



## Influence of Integrated Nutrient Management on Growth, Yield and Quality of Okra [*Abelmoschus esculentus* (L.) Moench] cv. Arka Anamika

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An investigation using farm yard manure (FYM) and graded doses of N,P,K along with different biofertilizers viz., Azophos, Methylobacterium and Azophosmet on growth, yield and quality of okra [*Abelmoschus esculentus* (L.) Moench] was conducted at Department of Horticulture, Agricultural College and Research Institute, Madurai. The experiment revealed that the growth attributes viz., plant height and number of leaves and the yield parameters such as number of fruits per plant, fresh weight of fruit, fruit length, fruit girth, and yield per hectare registered the highest values by the application of 50 per cent recommended dose of N, P and 100 per cent recommended dose of K + 2 kg Azophosmet per ha. Low crude fibre content was exhibited in the plants applied with 50 per cent recommended dose of N, P and 100 per cent recommended dose of K +2 kg Azophosmet per ha.

**Key words:** Okra, INM, *Arka Anamika*, Azophos, Methylobacterium and Azophosmet.

Okra [*Abelmoschus esculentus* (L.) Moench] native to tropical Africa grown for its immature fruits, whose demand remains throughout the year. In India, it is cultivated in an area of 452.5 hectares with an annual production of 4803.3 million tonnes and productivity is 10.6 million tonnes per hectares. To ensure high yield and quality, adequate application of nutrients are of paramount importance than any other improved cultural practices. Use of organic manure along with chemical fertilizers maintain the soil health (Sarkar, 1995). This Integrated Nutrient Management (INM) for sustainable and quality production with minimum adverse effect on soil health and environment. The present study on Integrated Nutrient Management in Okra [*Abelmoschus esculentus* (L.) Moench] was undertaken at Department of Horticulture, Agricultural College and Research Institute, Madurai to study the influence of INM on growth, yield and quality of okra.

### Materials and Methods

An investigation was conducted to study the effect of organic manures like Farm yard manure (FYM – 25t/ha) and graded doses of N,P,K along with different biofertilizers viz., Azophos, Methylobacterium and Azophosmet on growth, yield and quality of okra [*Abelmoschus esculentus* (L.) Moench] var. Arka Anamika at Department of Horticulture, Agricultural College and Research Institute, Madurai, during (August, 2010 to November, 2010) and the second experiment was carried out during (December, 2010 to March, 2011). The experiment was laid out in a randomized block design with three replications.

The potassium was applied at 100% RDF uniformly to all the treatments.

### Treatment details

- T<sub>1</sub> : 40 Kg N + 50 Kg P<sub>2</sub>O<sub>5</sub> + 30 Kg K<sub>2</sub>O (100% RDF) (Control)  
T<sub>2</sub> : 100% NPK RDF + 2 kg Azophos  
T<sub>3</sub> : 100% NPK RDF + 2 kg Methylobacterium  
T<sub>4</sub> : 100% NPK RDF + 2 kg Azophosmet  
T<sub>5</sub> : 75% NP RDF + 100% K RDF + 2 kg Azophos  
T<sub>6</sub> : 75% NP RDF + 100% K RDF + 2 kg Methylobacterium  
I<sub>7</sub> : 75% NP RDF + 100% K RDF + 2 kg Azophosmet  
T<sub>8</sub> : 50% NP RDF + 100% K RDF + 2 kg Azophos  
T<sub>9</sub> : 50% NP RDF + 100% K RDF + 2 kg Methylobacterium  
I<sub>10</sub> : 50% NP RDF + 100% K RDF + 2 kg Azophosmet.

Seeds were treated with Azophos, Methylobacterium and Azophosmet each at 200 g and sown at different treatment combinations with plant to plant spacing of 30 cm and row to row 45 cm by simple hand dibbling. Remaining quantity of Azophos, Methylobacterium and Azophosmet @ 1.8 kg each was applied in the soil along with the FYM before sowing the seed. According to treatment structure Methylobacterium was sprayed at two times 300ml/ ha during 25 and 35 days after sowing. Observations on growth, yield and quality parameters of both seasons crop were recorded.

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## Results and Discussion

### Growth attributes

The plant height of okra was found to be increased to a significant extent with the application of inorganic fertilizers and biofertilizers during growth stages. The plant height was recorded at three stages viz., 30, 60 and 90 DAS in first and second

seasons. In the treatment T<sub>10</sub> (50% NP RDF + 100% K RDF + 2 kg Azophosmet) recorded highest plant height during 30 DAS (46.85, 45.60 cm), 60 DAS (92.36, 90.41cm) and 90 DAS (146.89, 144.52cm) and number of leaves per plant during 30 DAS (14.84, 13.85), 60 DAS (23.26, 24.61) and 90 DAS (27.72, 28.61) respectively during both seasons (Table,1). Increased plant height and leaves may be due to

**Table 1. Effect of integrated nutrient management on growth parameters of okra**

Treatment	Plant height (cm)									No. of leaves per plant								
	30 DAS			60 DAS			90 DAS			30 DAS			60 DAS			90 DAS		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean
T <sub>1</sub>	38.54	36.73	37.64	78.14	76.66	77.40	110.36	108.57	109.47	10.81	9.63	10.22	19.36	18.57	18.97	21.88	22.77	22.33
T <sub>2</sub>	41.48	40.24	40.86	78.86	77.43	78.15	112.84	110.74	111.79	9.53	10.73	10.13	16.65	19.69	18.17	20.28	24.67	22.48
T <sub>3</sub>	41.90	42.80	42.35	86.83	87.50	87.17	126.54	127.67	127.11	8.78	9.60	9.19	17.55	17.80	17.68	20.90	21.77	21.34
T <sub>4</sub>	36.77	35.77	36.27	76.81	74.76	75.79	112.22	111.64	111.93	10.22	10.89	10.56	19.19	18.57	18.88	21.48	22.58	22.03
T <sub>5</sub>	43.77	43.74	43.76	84.71	83.52	84.12	128.30	125.69	127.00	8.56	9.22	8.89	16.52	17.13	16.83	19.52	21.66	20.59
T <sub>6</sub>	40.21	41.85	41.03	77.59	75.55	76.57	119.26	117.74	118.50	9.51	9.86	9.69	18.34	18.52	18.43	20.55	23.84	22.20
T <sub>7</sub>	36.35	34.57	35.46	70.71	71.56	71.14	112.84	110.76	111.80	10.44	10.85	10.65	18.74	18.48	18.61	21.81	23.65	22.73
T <sub>8</sub>	39.21	37.64	38.43	76.75	75.69	76.22	115.17	117.76	116.47	10.85	11.76	11.31	19.40	19.61	19.51	21.59	22.47	22.03
T <sub>9</sub>	44.71	43.76	44.24	88.71	89.39	89.05	131.84	133.67	132.76	11.57	12.51	12.04	20.73	21.63	21.18	23.43	25.77	24.60
T <sub>10</sub>	46.85	45.60	46.23	92.36	90.41	91.39	146.89	144.52	145.71	14.84	13.85	14.35	23.26	24.61	23.94	27.72	28.61	28.17
SEd	0.76	0.75	*	1.51	1.49	*	2.27	2.25	*	0.19	0.20	*	0.35	0.36	*	0.41	0.44	*
CD (P=0.05)	1.60	1.58	**	3.18	3.14	**	4.77	4.73	**	0.40	0.42	**	0.75	0.75	**	0.85	0.92	**

Pooled analysis	Plant height (cm)									No. of leaves per plant				
	SEd			CD (P=0.05)			SEd			CD (P=0.05)				
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS		
Treatments	0.5356	1.0642	1.5992	1.0765	2.1390	3.2145	0.1389	0.2513	0.2993	0.2791	0.5051	0.6016		
Seasons	0.2395	0.4759	0.7152	0.4814	0.9566	1.4375	0.0621	0.1124	0.1339	0.1248	0.2259	0.2690		
Season x Treatments	0.7574	1.5050	2.2617	1.5224	3.0250	4.5459	0.1964	0.3554	0.4233	0.3947	0.7144	0.8508		

increased uptake of nitrogen, which being the constituent of protein and protoplasm. The role of organic manures in enhancing the growth characters is well known and they usually have a positive relationship with growth as indicated in the present study. Improvement in growth due to INM has been reported in vegetable crops like tomato (Poopathi, 1994) beans (Mahendran *et al.*, 1995) and okra (Rajasekar *et al.*, 1995).

### Yield Parameters

Application of inorganic fertilizers along with biofertilizers had the significant effect on yield attributes of crop. The treatment T<sub>10</sub> (50% NP RDF +

100% K RDF + 2 kg Azophosmet) recorded increased No. of fruits per plant (29.00, 30.19), fruit length (15.63, 14.88cm), fruit girth (5.96, 5.94cm), fruit weight (18.78, 17.93g) and fruit yield per hectare (18.63, 18.85t) during both the season respectively (Table 2).

The application of organics helps the soil microorganisms to produce polysaccharides and thus build better soil structure. N fixation and P solubilization were reported to be due to the improved microbial activity in the organically amended soil (Balasubramanian, 1972).

Studies conducted elsewhere have indicated that

**Table 2 Effect of integrated nutrient management on yield parameters of okra**

Treatment	No. of fruits per plant			Fruit length (cm)			Fruit Girth (cm)			Fruit Weight (g)			Yield per ha (tonnes)		
	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean	1 <sup>st</sup> season	2 <sup>nd</sup> season	Pooled Mean
	T <sub>1</sub>	26.47	25.86	26.17	12.45	11.53	11.99	5.41	4.49	4.95	15.25	13.76	14.51	10.35	11.2
T <sub>2</sub>	27.48	28.57	28.03	11.50	10.65	11.08	5.48	4.86	5.17	15.41	14.67	15.04	11.17	13.5	12.34
T <sub>3</sub>	25.34	24.80	25.07	12.32	12.57	12.45	5.62	5.25	5.44	15.33	14.54	14.94	12.74	14.2	13.47
T <sub>4</sub>	26.70	27.54	27.12	12.79	11.74	12.27	5.64	5.27	5.46	15.82	15.15	15.49	12.96	13.75	13.36
T <sub>5</sub>	25.41	26.65	26.03	13.27	12.53	12.90	5.72	5.81	5.77	15.95	14.80	15.38	13.81	14.5	14.16
T <sub>6</sub>	25.51	25.86	25.69	13.43	11.67	12.55	5.74	5.35	5.55	15.88	15.65	15.77	14.02	15.75	14.89
T <sub>7</sub>	26.34	27.58	26.96	13.74	12.57	13.16	5.81	5.83	5.82	16.35	15.84	16.10	15.21	16.75	15.98
T <sub>8</sub>	28.14	29.69	28.92	13.97	12.94	13.46	5.86	5.81	5.84	17.20	16.67	16.94	16.25	17.5	16.88
T <sub>9</sub>	28.44	29.89	29.17	14.01	13.27	13.64	5.81	5.87	5.84	18.36	16.89	17.63	17.85	17.62	17.74
T <sub>10</sub>	29.00	30.19	29.60	15.63	14.88	15.26	5.96	5.94	5.95	18.78	17.93	18.36	18.63	18.85	18.74
SEd	0.50	0.51	*	0.25	0.23	*	0.11	0.10	*	0.31	0.29	*	0.28	0.30	*
CD (P=0.05)	1.05	1.08	**	0.53	0.49	**	0.23	0.22	**	0.65	0.62	**	0.57	0.61	**

Pooled analysis	No. of fruits per plant			Fruit length (cm)			Fruit Girth (cm)			Fruit Weight (g)			Yield per ha (tonnes)		
	SEd		CD (P=0.05)	SEd		CD (P=0.05)	SEd		CD (P=0.05)	SEd		CD (P=0.05)	SEd		CD (P=0.05)
	Treatments	0.3589	0.7213	0.1725	0.3466	0.0750	0.1507	0.2128	0.4277	0.1975	0.3970				
Seasons	0.1605	0.3226	0.0771	0.1550	0.0335	0.0674	0.0952	0.1913	0.0883	0.1775					
Season x Treatments	0.5075	1.0201	0.2439	0.4902	0.1060	0.2131	0.3009	0.6048	0.2793	0.5614					

organic manures improved the soil structure, texture, tilth and availability of macro nutrients and thereby increased yield (Biswas, 1971 and Gaur *et al.*, (1972). The increase in the number of fruits over control may be due to the increased amount of food manufactured by foliage and increased accumulation of sink. Azophosmet inoculation treatment with inorganic fertilizers had increased the yield in both the seasons. Priya 2011 reported similar results in brinjal using Azophosmet. The results are in close conformity with the earlier findings in okra (Veeraragavathatham *et al.*,

1988), Onion (Gurubatham *et al.*, 1989), Cabbage (Jeeva Jothi *et al.*, 1993), Chilli (Paramaguru and Natarajan, 1993), Onion (Sankar, 1995) carrot (Wange, 1996) and Brinjal (Anburani and Manivannan, 2002).

#### Quality parameters

The treatment T<sub>10</sub> had the least crude fibre content (6.99 and 7.00 per cent) and the treatment T<sub>1</sub> had highest crude fibre content (7.82 and 7.63 per cent) during first and second seasons respectively (Fig.1). Nitrogen had a negative

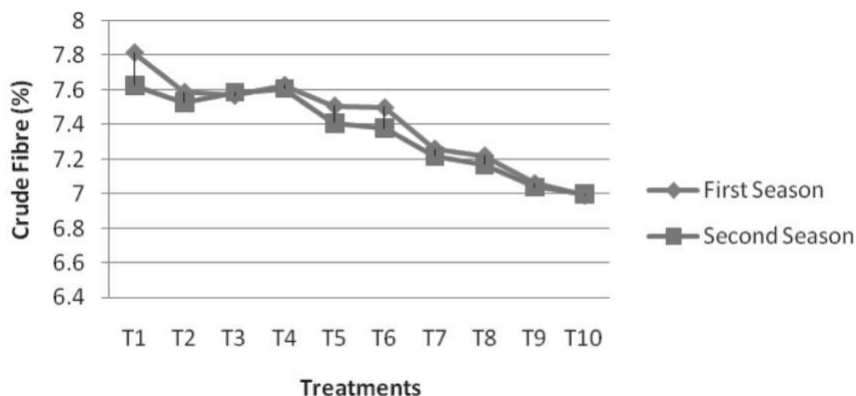


Fig.1. Effect of integrated nutrient management on crude fibre content (%) in Okra.

influence on the crude fibre content in the present study. Application of Azophosmet in okra balanced the N content requirement and made the low crude fibre content which is considered as desirable character (Balasubramani, 1988). Decreased crude fibre due to increased N application has been observed earlier in okra (Mani and Ramanathan, 1981a).

#### Conclusion

In conclusion, the treatment T<sub>10</sub> (50% NP RDF + 100% K RDF + 2 kg Azophosmet) registered highest values for growth attributes viz., plant height and number of leaves, yield parameters such as number of fruits per plant, fresh weight of fruit, fruit length, fruit girth, yield per hectare with low fibre content of fruits in okra.

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