.94	13.80	13.89	13.84
N ₁ M ₃	16.87	17.56	17.22	281.27	309.14	295.20	11.61	12.73	12.17
N ₁ M ₄	19.56	20.11	19.84	324.40	313.40	318.90	13.18	14.46	13.82
N ₂ M ₁	19.82	18.00	18.91	318.78	312.10	315.44	13.79	13.74	13.76
N ₂ M ₂	20.39	20.15	20.27	321.85	316.29	319.07	14.23	13.38	13.80
N ₂ M ₃	15.61	17.48	16.55	289.18	322.43	305.80	12.31	12.05	12.18
N ₂ M ₄	20.15	21.20	20.68	333.86	331.19	332.52	14.66	17.01	15.83
N ₃ M ₁	17.78	17.82	17.80	290.93	281.27	286.10	13.53	13.01	13.27
N ₃ M ₂	15.78	18.41	17.10	292.41	277.93	286.07	13.41	13.43	13.42
N ₃ M ₃	14.48	16.48	15.48	264.10	268.68	266.39	11.77	12.46	12.11
N ₃ M ₄	19.11	20.39	19.75	306.45	293.40	299.92	12.78	12.95	12.86
N ₄ M ₁	18.60	19.47	19.04	319.32	327.79	323.55	13.81	14.10	13.95
N ₄ M ₂	20.22	20.55	20.39	313.76	321.74	317.75	14.13	14.32	14.22
N ₄ M ₃	16.50	18.45	17.48	293.24	305.23	299.23	12.13	13.34	12.73
N ₄ M ₄	22.26	23.50	22.88	351.34	344.83	348.08	15.88	17.43	16.65
CD at 5 %	1.437	1.483	0.996	10.411	11.064	7.652	4.894	4.615	3.288

*Treatment details are in materials and methods

Effect of bio mulches

The pooled data presented in tables 1–4 revealed that the vegetable legume plant residue mulch (M₄) emerged as superior among other types of bio mulches in regarding to growth, physiology and yield of okra plant. The bio mulch M₄ resulted highest plant height at 60 DAS (67.56 cm), stem girth at the time of last harvesting (19.61 mm), days to last harvest (85.73 days). The dry water hyacinth mulch (M₂) took minimum days to 50% flowering (48.79 days) and days to first harvest (55.82 days) in pooled but M₄ resulted maximum days to last harvest (85.73 days). In relation to physiological parameter M₄ exhibited highest chlorophyll content (37.25), crop growth rate at 45-60 DAS (4.64 gram/m²/day) and maximum dry matter at 60 DAS (21.74 %). The maximum no. of fruit per plant (20.79), yield per plant (324.86 gram/ plant) and total yield (14.79 t/ha) were also observed by M₄.

The application of vegetable legume plant residue mulch having low C:N ratio than other bio mulches may be increased soil micro flora and provide major plant nutrient like nitrogen for better crop growth which subsequently triggered crop growth , metabolism and yield.

Effect of interaction of organic nutrient and bio mulches

The interaction effect of organic nutrient sources and bio mulches showed marked influence on different growth, physiology and yield attributes of okra plant. The pooled results revealed that maximum plant height at 60 DAS (69.93 cm), lower days to 50% flowering (46.99 days), earlier harvesting (54.02 days) were obtained when okra was grown under the treatment combination comprising of *Azophos* biofertiliser enriched vermicompost (5t/ha) with three times foliar

application of seaweed extract (at 30 DAS, 40 DAS, 50 DAS) along with vegetable legume plant residue as mulch material (N₄M₄). The treatment combination N₄M₄ resulted maximum leaf chlorophyll content (41.91 SPAD value) and crop growth rate (5.17 gram/m²/day). The same treatment combination also recorded maximum number of fruits per plant (22.88), highest total yield per plant (348.08 gram), total yield per hectare (16.65 t/ hectare).

The findings indicated that combined application of vermi compost with biofertiliser along with foliar application of sea weed extract have pronounced effect on yield attributes. This might be properties of vermin compost and bio fertilizer that enhanced soil physicochemical properties by solubilizing and mineralizing the reserve nutrient content of soil. Further the foliar application of seaweed extract act as a plant soil conditioner by increasing the plant metabolism and plant physiology (Fan *et al.*, 2013).

The experiment concluded that *Azophos* biofertiliser enriched vermicompost with three time foliar spray of sea weed extract (at 30 DAS, 40 DAS and 50 DAS) along with dry vegetable legume plant residue as mulch material emerged as best treatment combination with respect to every attribute for organic okra cultivation under Terai Zone Of west Bengal.

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