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Impact of integrated nutrient management on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]

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Abstract
The present experiment was conducted at Horticulture Research Farm, R.A.K. College of Agriculture, Sehore (M.P.) during *kharif* season of 2019 to study about the "integrated nutrient management on growth and yield of okra [*Abelmoschus esculentus* (L.) Moench]" were laid out in randomized block design with eight treatments combination were replicated in each three blocks. The result revealed that the treatment T_8 significantly found best among the all treatments at all growth traits in almost all the characters *i.e.* plant height (cm) (83.01), number of leaves per plant(33.26), leaf area (cm^2) (2632.9), and yield traits; days to first flower initiation (35.33), days to taken first picking (46.66), fruit number per plant (18.77), fruit girth (mm) (17.01), fruit yield per plot (kg) (4.222) while the treatment T_1 (control) showed minimum response in term of growth and yield of okra.

Keywords: Okra, RDF, vermicompost, poultry manure, neem cake, growth and yield

Introduction
Okra [*Abelmoschus esculentus* (L.) Moench] popularly known as 'lady finger' or 'bhindi' that belongs to the family of Malvaceae and chromosome number is (2n=2x=130). Originated from Tropical Africa, okra has secured a prominent role among vegetables. Okra has strong years round market for its tender fruit and called some of the major tropical and subtropical portions of the world's main vegetable crops.

Okra seeds contain about 20-30% protein and 40% oil (Selvakumar, 2014) [12]. It is also a good source of iodine and it is useful for goitre care. Dry fruit skin and fibres are used in paper; packaging and fibre processing. Root and stem are used to clear the cane juice for jaggery preparation.

In okra a lot of research has been done for optimum fruit yield production by standardisation of crop nutrition due to the availability of improved okra varieties and hybrids, climatic condition and pest disease occurrence. Currently, we can produce a bumper yield during the year but some major problems such as the emergence of viral diseases, fruit borer attack, economic loss due to weak plant vigour, low fruit setting and small fruit size.

Inorganic fertilizers such as N, P_2O_5 and K_2O are long term residual effects and fixed in soil. But now a day is expensive things and it raises agricultural costs. Second, the more use of inorganic fertilizers deteriorates the level of soil productivity daily, which immediately improves productivity but destroys the environment and harms human health.

Organic manures *viz.* vermicompost, poultry manure and neem cake is high in organic matter and provides important nutrients. Organic manure increases soil utility of CEC, water holding capacity and phosphates. Using organic manure in INM is therefore so important for maintain productivity. Since and improving efficiency.

It is important to standardise fertilizer doses to achieve higher yields through an integrated nutrient management system. Keeping in mind the value of integrated nutrient management in sustainable vegetable production, field experiments to try and mix various forms of organic manures and inorganic fertilizer.

Materials and Methods

The experiment was conducted at Horticulture Research Farm, R.A.K. College of Agriculture, Sehore (M.P.) during *kharif* season of 2019. The experiment was laid out in randomized block design with eight treatments, replicated three times. The treatments in were T_1 100%RDF (100:75:75 kg N_2:P_2O_5:K_2O/ha), T_2 (100%RDF + Vermicompost @ 5 t/ha), T_3 (100%RDF + Poultry manure @ 2 t/ha), T_4 (100%RDF + Neem cake @ 2 t/ha), T_5 (50%RDF + Vermicompost @ 5 t/ha), T_6 (50%RDF + Poultry manure @ 2 t/ha), T_7 (50%RDF + Neem cake @ 2 t/ha), T_8 (100%RDF + Vermicompost @ 5 t/ha + Poultry manure @ 2 t/ha + Neem cake @ 2 t/ha), where RDF is recommended dose of fertilizer. The field was prepared by ploughing and tillage operation to obtain a well tilth condition. Each plot of size was (3 m×2.4 m) and planting distance (60 cm×15 cm) made. Irrigation channels and bunds were also prepared as per layout. The pure viable seeds were direct sown in field by manually and covered with fine soil at 2-3 cm depth. A light irrigation is given soon after seed sowing to ensure good germination. The organic manure were applied at prior of sowing and full dose of NPK as per treatment were applied at just before the sowing, not in split doses. All cultural operation and plant protection measure were done as regularly during crop growth periods. The observations were recorded on growth characters; plant height (cm), number of leaves per plant, leaf area (cm^2) and yield characters; days to first flower initiation, days to taken first picking**,** fruit number per plant, fruit girth (mm), fruit yield per plot (kg). The data recorded on various parameters were analyzed as per statistical analysis through RBD.

Results and Discussion

The growth parameters as presented in table 1,2,3. The growth parameters significantly maximum value of plant height (cm) at 80 DAS (83.01), number of leaves per plant at 80 DAS (33.26), leaf area (cm^2) at 80 DAS (2632.9) were recorded in the treatment T_8 receiving in (100%RDF + Vermicompost @ 5 t/ha + Poultry manure @ 2 t/ha + Neem cake @ 2 t/ha). The minimum values were found for all the above growth parameters at T_1 (control). The results of this investigation are consistent with the finding of Singh *et al.* (2005) [14], Mal *et al.* (2013) [7], Sharma *et al.* (2014) [13], Yadav *et al.* (2015) [16], Amiry *et al.* (2017) [1], Dwivedi *et al.* (2018) [4], Sati *et al.* (2018) [11].

Table 1: Effect of integrated nutrient management on plant height (cm) of okra

S. No.	Treatments	Plant height (cm)		
		40DAS	60DAS	80DAS
T_1	Control: 100% RDF (100:75:75kg/ha)	30.03	51.01	63.25
T_2	100% RDF + Vermicompost @ 5t/ha	39.43	60.17	73.16
T_3	100% RDF + Poultry Manure @ 2t/ha	41.65	62.25	74.78
T_4	100% RDF + Neem Cake @ 2t/ha	43.20	63.17	76.14
T_5	50% RDF + Vermicompost @ 5t/ha	36.82	57.25	68.14
T_6	50% RDF + Poultry Manure @ 2t/ha	37.49	58.14	69.57
T_7	50% RDF + Neem Cake @ 2t/ha	38.61	59.16	71.08
T_8	100%RDF + Vermicompost @5t/ha + Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha	48.62	70.84	83.01
S. E±		1.67	1.56	2.31
C.D. (5%)		5.08	4.75	7.02

Table 2: Effect of integrated nutrient management on number of leaves per plant of okra

S. No.	Treatments	Number of leaves per plant		
		40DAS	60DAS	80DAS
T_1	Control:100% RDF (100:75:75kg/ha)	9.03	12.18	16.10
T_2	100% RDF + Vermicompost @ 5t/ha	12.80	18.43	26.63
T_3	100% RDF + Poultry Manure @ 2t/ha	14.72	19.70	27.34
T_4	100% RDF + Neem Cake @ 2t/ha	15.00	20.02	27.86
T_5	50% RDF + Vermicompost @ 5t/ha	11.16	16.2	23.64
T_6	50% RDF + Poultry Manure @ 2t/ha	11.78	17.16	24.79
T_7	50% RDF + Neem Cake @ 2t/ha	12.19	17.63	25.67
T_8	100%RDF + Vermicompost @5t/ha + Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha	18.26	25.16	33.26
S. E±		0.97	1.41	1.86
C.D. (5%)		2.94	4.30	5.64

Table 3: Effect of integrated nutrient management on leaf area (cm^2) of okra

S. No.	Treatments	Leaf area (cm^2)		
		40DAS	60DAS	80DAS
T_1	Control:100% RDF (100:75:75kg/ha)	410.65	503.57	601.37
T_2	100% RDF + Vermicompost @ 5t/ha	911.75	1273.2	1802.2
T_3	100% RDF + Poultry Manure @ 2t/ha	1000.9	1404.2	1210.4
T_4	100% RDF + Neem Cake @ 2t/ha	1149	1506.7	2101.4
T_5	50% RDF + Vermicompost @ 5t/ha	637.96	939	1260
T_6	50% RDF + Poultry Manure @ 2t/ha	745.74	1010.2	1430.1
T_7	50% RDF + Neem Cake @ 2t/ha	805.42	1115.9	1560
T_8	100%RDF + Vermicompost @5t/ha + Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha	1500.9	1975.1	2632.9
S. E±		62.85	115.57	248.64
C.D. (5%)		180.66	350.59	533.34

The yield parameters as shown in table 4, 5. The relevant earliest days to initiation of the first flower (35.33), days to taken first picking (46.66), number of fruits per plant (18.77), fruit girth (mm) (17.01), fruit yield per plot (kg) (4.222) were significantly maximum recorded in the treatment T_8 obtaining in (100%RDF + Vermicompost @ 5 t/ha + Poultry manure @ 2 t/ha + Neem cake @ 2 t/ha). The minimum values were found for all the above yield parameters in the treatment T_1 (control). The results of this investigation are consistent with the finding of Patil *et al*. (2000) [9], Bairwa *et al*. (2009) [2], Tripathy and Maity (2009) [15], Ghuge *et al*. (2015) [5], Kumar *et al*. (2017) [6], Sachan *et al*. (2017) [10], Chaudhari *et al*. (2018) [3], Muhammad *et al*. (2019) [8].

Table 4: Effect of integrated nutrient management on yield parameters of okra

S. No.	Treatment	Days to first flowering initiation	Days to taken first picking	Number of fruits/ plant
T_1	Control:100% RDF (100:75:75kg/ha)	47.00	57.00	11.83
T_2	100% RDF + Vermicompost @ 5t/ha	41.33	52.66	14.00
T_3	100% RDF + Poultry Manure @ 2t/ha	40.33	50.00	14.63
T_4	100% RDF + Neem Cake @ 2t/ha	39.33	49.66	15.20
T_5	50% RDF + Vermicompost @ 5t/ha	43.33	55.00	12.66
T_6	50% RDF + Poultry Manure @ 2t/ha	43.00	54.33	13.18
T_7	50% RDF + Neem Cake @ 2t/ha	42.00	53.00	13.83
T_8	100%RDF + Vermicompost @5t/ha+ Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha	35.33	46.66	17.01
S. E±		2.80	2.28	1.46
C.D. (5%)		8.50	6.93	4.45

Table 5: Effect of integrated nutrient management on yield parameters of okra

S. No.	Treatment	Fruit girth (mm)	Fruit yield per plot (kg)
T_1	Control:100% RDF (100:75:75kg/ha)	11.83	2.085
T_2	100% RDF + Vermicompost @ 5t/ha	14.00	3.257
T_3	100% RDF + Poultry Manure @ 2t/ha	14.63	3.565
T_4	100% RDF + Neem Cake @ 2t/ha	15.20	3.765
T_5	50% RDF + Vermicompost @ 5t/ha	12.66	2.604
T_6	50% RDF + Poultry Manure @ 2t/ha	13.18	2.842
T_7	50% RDF + Neem Cake @ 2t/ha	13.83	3.053
T_8	100%RDF + Vermicompost @5t/ha+ Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha	17.01	4.222
S. E±		1.46	0.474
C.D. (5%)		4.45	1.439

Conclusion

From the above findings it is concluded that the combination of treatment T8 (100%RDF + Vermicompost @5t/ha+ Poultry Manure @ 2t/ha + Neem Cake @ 2t/ha) resulted in maximum growth and yield in okra under Vindhya Plateau region.

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