www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(6): 839-844

www.thepharmajournal.com
Received: 22-02-2022
Accepted: 31-05-2022

Asha Nama
Research Scholar, School of Agriculture Sciences, Career Point University, Kota, Rajasthan, India

Rakesh Kumar Meena
Assistant Professor, Apex University, Jaipur, Rajasthan, India

Corresponding Author:
Asha Nama
Research Scholar, School of Agriculture Sciences, Career Point University, Kota, Rajasthan, India

Effect of Integrated Nutrient Management on Yield Parameters of Okra [*Abelmoschus esculentus* (L.) Moench.] Variety Parbhani Kranti under South Eastern Plain Zone V of Rajasthan

Asha Nama and Rakesh Kumar Meena

Abstract
The present investigation was carried out to observed effects of different organic manures (vermicompost, neem cake and farm yard manure) along with RDF either alone or in various combinations on yield and yield parameters of okra. The experiments were conducted at the Instructional farm, School of Agricultural Sciences, CPU Kota during Kharif season of 2019 and 2020. Number of fruits per plant, fruit length, fruit weight, fruit diameters, yield per plant and yield per hectare were calculated for each treatment including control (no manure). Results revealed the maximum yield was obtained if 140% RDF and vermicompost were applied together. In the economic study of the experiments, it was also found that on this combination, the maximum return was obtained which was highly significant than control or treatment with single manure.

Keywords: Organic manures, yield, yield parameters, economic study etc.

1. Introduction
Okra (*Abelmoschus esculentus* L) is commonly known as Bhindi or lady's finger belongs to family Malvaceae with 2n=130. It is one of the important crops among the vegetable and grown in many countries and distributed from Africa to Asia, Southern Europe and America. It is considered to be an important vegetable crop cultivated almost across the country under various agro climatic conditions. Several species of the genus *Abelmoschus* are grown in various part of the world among them *Abelmoschus esculentus* L. is mostly cultivated in Asia and has a great commercial demand due to its nutritional values. India produces okra i.e., 6371000 MT with an area of 519000 ha (NHB, 2019).
The soils of Rajasthan varied from light to heavy in texture with high pH and low nitrogen content. The application of nitrogen is quite essential for proper growth and development of plants (Ansari and Sukhraj, 2010) [3].
The fertilizers play a crucial role to meet out nutrient requirement to the crops. Persistent nutrient depletion is posing a greater threat to the sustainable agriculture. The application of chemical fertilizer to the crops involves high cost. However, bio-fertilizers are cheaper and renewable sources that contributes for the development strategies which do not lead to rise in consumption of non-renewable forms of energy (Subba Rao, 1974) [12].
Therefore, there is an urgent need to reduce the usage of chemical fertilizers and in turn to increase the usage of organics to improve the yield and quality. The aforesaid consequences have way to grow okra using different organic sources and bio fertilizers, use of organic manure in combination with chemical fertilizers that helps in improving physio-chemical properties of soil structure, water holding capacity and soil aeration, chemical properties and supply of essential nutrients in balanced ratio, supply of nutrients, slow release of nutrients, of the soil flora and fauna.
Organic waste from different sources helps in boosting up crop growth and yield as it contains most of the essential nutrients for plant growth and development hence, it responds well to the application of both organic manures and inorganic fertilizers. The bio fertilizers are gaining importance due to their low cost, non- residual toxicity and capacity to enrich soil fertility in addition to high returns under favorable conditions. Organic manures are known to supply the macro and micronutrients, apart from improving soil properties and fertility.

However, much information is not available on use of inorganic fertilizers in combination with organic manures and biofertilizers in okra seed production. Therefore, there is a need to work on the requirement of inorganic fertilizers in combination with organic manures and biofertilizers for suitable increased in seed yield and quality of okra (Akbasova *et al*., 2015) [1].

In the present investigation, we applied different organic manures i.e., vermicompost, neem cake, and farm yard manure (FYM) with recommended daily fertilizers (RDF) alone or in different combination to observe their effects of yield and yield parameters on Okra.

2. Materials and Methods

2.1 Experimental Site

The experiment was conducted at the Instructional farm, School of Agricultural Sciences, CPU Kota during Kharif season of 2019 and 2020. The site is situated in *humid south eastern plain zone V of* Rajasthan and covers geographical area of 26.43 lakh hectare that represents 7.71 per cent of the total geographical area of the state. The Rajasthan state lies between $23^0 3'$ and $36^0 12'$ N latitude, $78^0 17'$ E longitude in which Kota falls between $25^0 11'$N latitude and $75^0 54'$E longitude at 273-meter altitude from mean sea level (MSL) with an average rain fall ranging from 650 mm to 1000 mm annually. The area under cultivation is about 18.0 lakh hectares, out of which approximately 26% is under irrigated and remaining area is under rain fed and dry land conditions. It includes all tehsils of Kota, Bundi, Baran, Jhalawar and part of Sawai Modhopur districts.

2.2 Climate and weather conditions

This zone possesses typically sub-tropical climatic conditions characterized by mild winters and moderate summers associated with high relative humidity during the months of July to September. The annual rainfall of the region is 650 – 1000 mm, most of which is contributed by south west monsoon from July to September.

2.3 Detailed Methodology

The detailed information about experiment is given in table 1.

Table 1: Detailed Methodology

Location	Agriculture Research Farm, CPU Kota	Year	Kharif 2019 & Kharif 2020
Gross plot size (m^2)	3.6m x2.1m =7.56m^2 12 Rows of 14 plant each (168 plant/plot)	Total number of plots	20 x 3 =60
Net plot size (m^2)	3.0mx1.8m=5.40m^2 10 Rows of 12 plant each. (120plant/plot)	Area required (m^2)	7.5 m2 x60=453.60 m^2
Spacing (cm.)	30.00 cm x 15.00cm	30% Extra area required (m^2)	453.6m^2 x0.3=136.08 m^2
Treatment	Eight (8)	Total area (m^2)	589.68 m^2
Replication & Statistical design	Three (3) & RBD	Crop	Okra
Date of sowing	20 July in kharif 2019 and 25 July in Kharif 2020	Variety	Parbhani Kranti
Seed rate (kg/ha)	12.0-15.0kg/ha	Vermicompost(t/ha)	2.0
Date of picking	As and when required	FYM (t/ha)	25.0
Fertilizers NPK (kg/ha)	120:60:60 kg/ha respectively	Neem cake (t/ha)	3.0

2.4 Fertilizer application

Details of application of fertilizers are shown in Table 2.

In RDF, the 50% nitrogen and full dose of phosphorus and potash was applied as a basal and remaining 50% dose of nitrogen was given at 30-35 days after sowing. Organic manure was applied about 15 days prior to sowing. Organic and inorganic fertilizer was applied as per given standard procedure. FYM @ 18.9kg/plot (for 7.56 m^2 area) for all FYM treatment. Vermicompost@1.59kg/plot(for7.56m^2area) for all vermicompost. treatment. Neemcake @ 2.268kg/plot (for 7.56 m^2 area) for all neem cake treatment.

Table 2: Details of Treatment with their quantity for (7.56 m^2) plot area

S.N.	Treatment	Quantity required
T1	Absolute Control	No fertilizer & No manure
T2	RDF	NPK @120:60:60kg/ha Urea-157.0g. DAP- 97.6g MOP- 95.0g//plot
T3	FYM	@25 t/ha i.e., 18.9kg/plot
T4	Vermicompost	@2 t/ha i.e., 1.519kg/plot
T5	Neem Cake	@3t/ha i.e., 2.268kg/plot
T6	60%RDF+FYM	NPK @72:36:36kg/ha+25t/ha Urea-94.2g, DAP-58.56g & MOP-45.0g//plot + 18.90Kg FYM
T7	80%RDF+FYM	NPK @96:48:48kg/ha+25t/ha Urea-125.6g, DAP-78.08g & MOP- 60.0g//plot + 18.90Kg FYM
T8	100%RDF+FYM	NPK @120:60:60kg/ha+25t/ha Urea-157.0g, DAP-97.6g & MOP-95.0g//plot + 18.90Kg FYM
T9	120%RDF+FYM	NPK @144:72:72kg/ha+25t/ha Urea-188.40g, DAP-117.12g & MOP-90.0g//plot + 18.90Kg FYM
T10	140%RDF+FYM	NPK @168:84:84kg/ha+25t/ha Urea-219.8g, DAP-136.64g & MOP-105.0g//plot + 18.90Kg FYM
T11	60%RDF+Vermicompost	NPK @72:36:36kg/ha+2 t/ha Urea-94.2g, DAP-58.56g & MOP-45.0g//plot + 1.519Kg VC
T12	80%RDF+Vermicompost	NPK @96:48:48kg/ha +2 t/ha Urea- 125.6g, DAP-78.08g & MOP- 60.0 g//plot + 1.519Kg VC
T13	100%RDF+Vermicompot	NPK @120:60:60kg/ha+2 t/ha Urea-157.0g, DAP- 97.6g & MOP- 95.0g//plot + 1.519Kg VC
T14	120%RDF+ Vermicompost	NPK@144:72:72kg/ha+2t/ha Urea-188.40g, DAP-117.12g & MOP-90.0g/plot + 1.519Kg VC
T15	140%RDF+ Vermicompost	NPK @168:84:84kg/ha+2t/ha Urea-219.8g, DAP-136.64g & MOP- 105.0g/plot + 1.519Kg VC
T16	60% RDF + Neem Cake	NPK @72:36:36kg/ha+ 3t/ha Urea- 94.2g, DAP-58.56g & MOP-45.0g/plot + 2.268Kg NC
T17	80%RDF+Neem Cake	NPK @96:48:48kg/ha+ 3t/ha Urea-125.6g, DAP- 78.08g & MOP- 60.0 g/plot + 2.268Kg NC

T18	100%RDF+ Neem Cake	NPK @120:60:60kg/ha+ 3t/ha Urea-157.0g, DAP- 97.6g & MOP- 95.0g/plot + 2.268Kg NC
T19	120%RDF+ Neem Cake	NPK @144:72:72kg/ha+ 3t/ha Urea-188.40g, DAP-117.12g & MOP- 90.0g/plot + 2.268Kg NC
T20	140%RDF+ Neem Cake	NPK @168:84:84kg/ha+ 3t/ha Urea-219.8g, DAP-136.64g & MOP- 105.0g/plot + 2.268Kg NC

FYM = Farm yard manure, V.C= Vermicompost, N.C= Neem cake

2.5 Details of nutrients available in urea DAP and MOP in (%): In urea, 46.0% N was found. In DAP, 18.0% N and 46.0% P were present while in MOP, 60% K was recorded.

3. Results

3.1 Effect on yield and yield parameters

3.1.1 Number of fruits per plant

The significantly maximum fruits per plant was recorded with Treatment (T-15) i.e., where 140% RDF+ Vermicompost2t/ha was applied followed by treatment (T-19, T-9, T-16, T-18, T-20 and T-8) but all these treatments were found statistically at par to each other but were found superior than absolute control T-1 during both the season and year however, minimum fruits per plant was recorded with treatment RDF and absolute control (T-1) (Figure 1).

3.1.2 Fruit length

The significantly maximum fruit length (14.25cm, 14.92cm and14.58cm) was recorded in the treatment (T-15) where 140% RDF+ Vermicompost@2t/ha was given, when compared to any other treatment or its combination including RDF and control (T-1) however, minimum fruit length was found with the treatment absolute control (T-1). The similar trend was also observed with pooled mean data during both the season and year (Figure 1).

3.1.3 Fruit weight

The data showed that significantly maximum fruit weight (15.90 g, 16.90g and 16.40g) per fruit was found in the treatment (T-15) where 140% RDF+Vermicompost@2t/ha was given to the crop as per their recommendation followed by treatment (T- 9, and T-8.) when compared with RDF and absolute control (T-1) however, treatment T-8, T9, and T-14 including best treatment (T-15) were statistically similar to each other. The similar trend was however, also observed in pooled mean as well (Figure 1).

3.1.4 Fruit diameter

Among treatment, treatment (T-15) was the only treatment which has maximum fruit diameter (4.22 cm, 4.55 cm and 4.39 cm) when compared with any other treatment and their combination including control RDF and absolute control(T-1) during both the season and year. The pooled data of the same treatment i.e. (T-15) also showed the similar trend in fruit diameter (4.39 cm) (Figure 1).

3.1.5 Fruit Yield per plant (Kg.)

It is very clear from the table that significantly maximum fruit yield (0.29kg, 0.30kg.and 0.30kg.) was with the treatment (T-15) where 140% RDF+Vermicompost@2t/ha was given to the crop as per their recommendation during both the seasons and year including pooled mean as well when compared with any of treatment and their combination including control (T-1). The minimum fruit weight (0.10 kg, 0.11Kg and 0.13 Kg) was however, recorded with absolute control (T-1) (Figure 2).

3.1.6 Fruit yield (q/ha)

The pooled result showed that the treatment (T-15) was found to be the best however, treatment T-17, T-19 andT-20 were next in order but were statistically at par to each other however, all these treatments *viz*. T-17, T-19 and T-20 were also found statistically superior than RDF and absolute control (T-1). Among treatment, treatment (T-15) where 140% RDF+Vermicompost@2t/ha was given to the crop as per their recommendation during both the seasons and year. On the other hand, significantly maximum yield 150.99q/ha in kharif 2019, 157.66q/ha during kharif 2020 and 154.33q/ha in pooled mean year was also recorded with the treatment T-15 where 140%RDF + vermicompost @ 2t/ha was applied as per their recommendation, when compared to any other treatment and their combination including control (T-1), the absolute control showed the similar trend as in the treatment (T-15) (Figure 3).

Table 3: Effects of different treatments on yield and yield parameters of okra

Treatment	Number of fruits per plant			Fruit length			Fruit weight			Fruit diameter			Fruit yield per plant			Fruit yield per hectare		
	2019	2020	pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
T1	13.55	13.88	13.72	7.27	7.60	7.44	11.88	12.55	12.21	2.07	2.05	2.06	0.10	0.11	0.10	100.88	101.22	101.05
T2	14.00	14.33	14.17	8.12	8.45	8.29	12.10	12.77	12.43	3.00	3.33	3.17	0.11	0.12	0.13	104.32	104.99	104.66
T3	14.13	14.80	14.46	8.88	9.21	9.05	12.22	12.89	12.55	3.01	3.34	3.18	0.13	0.14	0.14	105.99	106.66	106.33
T4	14.79	15.46	15.12	7.60	7.93	7.77	12.00	12.67	12.33	3.00	3.33	3.17	0.12	0.14	0.13	105.44	106.44	105.94
T5	15.95	16.28	16.12	10.00	10.33	10.17	13.22	13.89	13.55	3.05	3.38	3.22	0.15	0.17	0.16	102.11	104.11	103.11
T6	16.22	16.55	16.39	10.10	10.43	10.27	13.33	14.00	13.66	3.06	3.39	3.23	0.17	0.18	0.17	107.88	109.55	108.71
T7	14.70	15.37	15.03	9.12	9.79	9.45	12.67	13.34	13.00	3.01	3.01	3.01	0.14	0.15	0.14	112.66	113.66	113.16
T8	18.12	18.45	18.29	10.12	11.45	10.79	14.89	15.56	15.22	3.06	3.39	3.23	0.22	0.25	0.24	105.66	108.99	107.33
T9	19.00	19.33	19.17	12.10	12.43	12.27	15.25	15.92	15.58	3.11	3.44	3.28	0.25	0.26	0.26	106.55	109.89	108.22
T10	15.94	16.27	16.11	9.36	10.03	9.69	12.88	13.55	13.21	3.03	3.36	3.20	0.14	0.15	0.14	106.99	110.33	108.66
T11	17.00	16.67	16.83	10.17	10.50	10.34	13.85	14.18	14.02	3.02	3.35	3.19	0.12	0.13	0.12	118.88	119.55	119.21
T12	17.35	18.02	17.68	11.00	11.33	11.17	14.15	14.82	14.48	3.04	3.37	3.21	0.21	0.20	0.20	118.44	115.11	116.77
T13	16.56	16.89	16.73	10.25	10.58	10.42	13.61	14.28	13.94	3.00	3.33	3.17	0.11	0.13	0.12	109.88	109.21	109.55
T14	19.10	19.43	19.27	12.18	12.51	12.35	14.65	15.32	14.98	3.18	3.51	3.35	0.24	0.22	0.23	120.22	123.55	121.89
T15	20.33	21.33	20.83	14.25	14.92	14.58	15.90	16.90	16.40	4.22	4.55	4.39	0.29	0.30	0.30	150.99	157.66	154.33
T16	18.25	20.92	19.58	11.25	12.25	11.75	14.70	15.37	15.03	3.09	3.42	3.26	0.22	0.23	0.23	135.88	139.21	137.55
T17	17.51	19.18	18.34	11.12	11.79	11.45	13.80	14.47	14.13	2.10	2.77	2.43	0.21	0.22	0.22	144.56	147.89	146.22
T18	18.19	19.86	19.02	10.14	10.81	10.47	12.90	13.57	13.23	2.98	3.31	3.15	0.21	0.22	0.22	139.18	135.85	137.51

T19	19.19	20.52	19.85	11.34	12.01	11.67	13.30	13.97	13.63	2.50	2.83	2.67	0.22	0.23	0.22	141.30	144.63	142.97
T20	18.89	20.56	19.72	11.78	12.11	11.95	14.10	14.77	14.43	2.60	2.93	2.77	0.20	0.23	0.21	140.10	143.43	141.77
CD (p = 0.05)	2.405	2.486	1.047	1.449	1.504	0.411	1.966	1.905	0.161	0.43	0.473	0.161	0.022	0.037	0.014	11.238	13.384	3.551
SE (m)	0.837	0.865	0.351	0.504	0.523	0.138	0.684	0.663	0.054	0.15	0.165	0.054	0.008	0.013	0.005	3.91	4.657	1.191
SE (d)	1.184	1.223	0.496	0.713	0.74	0.195	0.968	0.937	0.077	0.212	0.233	0.076	0.011	0.018	0.007	5.53	6.586	1.684

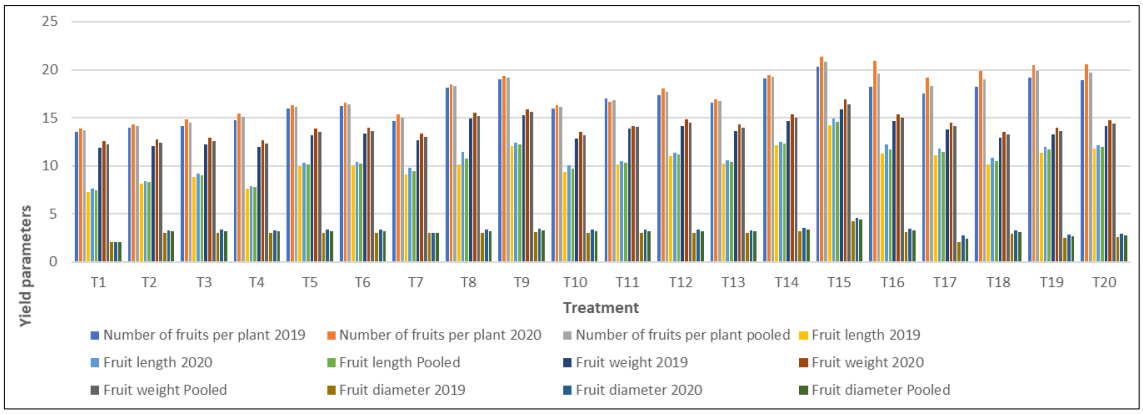

Fig 1: Effects of different treatments on yield parameters in okra

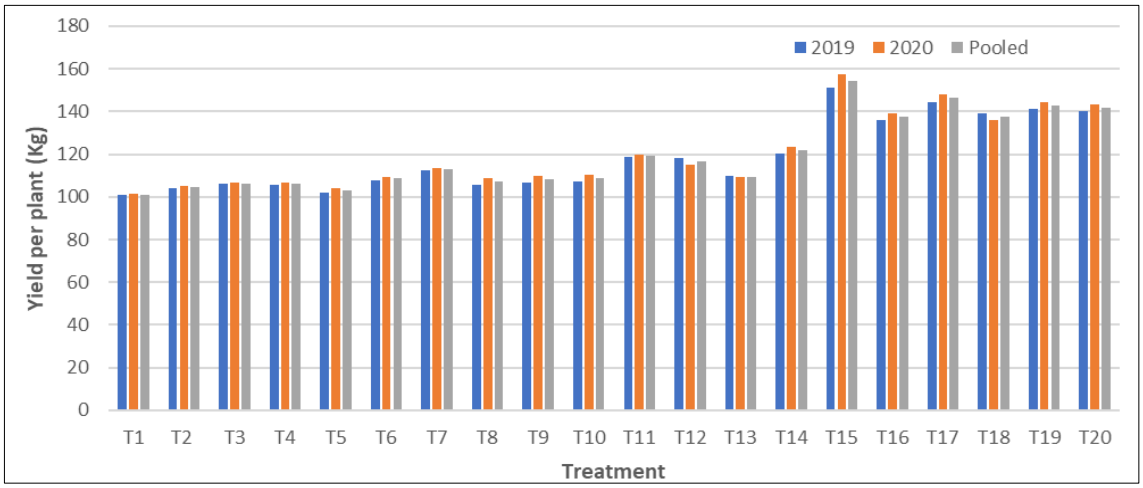

Fig 2: Effects of different fertilizer treatments on yield per plant in okra

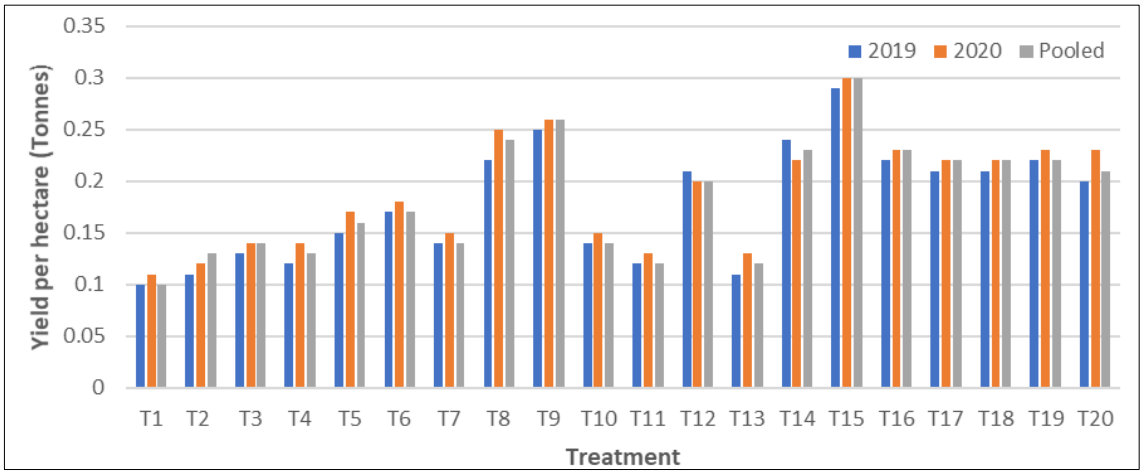

Fig 3: Effects of different fertilizer treatments on Yield per hectare in okra

3.2 Economic effects of the treatments

On the basis of pooled data, the maximum net return was recorded (Rs. 202374.434/ha.) with the treatment(T-15) when compared with absolute control (T-1) with Rs. 151575/ha. however, treatment RDF along with neem cake was also found to have better response on okra yield and net return as well with the treatment (T15-17, T-19 and T-20) with net return Rs. 184118.24 /ha, Rs. 176637.37/ha and Rs. 173534.434/ha respectively (Table 4) (Figure 1).

Table 4: Show the fertilizer and FYM

	Fertilizer (Cost Rs/ha)				Cost of V.C, FYM and N.C (Rs/ha)						
Treatment	**Urea**	**DAP**	**MOP**	**Fertilizer Cost (Rs/ha)**	**V.C**	**FYM**	**N.C**	**Fertilizer Cost (Rs/ha)**	**Total Cost (Rs/ha)**	**Yield (q/ha)**	**Total Return (Rs/ha)**
T1	0	0	0	0	0	0	0	0	0	101.05	151575
T2	1223.37	3130.32	2161	6514.69				6514.69	6514.69	104.66	156990
T3						62500		62500	62500	106.33	159495
T4					20000			20000	20000	105.94	158910
T5							30000	30000	30000	103.11	154665
T6	734.022	1878.192	1296.6	3908.814		62500		62500	66408.814	108.71	163065
T7	978.696	2504.256	1728.8	5211.752		62500		62500	67711.752	113.16	169740
T8	1223.37	3130.32	2161	6514.69		62500		62500	69014.69	107.33	160995
T9	1468.044	3756.38	2593.2	7817.628		62500		62500	70317.628	108.22	162330
T10	1712.718	4382.448	3025.4	9120.566		62500		62500	71620.566	108.66	162990
T11	734.022	1878.192	1296.6	390.814	20000			20000	20390.814	119.21	178815
T12	978.696	2504.256	1728.8	5211.752	20000			20000	25211.752	116.77	175155
T13	1223.37	3130.32	2161	6514.69	20000			20000	26514.69	109.55	164325
T14	1468.044	3756.38	2593.2	7817.628	20000			20000	27817.628	121.89	182835
T15	1712.718	4382.448	3025.4	9120.566	20000			20000	29120.566	154.33	231495
T16	734.022	1878.92	1296.6	3908.814			30000	30000	33908.814	137.55	206325
T17	978.696	2504.256	1728.8	5211.752			30000	30000	35211.752	146.22	219330
T18	1223.37	3130.32	2161	6514.69			30000	30000	36514.69	137.51	206265
T19	1468.044	3756.38	2593.2	7817.628			30000	30000	37817.628	142.97	214455
T20	1712.718	4382.448	3025.4	9120.566			30000	30000	39120.566	141.77	212655

Note: Cost of the Urea Rs 5.91 kg, DAP Rs 24.0 kg, MOP Rs 21.60 /kg Vermicompost (V.C) Rs 10 kg, FYM Rs 2.5/ kg and Neem cake Rs 10 /Kg sale price of okra Rs 15.00 /kg (Whole sale price) Rs.1500/q.

2. Other Labour operation cost in equal and common to all the treatment hense, These cost were not included in economic calculation.

4. Discussion

For better growth, development and yield of a crop, fertilizers should be used in suitable combinations with optimum dose. Overuse of fertilizers might be harmful for a crop. Different organic fertilizers provide different nutrients for a crop. This study was conducted to know the effects of organic fertilizers (either alone or in combination) on yield and yield parameters of okra.

In our study, maximum number of fruits per plant, highest fruit length, weight and diameter, highest yield per plant and highest yield per hectare were found to be maximum when 140% RDF and vermicompost@2t/ha were used together. Our findings were in accordance to results of Mal *et al*., 2013 [8]. They assessed the effect of diazotrophs, bio-fertilizers and azospirillum alone and in combination with fertilizer i.e.; 10t FYM/ha, 75% NPK of their recommended dose along with organic and chemical fertilizer vermicompost gave maximum fruit which also confirms the present finding.

Result obtained in this experiment had close conformity with the findings of Miglani, A. *et al.,* (2017) [9] when he applied bioagents in combination with nitrogen that showed and confirms the application of Azospirillum to seed +30.0kg nitrogen/ha gave highest fruit length, fruit girth, fruit weight and total numbers of fruits/plant in okra variety Pusa Sawani. It is now clear that application of organic, inorganic and bio agent have synergetic effect on physiological parameter including yields as well. Bhushan *et al*., (2013) [4] also confirms the results of present research finding and they also reported that the effect of Azotobactor and inorganic fertilizers on growth, fruit and seed yields of okra var. Hissar Unnut.

Results revealed that number of fruits per plant, fruit weight, fruit length, fruit diameter, fruit yield per plant and fruit yield per hectare was the highest with combination of 140% RDF+Vermicompost@2t/ha which was significantly higher than control and other plants which were treated with single fertilizer. Results of the current study strongly suggest that yield of okra can be enhanced by combined use of organic fertilizers in their optimum ration. Similar kinds of results were also shown by Akter *et al.,* (1993) [2]. They also found that combination of different manures and fertilizers significantly enhance yield and yield parameters in comparison to using fertilizer/manure alone. It has also been cleared by other scientists also that the combined application of organic manures and inorganic fertilizers is highly beneficial for sustainability in crop production (Khan, A.R. *et al.,* 2001; Liu *et al*., 1990) [5, 7]. Supplying different fertilizers together increases the quantities the quantities of a variety of nutrients simultaneously and can reduce the amount of N loss (Kramer *et al.,* 2002) [6].

Myint *et al.,* (2011) [10] suggested that the main advantage of using organic manures was to provide plants with nutrients that are released slowly throughout the growing season. Uses of waste as manure cut the investment cost for a crop.

5. Conclusion

By results of the present investigation, it can be concluded that use of 140% RDF and vermicompost together can give better yield of okra and farmers can get more economic return by using this combination.

6. References

1. Akbasova AD, Sainova GA, Aimbetova IO, Akeshova MM, Sunakbaeva DK. Impact of vermicompost on the productivity of Agricultural crops. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2015;6:2084-2088.
2. Akter MS, Hasan MKS, Adhikery RC, Chowdhury MK. Integrated Management of Sesbania rostrata and Urea-Nitrogen in Rice under a Rice-Rice Cropping System. The Annals of Bangladesh Agriculture. 1993;3:114-189.
3. Ansari A, Sukhraj K. Effect of vermiwas and

vermicompost on soil parameters and productivity of okra (*Abelmoschus esculentus*) in Guyana. African Journal of Agricultural research, 2010, 5(14).
4. Bhushan A, Bhat KL, Sharma JP. Effect of *Azotobactor* and inorganic fertilizers on fruit and seed yield of okra cv. Hisar Unnat. Agricultural science digest-A research journal. 2013;33(2):135-138.
5. Khan AR, Sarkar S, Nanda P, Chandar D. Organic Manuring through *Gliricidia maculata* for Rice Production. International Centre for Theoreti-cal Physics (UNESCO and IAEA), Trieste, Italy Int. Rep. IC/IR/2001. 2001;10:1-4.
6. Kramer AW, Doane TA, Horwath WR, Kessel CV. Combining Fertilizer and Inorganic Inputs to Synchronize N Supply in Alternative Cropping Systems in California. Agriculture, Ecosystems & Environment. 2002;91:233-243.
7. Liu JR, Zhang DY, Zhou W. The Effect of Mixed Application of Organic and Inorganic Fertilizers to Paddy Soil (The Third Report). Acta Agriculturae Universitis Jiangxiensis. 1990;12:37-42.
8. Mal B, Mahapatra P, Mohanty S, Mishra N. Growth and yield parameters of okra (*Abelmoschus esculentus*) influenced by Diazotrophs and chemical fertilizers. J Crop and Weed. 2013;9(2):109-112.
9. Miglani A, Gandhi N, Singh N, Kaur J. Influence of different organic manures on growth and yield of okra. International Journal of Advance Research in Science and Engineering. 2017;6(1):886-892.
10. Myint AK, Thao HTB, Sarr PS. Effects of organic manure application on growth, grain yield, and nitrogen, phosphorous, and potassium recoveries of rice variety Manawthuka in paddy soils of differing fertility. Communications in soil science and plant analysis, 2010, 42(4).
11. National Horticulture Board. Ministry of Agriculture and Farmers management, New Delhi, India, 2019.
12. Subba Rao NS. Current developments in biological nitrogen fixation. Published by Lond, Balttimore, Md., USA: E. Armold, 1974.