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Response of Organic and Natural Farming Management Practices on Productivity and Profitability of Okra [*Abelmoschus esculentus* (L.) Moench]

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The effects of different nutrition *viz.,* organic, natural and their combinations were studied in okra for productivity and profitability analysis. Field experiments were conducted at Research Farm of the School of Organic Farming, Punjab Agricultural University, Ludhiana for three years from 2019-2021. The experiment was comprised of different nutritional treatments *viz.,* T_1- 100% recommended N (nitrogen) from Farm yard manure (FYM), T_2- natural farming (NF) practices, T_3- 100% N from FYM + NF practices, T_4-75% N from FYM + 25% N from vermicompost and T_5- unfertilized control in main plots involving two sub-plots with paddy straw mulching (S_2) and without mulching (S_1) treatment following split plot design with three replications. Results revealed that maximum average plant height (81.23 cm), pod length (11.23 cm), no of branches per plant (8.43) and yield (96.04 q/ha) were recorded in T_3 treatment involving combination of organic and natural farming practices whereas the minimum values were observed in T_5 (unfertilized control) treatment. Results also showed that in subplots maximum average plant height (71.21 cm), pod length

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(10.87cm), no of branches per plant (7.66), TSS (6.50°Brix) and yield were recorded in S_2 treatment (paddy straw mulching) than S_1 treatment (without mulching). Overall, on the basis of economic perspective highest benefit cost ratio were obtained with FYM in main nutrition plots and with paddy straw mulch in sub plots.

Keywords: Abelmoschus esculentus (L.) Moench; natural farming; okra; organic farming; organic manures; and sustainability.

1. INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench], generally a summer and rainy season vegetable crop grown widely in tropical and subtropical regions of the world, belongs to *Malvaceae* family (Abdelhamied *et al.,* 2024; Fogawat *et al.,* 2024). It has nutritious pods containing vitamins (A and C), minerals, calories and amino acids found in seeds (Masih *et al.,* 2025). It is high in iodine and also contains carbohydrate, protein etc. (Elkhalifa *et al.,* 2021; Singh *et al.,* 2014). Mucilage content present in okra fruits is due to polysaccharides which bind cholesterol and bile acid (galacturonic and glucuronic acids) (Gemede *et al.,* 2015). From ages it has been utilized as medicine such as a diuretic, gastro protective and anti-ulcerogenic in many countries (Kumar *et al.,* 2021).As of 2022 all over the world India ranks first in the production of okra with 6.87 million tonnes accounting 61.19 per cent of the total production (FAOSTAT 2023). In India among different states Uttar Pradesh is the major okra producing state. Nowadays vegetable growers mostly depends upon the use of inorganic fertilizers, herbicides, fungicides, pesticides and growth regulators for enhancing crop productivity; imbalance use of these agrochemicals has led to several ill effects on soil and surrounding environment. On the other hand these agrochemicals are very costly and uneconomical for poor farmers. Therefore, researchers are trying to find out the alternate economical and eco-friendly approaches to improve crop productivity through organic, natural farming, and their integration to reduce the ill effects of modern agricultural practices. Organic manures play a vital role in improving various aspects of soil health (Dotaniya *et al.,* 2020). The organic inputs enhance soil physical properties (Khandagle *et al.,* 2019a), chemical properties (Khandagle *et al.,* 2019b), and biological properties (Yashona *et al.,* 2018). Further, the regular application of organic manures helps increase soil organic carbon content (Aher *et al.,* 2019). The enhanced organic carbon acts as a habitat for variety of microbes and enhances the spore life of the beneficial microbes in adverse conditions which is crucial for long-term soil fertility and climate resilience (Argal *et al.,* 2015). The release of nutrients from the mineralization of added organics enhances yield and nutrient uptake of the crops (Mandale *et al.,* 2019). Farm yard manure (FYM) is one of the option it has nitrogen, phosphorus and potassium and its application in the soil increases the availability of phosphorus and other nutrients (exchangeable K, Ca and Mg content) (Magdoff 1998). Apart from providing nutrients to the crops FYM has beneficial effects on soil properties such as improving moisture retention capacity, water infiltration rate and the hydraulic conductivity of soil (Bhuma 2001). Although natural and organic source of nutrition contain plant nutrients in very minute quantities than inorganic fertilizers but in return improve the acidic condition of soils and provide adequate amount of nutrients for the long term soil productivity (Prakash *et al.,* 2002; Akande *et al.,* 2010). For the sustainability of agriculture application of organic manures to meet the nutrition requirement of crop would be an inevitable practice in the coming years. In agriculture sustainability refers to the capacity of soil to remain fertile for long while maintaining the productivity and biodiversity of the crops. Organic and natural farming generally promotes the health of soils, living organisms and overall ecosystem leading to maintaining agriculture sustainability. It mainly based on biological processes, biodiversity, and cycles that are tailored to local conditions. These management strategies help to bring together tradition, creativity, and science to encourage fair relationships, and improve everyone's quality of life. However, organic and natural farming inputs contain nutrients in different composition and quality therefore may react differently when applied to the soil with respect to soil properties, crop yield and quality. This aspects need to be investigated especially in Punjab where such data on the effects of different organic and natural farming practices are lacking. Okra yield responses to organic manures have been reported by several workers (Adekiya *et al.,* 2018; Adekiya *et al.,* 2019; Agbede & Adekiya

2012; Khandaker *et al.,* 2017; Tiamiyu *et al.,* 2012). Considering the potential benefits of organic and natural farming system and its environmental sustainability, the present study was conducted with the objective to evaluate the economic perspective and productivity of okra crop under Punjab conditions.

2. MATERIALS AND METHODS

2.1 Site Description and Meteorological Observations

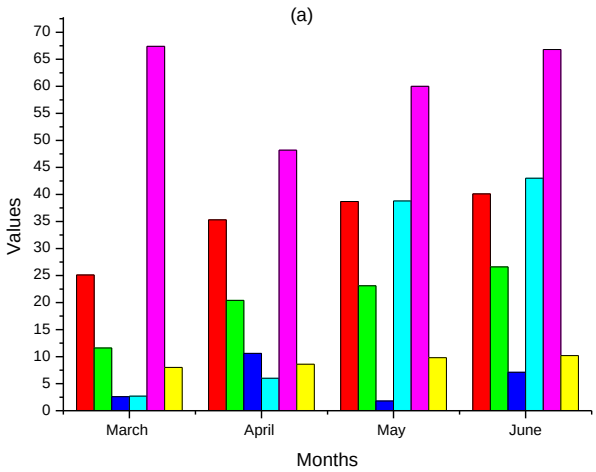
Field experiments were conducted at Research Farm of School of Organic Farming, Punjab Agricultural University, Ludhiana situated at 30◦54′N, 75◦48′E and an altitude of 247 m above mean sea level during 2019, 2020 and 2021 to investigate the effect of organic and natural farming crop management conditions on okra productivity and profitability. During the okra cropping season the crop received 5.5, 28.3 and 49.4 mm rainfall during 2019, 2020 and 2021 respectively. The mean monthly maximum and minimum temperature ranged between 34.8°C, 32.9°C & 34.1°C and 20.4°C, 19.7°C & 20.2°C during 2019, 2020 and 2021 respectively (Fig. 1).

2.2 Experimental Details

The experiments were conducted in a Split plot design replicated thrice, in the newly started organic and natural farming trial. There were five nutrition treatments in main plots and two sub plot treatments with paddy straw mulch and without mulch. The main treatments consisted of farmyard manure (FYM) to supply recommended nitrogen to the crop @ 9 tonnes per hectare, natural farming practices include 250 Kg FYM/ha + on-farm concoctions prepared from dung and urine of cow (*beejamrit, ghanjeevamrit* and *jeevamrit*) + on-farm botanicals for pest management, combination of FYM and NF practices and combination of FYM and vermicompost along with paddy straw mulch @ 90 quintal/ha and without mulch. Organic farming inputs were applied one week before sowing of the okra crop. Seeds of okra variety Punjab Suhawani were sown in March month of 2019, 2020 and 2021 at a seeding rate 25 Kg/ha and a spacing of 45 × 15 cm from row × row and plant × plant respectively. Irrigation was done as per the requirement. During the entire three years crop was cultivated as per the organic agricultural practices with no use of agrochemicals (herbicides, fungicides, pesticides) and with manual weeding three times in without mulching plots (Anonymous, 2025). The crop was not infested by any major insect-pests and diseases during three years. Bird perches were also installed in field to reduce the damage from insect-pests. However, as per the need neem based pesticides and *Trichoderma sp.* (bio-fungicide) were used as a prophylactic measure against insect-pests and diseases, respectively. Fresh pods of okra were harvested as twelve pickings at three to four days intervals. Data on growth parameters like plant height, number of branches, pod length and fresh pod yield (tender young pods) were recorded.

2.3 Statistical Analysis

The mean data were subjected to statistically using the *F*-test, as per the procedure given by Gomez and Gomez (1984). The significant difference between treatments pooled means were compared with the least significance at 5% level of probability. Profitability analysis were



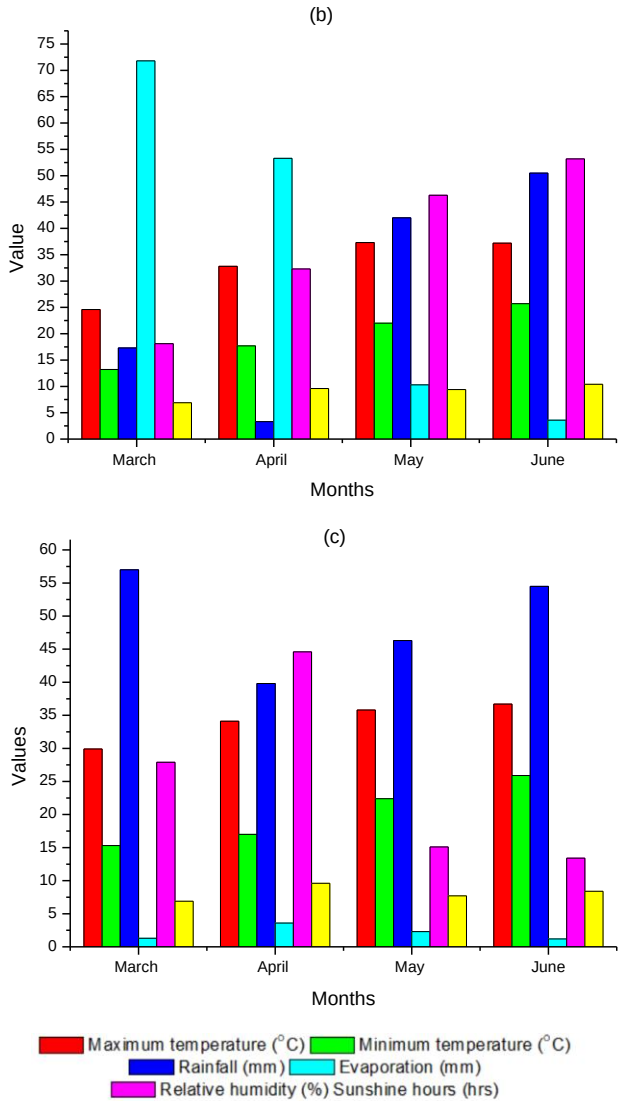


Fig. 1. Meteorological parameters for the year (a) 2019 (b) 2020 (c) 2021

also done by calculating crop cost of cultivation and benefit cost ratio was worked out with 25 and 50 per cent price premium taking into consideration the cost of cultivation and net return.

3. RESULTS AND DISCUSSION

The pooled data analysis of three years (2019-21) inferred that among nutrition treatments maximum average plant height (81.23 cm) was recorded where basal dose of FYM to supply recommended N was supplemented with natural farming practices (T_3) however it was statistically at par with treatments FYM (75%) + vermicompost (25%) (T_4) and FYM (T_1) (Table 1). It has been observed by researchers that organic manures release nitrogen at slow rate and only 25 to 50 per cent released during first year (Gopalakrishnan 2007). Further efficiency of organic manures such as FYM is better due to the fact that it contains all the micronutrients *viz.,* copper (Cu), zinc (Zn), magnesium (Mg), Manganese (Mn) and Iron (Fe) and all these micronutrients are involved in various metabolic pathways of the plants. For example Cu and Mn act as important coenzymes for certain respiratory pathways. For the biochemical synthesis of Indole Acetic Acid (IAA) Zn is involved for the conversion of tryptophan to IAA and Fe is associated with chlorophyll synthesis pathway. Magnesium is entangled in chlorophyll synthesis which in response to increases the photosynthesis rate. So the application of organic manures increase the concentration of auxin supply with higher levels of nitrogen brought about increase in the plant height (Anburani & Manivannan 2002). Similar findings were also

reported by Sachan *et al.,* (2017). For pod length (cm) among the different treatments in main plots T_3 (FYM + Natural Farming) recorded maximum pod length of 11.23 cm, followed by, T_4 (FYM (75%) + vermicompost (25%)) with 11.04 cm, whereas minimum pod length of 9.51 cm recorded in T_5 (unfertilized control). The higher fruit length in these treatments might be due to accelerated mobility of photosynthetic from the source to the sink as influenced by the growth hormone, released or synthesized due to the organic sources of nutrition (Susan, 1995). Among the other growth and quality parameters such as no of branches per plant and TSS similar results have been reported. The maximum fresh pod yield (96.04 q/ha) was recorded in T_3 (FYM + NF) treatment which was statistically at par with T_4 {FYM (75 per cent) + vermicompost (25 per cent)} and T_1(FYM sole) treatment. But significantly higher than NF alone and unfertilized control treatments. The reason for increased fruit yield could be due to solubilisation of plant nutrients by the application of FYM, leading to increased uptake of nitrogen, phosphorus & potassium and also contain appreciable quantities of magnesium, which might have helped in chlorophyll synthesis which in turn increased the rate of photosynthesis leads to increase in fresh pod yield (Nehra *et al.,* 2001 & Sanwal *et al.,* 2007). Further application of FYM would have helped the soil to improve the nutrients status, water holding capacity by improving physical and biological properties of soil (Subbarao *et al.,* 2001). The results obtained were in agreement with the findings of Premsekhar & Rajashree (2009) in okra in which they reported that higher yield response of crops due to organic manure application could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants. Further liquid organic manure such as *Jeevamrit* used in T_3 treatment (FYM +NF) generally contain many beneficial microorganisms, namely nitrogen fixers, phosphorus solubilizers, actinomycetes, lactic acid bacteria, phototrophic bacteria and yeasts these microorganisms in returns increase the microbial diversity of the soil ecosystem and significantly improved crop growth and yield of different crops (Ghasemzadeh *et al.,* 2011; Zoraida *et al.,* 2012; Gore & Sreenivasa 2011). Further various studies have reported that natural farming inputs such as *beejamrit* and *jeevamrit* helps in reducing soil-borne pathogens, increased availability of nutrients to the plants, decomposition rate of organic waste due to beneficial effects of effective microorganisms (Van Bruggen *et al.,* 2016). In sub plot treatments mulching with paddy straw (S_2) gave significantly higher plant height (71.21 cm), pod length (10.87), no of branches per plant (7.66), TSS (6.50°Brix) and yield (81.95) as compared to without mulch (S_2) treatment (Table 1). Paddy straw mulch generally manage weed infestation by reducing crop competition also prevent runoff in the soil and decrease the water evaporation. Therefore as a result soil moisture retention capacity improved which further control temperature fluctuations, and improved various properties of soil (Kumar *et al.,* 1990). It has been observed that availability of potassium, phosphorus and organic carbon increased with the application of organic mulches (Kar & Kumar 2007). Gupta & Gupta (1987) found that application of paddy straw mulch @ 60 quintal per hectare improved the okra yield (200 per cent) over the control. In Tomato Gandhi & Bains (2006) observed that with the application of paddy straw mulch there was more number of branches, fruit weight and total fruit yield than no mulch treatment. Jelde & Berhanu (2020) investigated that when FYM + paddy straw mulch incorporated into the soil productivity of maize enhanced.

3.1 Profitability Analysis

In this study profitability analysis of okra crop grown under organic and natural farming conditions were studied with 25 and 50 per cent price premium because with the increasing demand for organic produce new opportunities for export have been created in developing countries like India. So in this study cost of cultivation was calculated for all the treatments in all the three years and found that higher cost of cultivation was recorded in FYM + VC (86247 ₹/ha) treatment and lowest in unfertilized control treatment (45669 ₹/ha) (Table 2). This might be due to higher cost involved with vermicompost preparation/purchasing. The highest gross income of 180069 ₹/ha and 216083 ₹/ha was observed in FYM + Natural farming treatment followed by net income of 103167 ₹/ha and 139181 ₹/ha high with 25 and 50 per cent premium respectively. But higher B: C ratio (*i.e.,* 1.44 and 1.93) was obtained with treatment FYM with 25 and 50 per cent price premium, respectively due to higher cost involved in preparation and field application of natural farming inputs *viz., beejamrit*, *ghanjeevamrit*, *jeevamrit* and on farm concoctions for insect pest management in OF + NF (T_3) treatment. In sub plots treatments highest gross income

Table 1. Yield and yield attributes of okra as influenced by different nutrient management conditions (Mean of three years)

Treatments	Plant height(cm)	Pod length(cm)	No of branches /plant	TSS(°Brix)	Yield(q/ha)
Main Plots (Nutrient management)					
T_1: FYM to supply recommended nitrogen	78.85	10.56	7.85	6.96	90.60
T_2: Natural Farming (NF)*	58.75	10.40	5.67	5.60	47.53
T_3: FYM + NF	81.23	11.23	8.43	6.71	96.04
T_4: FYM (75%) + vermicompost (25%)	80.25	11.04	7.78	5.92	93.38
T_5: Unfertilized Control	57.25	9.51	4.80	5.69	44.90
CD (p=0.05)	2.48	NS	1.08	0.42	15.32
Sub Plots					
S_1:Without Mulch	65.53	10.36	6.47	6.20	69.54
S_2:Paddy Straw Mulch	71.21	10.87	7.66	6.50	81.95
CD (p=0.05)	1.87	NS	0.60	NS	8.18

Table 2. Economics of okra as influenced by different nutrient management conditions (Mean of three years)

Treatments	Pod yield (q/ha)	COC* (₹/ha)	Gross returns (₹/ha)		Net returns (₹/ha)		B:C ratio	
			With 25% premium	With 50% premium	With 25% premium	With 50% premium	With 25% premium	With 50% premium
Main Plots (Nutrient management)								
T_1: FYM to supply recommended N	90.60	69649	169875	203850	100226	134201	1.44	1.93
T_2: NF*	47.53	52644	89113	106935	36469	54291	0.69	1.03
T_3: FYM + NF*	96.04	76902	180069	216083	103167	139181	1.34	1.81
T_4: FYM (75%) + VC (25%)	93.38	86247	175081	210098	88834	123851	1.03	1.44
T_5: Unfertilized Control	44.90	45669	84188	101025	38519	55356	0.84	1.21
Sub Plots								
S_1:Without Mulch	69.54	61915	130388	156465	68473	94550	1.11	1.53
S_2:Paddy Straw Mulch	81.95	60121	153663	184395	93542	124274	1.56	2.07

Natural Farming (NF): Seed treatment with bijamrit + basal application of ghanjeevamrit @ 250 kg/ha + FYM @ 250 kg/ha + jeevamrit + mulching + pesticides/fungicides prepared from locally available organic material; Normal price of Okra: ₹ 1500/qtl, Price of FYM: ₹: 1000/tonnes on dry weight basis, VC: Vermicompost, COC: Cost of cultivation*.

(153663 ₹/ha, 184395 ₹/ha), net returns (93542 ₹/ha, 124274 ₹/ha) and benefit cost ratio (1.56, 2.07) was highest in S_2(Paddy Straw Mulch) treatment with 25 and 50 per cent price premium respectively than S_1 treatment. Overall, on the basis of profitability analysis highest benefit cost ratio were obtained with FYM in main nutrition plots and with paddy straw mulch in sub plots (Table 2). Russo & Taylor, 2006 investigated that cost of production of organically raised crops could be mitigated if a price premium is available.

4. CONCLUSION

The results obtained revealed that in the nutrition treatments okra responded well to the application of FYM @ 9 tonnes per hectare + Natural farming practices which include application of FYM @ 250 Kg/ha + on-farm concoctions *viz., beejamrit*, *ghanjeevamrit*, *jeevamrit* prepared from dung and urine of cow + on-farm botanicals for pest management compared to the Natural farming alone and unfertilized control treatment in the study and in sub plots paddy straw mulch application @ 90 quintals per hectare has shown significant results than without mulch treatment. On the basis of benefit cost ratio highest benefit cost ratio were obtained with FYM in main nutrition plots and with paddy straw mulch in sub plots. So the farmers interested in organic and natural farming practices can follow these practices for successful cultivation of crop under organic and natural farming conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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