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Influence of organic, natural farming and recommended package of practices on growth, yield and economics of okra

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Abstract
A field experiment was conducted to study the effect of different cultivation practices (Natural farming, organic farming, package of practice and farmers practice) on growth and yield of okra (Halu Bhendi) during 2019-20 at Zonal Agricultural and Horticultural Research Station, Brahmavar. Results of field experiment revealed that significantly higher plant height was recorded in package of practice during all the growth stages. Among the treatments, the maximum number of fruits per plant (24.56) and fruit yield per plant (1.66 kg) were recorded in package of practice. While, the minimum number of fruits per plant (17.12) and fruit yield per plant (0.90 kg) were observed in farmers practice treatment. The maximum yield (14.38 t ha^{-1}) was obtained under package of practice treatment followed by organic farming treatment (11.53 t ha^{-1}). The highest benefit: cost ratio of 2.83 was obtained in natural farming treatment. While, the lowest (1.26) was found in organic farming treatment.

Keywords: okra, cultivation, growth and fruit yield

Introduction
Okra (*Abelmoschus esculentus* (L). Moench) belongs to the family Malvaceae. It is an economically important vegetable crop grown in tropical and sub-tropical parts of the world. It is well distributed throughout the Indian sub-continent and East Asia (Talukder *et al*., 2016) [11]. Okra is native of tropical Africa and is widely cultivated in India. Uttar Pradesh, Assam, Bihar, Orissa, Maharashtra, West Bengal and Karnataka are important okra growing states. This crop has a prominent position among vegetable fruits due to its higher nutritive and medicinal value, ease of cultivation and wider adaptability to varying climatic conditions (Reddy *et al*., 2012) [7]. Okra is a good source of vitamin A, B, C and is also rich in proteins, carbohydrates, fats, minerals, iron and iodine. The okra variety white velvet (*Abelmoschus esculentus* v. white velvet) was introduced to the public in 1890 by Peter Henderson & Company of New York. White Velvet okra are long, white and velvety, widely popular due to its tender fruit lacking spines. It is a very popular local variety in coastal Karnataka.

Vegetable crops show good response to nutrient supply through organic manures and chemical fertilizers (Kale *et al*., 1991) [2]. It is well accepted that growth, yield and quality of plants are highly influenced by wide range of nutrient availability in the soil. Okra requires balanced and adequate supply of nutrients for higher yield and better quality because it produces fruits for longer time. Nitrogen and phosphorous plays an important role in fruit, seed and quality development of okra (Nihort, 1985) [4]. Potassium is one the important nutrients for plant growth and plays an important role in physiological and biochemical functions in plants. These nutrients are specific in function and must be supplied to plants at the right time and at the right quantity. Lack of sufficient amounts of these nutrients adversely affect the growth and yield of okra.

With the increase in population, demand of the crop is significantly increasing, which emphasises the use of chemical fertilizers. As a result, growers indiscriminately use chemical fertilizers, which pose serious threat to the environment, health of the soil and people throughout the world. Green Revolution brought with its excessive use of fertilizers an imbalance in soil health (Patra *et al*., 2016) [5] by destroying useful soil microflora. Therefore, in order to reduce costs and adopt more ecofriendly practices, research on alternative growth substrates is of great interest. To overcome the challenges of loss in soil fertility and health innovative methods like natural farming, organic farming *etc*., are practiced by some farmers as an alternative to conventional agriculture.

Natural farming is a farming practice advocating the natural growth of crops without adding fertilizers and pesticides or any other foreign elements. Natural farming conserves biodiversity and nurtures the balance. It not only decreases soil erosion but also makes the soil breathe again. It enriches the soil with nutrients. Organic farming is a method of farming adopted from ancient times which is mainly aimed at cultivating the field and growing crops in such a way as to retain the soil alive, fertile and healthy by the use of organic wastes (crop, animal and farm wastes) and other biological substances along with valuable microbes (bio fertilizers) to release macro and micro nutrients to plants for enhanced sustainable production in an eco-neighbourly, pollution free nature.

Due to meagre documented work conducted to investigate the influence of different cultivation practices on the performance of okra this study was undertaken to compare the performance of okra under different cultivation practices in Brahmavar (Zone-10), Udupi of Karnataka.

Material and Methods

The field experiment with okra (Halu bhendi) was conducted at seed farm, Zonal Agricultural and Horticultural Research Station, Brahmavar during summer, 2019. The soil of the experimental site is sandy loam in texture and acidic in reaction. The experiment was laid out in randomized complete block design (RCBD) with four treatments and five replications. Treatments involved were T_1: Natural farming (ZBNF), T_2: Organic farming (OF), T_3: Package of practice (POP), T_4: Farmers practice (FP). The field was thoroughly prepared and experimental plots of 7.2 m x 6.3 m size were made. Irrigation channels and bunds were prepared according to layout. Seeds were sown at a spacing of 120 × 90 cm. All the treatment details are presented in Table 1.

Table 1: Treatment details of the experiment

T_1: Natural farming
1. Application of Ghanajeevamruta @ 1000 kg per ha
2. Seed treatment with Beejamruta @ 50 litres per ha
3. Application of Jeevamruta @ 500 litres per ha at an interval of 15 days (6 times)
4. Mulching
5. Application of Neemastra @ 500 litres per ha against sucking pests and diseases (2 times)
T_2: Organic farming
1. Application of FYM @ 25 tonnes per ha before sowing
2. Application of vermicomposts @13 tonnes per ha
3. Application of cow urine @ 2500 litres per ha
4. Seed treatment with *Azotobacter* and PSB @ 200 g each per kg seeds
5. Application of neem oil @ 3 ml per litre against sucking pests (2 times)
T_3: Package of practice
1. Application of FYM @ 25 tonnes per ha before sowing
2. Application of 125:75:63 kg NPK per ha
3. Application of Dimethoate 30 EC @ 1.7 ml per litre against sucking pests (2 times)
T_4: Farmers practice
1. Application of FYM @ 12.5 tonnes per ha before sowing
2. Application of 17:17:17 @ 150 kg per ha at the time of planting
3. Application of Dimethoate 30 EC @ 1.7 ml per litre against sucking pests (1time)

Results and Discussion

Table 2: Influence of different cultivation practices on plant height in okra at different growth stages

Treatments	Plant height (cm)			
	30 DAP*	60 DAP	90 DAP	120 DAP
T_1- Natural Farming (ZBNF)	17.84	49.72	79.40	86.84
T_2- Organic Farming (OF)	18.00	55.68	85.84	101.60
T_3-Package of Practice (POP)	20.02	59.36	97.60	113.96
T_4- Farmer's practice (FP)	18.96	47.72	70.56	79.08
S.Em±	0.72	2.59	3.51	4.16
CD @ 5%	NS	7.98	10.82	12.82

Note: NS: Non Significant *DAP: Days after planting

The effect of different cultivation practices on plant height in okra was found significant at different stages of plant growth except at 30 days after planting. Among the different treatments, significantly higher plant height was recorded in package of practice (59.36 cm) and the lowest was observed in farmers practice treatment (47.72 cm) at 60 days after planting (Table 2.). Similar trend was noticed even at 90 and 120 days after planting. This may be due to the application of optimum quantity of nitrogen which enhanced the cell division and formation of more tissues resulting in luxuriant vegetative growth and thereby increased plant height. Majanbu *et al*. (1985) [3] observed that in okra, plant height was enhanced by the application of N fertilizers. Potassium (K) is an essential plant nutrient that plays an important role in plant growth and development. Singh *et al*. (1998) [10] reported that application of K increased the plant height of okra and stated that it plays an important role in promoting vegetative growth by enhancing cell division and cell elongation in okra. Phosphorous is known to play an important role in photosynthesis. It is a constituent of nucleo-protein which is responsible for growth, thus emphasizing the fact that phosphorus promotes the growth.

Table 3: Influence of different cultivation practices on yield and yield parameters in okra

Treatments	Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	Number of fruits/plant	Fruit yield/plant (kg)	Fruit yield/ha (t)
T_1- Natural Farming	23.56	7.32	54.87	18.92	1.04	9.20
T_2- Organic Farming	24.68	7.60	56.71	21.96	1.22	11.53
T_3-Package of Practice	26.88	8.52	67.15	24.56	1.66	14.38
T_4- Farmer's practice	21.48	7.08	51.68	17.12	0.90	8.58
S.Em±	1.00	0.32	2.35	1.45	0.10	0.88
CD @ 5%	3.08	0.99	7.24	4.46	0.29	2.72

In okra, the yield and yield parameters varied significantly between different cultivation practices. Among the treatments, the maximum fruit length (26.88 cm), fruit girth (8.52 cm), average fruit weight (67.15 g) and number of fruits per plant (24.56) were recorded in package of practice (Table 3.). This may be due to adequate supply of nitrogen, phosphorus and potassium at recommended dose that led to formation of soil solution rich in almost all ions required to the plants. The availability of nutrients at critical stages of crop growth resulted in early establishment, vigorous growth and proper development of plants leading to longer and wider fruits. The increase in fruit weight may be due to transportation of photo assimilates from source to sink organs. Similar results were also reported by Singh *et al*., (2010) [9]. Phosphorus fertilization can influence fruit development of okra. Phosphorus helps in uptake of nutrients by promoting root growth and thereby ensuring higher pod yield through the increase in total dry matter (Shama and Yadev, 1976) [8]. This indicates the significance of NPK fertilizer inputs as plant nutrient sources.

The higher fruit yield per plant (1.66 kg) and per hectare (14.38 t) was obtained in the package of practice treatment, whereas the lower fruit yield per plant (0.90 kg) and per hectare (8.58 t) was noticed in farmers practice treatment. This might be due to increased number of fruits per plant and fruit weight in package of practice treatment which results in higher fruit yield per plant. The increase in yield of okra due to combined effect of NPK fertilizers in the present investigation are in line with the findings of Ahmed and Tullock-Reid (1986) [1] and Philip *et al*. (2010) [6].

Table 4: Influence of different cultivation practices on economics in okra cultivation

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross Returns (Rs. ha^{-1})	Net Returns (Rs. ha^{-1})	B:C ratio
T_1- Natural Farming (ZBNF)	91,170.50	2,57,600.00	1,66,429.500	2.83
T_2- Organic Farming (OF)	2,55,705.00	3,22,840.00	67,135.000	1.26
T_3-Package of Practice (POP)	1,58,960.00	4,02,640.00	2,43,680.000	2.53
T_4- Farmer's practice (FP)	1,11,640.00	2,40,240.00	1,28,600.000	2.15

The higher cost of cultivation of Rs. 2,55,705.00 per hectare was noticed in organic farming treatment followed by Rs. 1,58,960.00 per hectare in package of practice treatment as compared to Rs. 91,170.50 per hectare in natural farming treatment (Table 4.). The highest benefit: cost ratio of 2.83 was obtained in natural farming treatment. While, the lowest (1.26) was found in organic farming treatment.

Conclusion

On the basis of the results emanated from present investigation, it can be concluded that package of practice treatment was found to be the best in terms of growth, yield and net profit of okra, followed by organic farming treatment as compared to farmers practice treatment.

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