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EVALUATION OF FARMING SYSTEMS ON ORGANOLEPTIC QUALITIES, SOIL HEALTH AND ECONOMIC VIABILITY IN PAPAYA (*CARICA PAPAYA* L.) CV. GJP 1

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ABSTRACT

An investigation was carried out at Fruit Research Station, Madhadibaug, Junagadh Agricultural University, Junagadh, during the years 2022-23 and 2023-24. The experiment was laid out in large plot technique having three treatments of different farming systems *viz*., low-cost natural farming, organic farming and conventional farming. Result reveled that the maximum appearance (7.97, 8.15 and 8.06), taste (7.93, 8.18 and 8.06), flavor (8.25, 8.42 and 8.33), color (8.05, 8.22 and 8.13) score, highest level of available nitrogen (231.76, 251.71 and 241.74 kg/ha), phosphorus (29.11, 34.96 and 32.04 kg/ha) and potassium (238.12, 254.53 and 246.32 kg/ha) in soil were recorded in conventional farming while, highest organic carbon (0.65, 0.77 and 0.71 %) in soil was observed in organic farming during both the years as well as in pooled, respectively. Other soil parameters like bulk density (Mg/m^3), porosity (%) and water holding capacity (%) recorded non-significant in all farming systems during the year 2022-23, 2023-24 as well as in pooled analysis. Conventional farming gave the highest net return (Rs. 563252/ha) and BCR (2.30), while the lowest values were noted in organic farming.

Key words : Conventional farming, Low-cost natural farming, Organic farming.

Introduction

Papaya (*Carica papaya* L.) is a highly important fruit crop in tropical and subtropical regions around the globe. Often called a “wonder fruit” of these climates, papaya was introduced to India by Dutch traders in the 16th century. It belongs to the dicotyledonous family Caricaceae and has a chromosome number of 2n=18. Papaya trees produce fruit year-round, require little space, begin fruiting within a year, are easy to grow and generate significant income per hectare, second only to bananas. In India, papaya flourishes in the southern peninsular states of Tamil Nadu, Karnataka, Kerala, Andhra Pradesh and is also successfully cultivated in the subtropical states of Maharashtra, Gujarat, Madhya Pradesh, Uttar Pradesh, Bihar and West Bengal. In Gujarat, key districts for papaya farming include Tapi, Kutch, Anand, Baroda, Bhavnagar, Kheda, Junagadh and Mahesana. In India total area under papaya cultivation is around 1.50 lakh hectares, yielding a total annual production of 53.41 lakh MT with a productivity of 37.94 MT/ha (Anonymous, 2021). Gujarat is the top papaya producer in India, followed by Andhra Pradesh. In Gujarat, papaya is grown on approximately 18,288 hectares, producing 10.67 lakh MT with a productivity of 58.38 MT/ha (Anonymous, 2021).

Papaya is well known for its rich nutritional and medicinal properties. Often enjoyed as a breakfast or dessert fruit, papaya is also widely used in fruit salads, beverages, jams, jellies, marmalades, candies and crystallized fruits. The proteolytic enzyme papain, found in papaya latex, has a variety of important applications. Raw papaya fruits can be a source of pectin, which is used in the food industry as a flavoring agent and as an emulsifier in beer production (Panda, 2017). Moreover, papain is used in pharmaceutical formulations to treat conditions like intestinal cancer, tapeworm and roundworm infestations and kidney disorders. Studies show that papain possesses anti-inflammatory properties

(Owoyele *et al.*, 2008), promotes wound healing (Gurung and Skalko, 2009), demonstrates antitumor and immunomodulatory effects (Otsuki *et al.*, 2010) and acts as an antioxidant (Imaga *et al.*, 2010). Additionally, papain is utilized in the manufacturing of chewing gum, cosmetics, paper, adhesives and in extracting oil from tuna fish liver. Papaya is second only to mango as a source of vitamin A precursor. The fruit is rich in vitamins, particularly A, C and E and is also a good source of minerals such as calcium, phosphorus and iron.

Organic farming utilizes natural inputs that improve soil qualities such as water retention, aeration, organic carbon levels, humus content and microbial activity. Papaya is rapidly becoming a valuable crop globally, appreciated both as fresh fruit and in processed forms. Given its high and continuous nutrient requirements, depending solely on large amounts of synthetic fertilizers is not advisable. This practice poses risks to fruit quality, health, the environment and is costly for farmers. Excessive use of chemical fertilizers can harm the environment, negatively affect soil structure, disrupt microflora, degrade water quality and lead to long-term productivity declines. The addition of organic matter can also help mitigate soil compaction, which is often worsened by increased orchard machinery use.

In response to the negative impacts of conventional chemical farming, a new agricultural technique called Low-Cost Natural Farming (LCNF) has been introduced to farmers. LCNF aims to minimize production costs by aligning farming practices with natural processes, eliminating the need for external inputs. It incorporates a variety of farming methods and has developed into a grassroots peasant movement in several Indian states. This approach has gained significant popularity in Southern India, particularly in Karnataka, where it originated (Kumar, 2012). LCNF is a form of natural farming that replaces chemical fertilizers with biological alternatives. Farmers utilize natural inputs such as earthworms, cow dung, urine, plants, human waste and biological fertilizers for crop cultivation. Four key practices central to LCNF include: (1) *Beejamrut*, the coating of seeds with microbial solutions made from cow dung and urine; (2) *Jeevamrut*, a mixture of cow dung, cow urine, jaggery, pulse flour, water and soil to boost soil microbial populations; (3) *Acchadana* (mulching), where the soil is covered with organic materials to reduce water loss and build soil humus; and (4) *Whapasa*, which focuses on enhancing soil aeration and creating a favorable microclimate.

Materials and Methods

The research was carried out on a non-organic fixed plot using a large plot technique to evaluate growth, yield and quality across different farming systems from 2022-23 to 2023-24 at the Fruit Research Station, Madhadibaug,

Table 1 : Modules of various treatments across different farming systems.

Treatments	Module details
Module-I	**Low Cost Natural Farming (LCNF)** • Seed treatment: Soaking of seeds for 24 hours in *Beejamrut* • *Achhadan*: Uprooted weed/crop residue • Intercropping with marigold (60 cm x 60 cm) • *Ghan Jeevamrut* 2 kg/plant + FYM 3 kg/plant at the time of transplanting • Foliar spray of *Jeevamrut* @ 5 and 7 % at 1st and 2nd and 10 % at 3rd and 4th month of transplanting • Foliar spray of buttermilk @ 3 % at the time of fruit set • Foliar spray of coconut water @ 1 % after 15 days of fruit set and 15 days before harvest • Plant protection: *Agniastra*, *Brahmastra* and *Neemastra*, as and when required
Module-II	**Organic Farming (OF)** • Seed treatment: *Trichoderma* @ 20 g/250 g of seeds • *Achhadan*: Organic mulch • FYM @ 20 kg/plant at the time of transplanting • FYM @ 10 kg/plant at 3rd and 5th month after transplanting • Neem cake @ 1.50 kg/plant at 7th month after transplanting • Plant protection: Fruit fly trap, *Trichoderma*, *Beauveria etc.*, as and when required
Module-III	**Conventional Farming (CF)** • Seed treatment: Soaking of seeds for 24 hrs in Carbendazim @ 0.1 % • FYM @ 10 kg/plant at the time of transplanting and N:P:K @ 200:200:250 g/plant (N in four equal splits at the time of transplanting and 1½, 3rd and 4½ months after transplanting; P and K in two equal splits at the time of transplanting and at 3rd month of transplanting) • Plant protection: Fungicides, insecticides and herbicides, as and when required

College of Horticulture, Junagadh Agricultural University, Junagadh. Six plants were randomly selected and tagged from each treatment for observation recording. The data collected from each treatment replication were averaged. The studied characteristics were statistically analyzed using the analysis of variance (ANOVA) technique for a completely randomized design (CRD), as outlined by Panse and Sukhatme (1985). The details of the different farming modules are provided in Table 1.

Preparation of Bio-Enhancers

The following methods were used to prepare *Beejamrut*, *Jeevamrut* and *Ghan Jeevamrut* at Fruit Research Station, Madhadibaug, Department of Fruit Science, College of Horticulture, JAU, Junagadh. Till date, there is not standard evolution of major component for the ingredients.

Beejamrut

Beejamrut, an organic preparation, was applied to seeds before sowing to enhance germination and protect young roots from fungal infections, as well as soil-borne and seed-borne diseases. The ingredients include local cow dung, a strong natural fungicide, and cow urine, an effective antibacterial agent, along with lime, water and soil.

Jeevamrut

In the plant system, *Jeevamrut*, an organic product, enhances growth and boosts plant immunity. It is composed of four key ingredients: cow dung, cow urine, chickpea flour and jaggery. When these components are properly mixed and applied, they produce remarkable effects.

Ghan Jeevamrut

Ghan Jeevamrut is a dry or solid form of *Jeevamrut* that serves as a natural fertilizer for crops. It is made from desi cow dung, cow urine, jaggery and pulse flour.

Neemastra

One of the natural insecticides or pesticides targets caterpillars and sucking pests. To prepare it, you need water, cow urine, cow dung and neem leaves and stems.

Results and Discussion

The organoleptic parameters *viz*., appearance, taste, flavor and color was significantly affected by the different farming systems in papaya.

The maximum appearance score (7.97, 8.15 and 8.06) was recorded in conventional farming followed by organic farming (7.30, 7.55 and 7.43) during the year 2022-23, 2023-24 as well as in pooled, respectively. Whereas, the minimum appearance score (6.65, 7.07 and 6.86) was recorded in low cost natural farming during both the years as well as in pooled, respectively. The maximum taste score (7.93, 8.18 and 8.06) was observed in conventional farming which was statistically at par with organic farming (7.75, 7.80 and 7.78) during the year 2022-23, 2023-24 as well as in pooled, respectively. While, the minimum taste score (7.07, 7.37 and 7.22) was observed in low cost natural farming during both the years as well as in pooled, respectively. The maximum flavor score (8.25, 8.42 and 8.33) was found in conventional farming followed by organic farming (7.70, 7.95 and 7.83) during the year 2022-23, 2023-24 as well as in pooled, respectively. Further, minimum flavor score (6.98, 7.10 and 7.04) was found in low cost natural farming during both the years as well as in pooled, respectively. The maximum color score (8.05, 8.22 and 8.13) was noted in conventional farming followed by organic farming (7.38, 7.55 and 7.47) during the year 2022-23, 2023-24 as well as in pooled, respectively. Whereas, the minimum color score (6.68, 7.12 and 6.90) was noted in low cost natural farming during both the years as well as in pooled, respectively (Table 2).

Conventional farming can enhance the organoleptic properties of papaya. It might be due to providing a consistent and optimal supply of nutrients through synthetic fertilizers, which promote uniform growth and vibrant coloration. Controlled irrigation ensures adequate water, leading to plump and visually appealing fruits. This might be due to environmental factor such as light intensity, light quality, temperature, humidity *etc.* (Parmar and Karetha, 2021). Effective pest and disease management minimizes blemishes and damage, contributing to better appearance and taste. These finding were confirmed with Meera *et al.* (2018) in papaya; Parmar and Karetha (2020) in dragon fruit; Rana *et al.* (2020) in guava; Bandhiya *et al.* (2022) in khirni; Kanzaria *et al.* (2022) in mango; Jotava *et al.* (2022) in papaya and Makavana *et al.* (2022) in jamun.

Low cost natural farming and organic farming gave less effect on organoleptic properties of papaya. It might be due to due to the absence of synthetic pesticides and fertilizers. The reliance on organic matter and natural nutrient cycles may result in slower growth and varied shape, size, flavor and color of the fruit.

Soil analysis

The soil parameters *viz.*, organic carbon, available nitrogen, available phosphorus and available potassium significantly affected by the different farming systems in papaya.

The highest organic carbon in soil (0.65, 0.77 and

Table 2 : Effect of low cost natural farming, organic farming and conventional farming on organoleptic qualities of papaya cv. GJP 1.

Treatments	Appearance			Taste			Flavor			Color		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
LCNF	6.65	7.07	6.86	7.07	7.37	7.22	6.98	7.10	7.04	6.68	7.12	6.90
OF	7.30	7.55	7.43	7.75	7.80	7.78	7.70	7.95	7.83	7.38	7.55	7.47
CF	7.97	8.15	8.06	7.93	8.18	8.06	8.25	8.42	8.33	8.05	8.22	8.13
S.Em.±	0.13	0.15	0.12	0.12	0.15	0.11	0.12	0.12	0.10	0.09	0.10	0.08
C.D. at 5%	0.39	0.44	0.35	0.36	0.44	0.34	0.35	0.37	0.31	0.28	0.30	0.24
Y X T												
S.Em.±			0.17			0.16			0.15			0.12
C.D. at 5%			NS			NS			NS			NS
C.V.%	4.31	4.74	5.51	3.82	4.57	5.14	3.74	3.83	4.64	3.04	3.20	3.83

0.71%) was observed in organic farming during the year 2022-23, 2023-24 as well as in pooled, respectively. It was statistically at par with conventional farming (0.61, 0.66 and 0.64%) during the year 2022-23. However, the lowest organic carbon in soil (0.55, 0.58 and 0.57%) was observed in low cost natural farming during both the years as well as in pooled, respectively. The highest level of available nitrogen in soil (231.76, 251.71 and 241.74 kg/ha) was found in conventional farming followed by organic farming (205.78, 210.58 and 208.18 kg/ha) during the year 2022-23, 2023-24 as well as in pooled, respectively. Whereas, the lowest level of available nitrogen in soil (203.57, 207.19 and 205.38 kg/ha) was found in low cost natural farming during both the years as well as in pooled, respectively. The highest level of available phosphorus in soil (29.11, 34.96 and 32.04 kg/ha) was noted in conventional farming followed by organic farming (22.47, 25.26 and 23.87 kg/ha) during the year 2022-23, 2023-24 as well as in pooled, respectively. While, the lowest level of available phosphorus in soil (20.88, 22.66 and 21.77 kg/ha) was noted in low cost natural farming during both the years as well as in pooled, respectively. The highest level of available potassium in soil (238.12, 254.53 and 246.32 kg/ha) was observed in conventional farming followed by organic farming (217.86, 224.03 and 220.94 kg/ha) during the year 2022-23, 2023-24 as well as in pooled, respectively. Moreover, the lowest level of available potassium in soil (213.89, 217.52 and 215.71 kg/ha) was observed in low cost natural farming during both the years as well as in pooled, respectively (Table 3).

Soil fertility in the production systems is controlled by organic amendments, such as FYM, neem cake. Addition of organic manures to an agricultural soil has a variety of effects on enzyme activities, which play an essential role in the nutrient mineralization (Gopinath *et al*., 2008). Higher organic carbon and available nutrients in soil after harvest in the conventional and organic farming might be due to addition of more organic matter and production of carbon dioxide and organic acids released during the process of decomposition of FYM which increase the availability of nutrients from native as well as due to applied fertilizers during crop cycle (Mere *et al*., 2012). Addition to this, increased microbes biomass helps to mineralize the native elements and also fixes atmospheric N by nitrogen fixing bacteria. Similarly, FYM and neem cake are store house of nutrients and hormones for plant growth and development and also improves soil environment by improving physico chemical properties of soil. Poorer results under the natural farming might be due to addition of smaller quantity of supplements. Similar results were also reported by Katkar *et al.* (2011) in sorghum; Arbad *et al.* (2014) in soybean, Bhatt *et al.* (2017) in wheat, Sikka *et al.* (2018) in soybean, Jadhao *et al.* (2019) in sorghum, Kumar *et al.* (2020) in rice and Parsana *et al.* (2023) in custard apple.

Economic Viability of Farming Systems

The maximum gross returns and net returns were obtained under conventional farming over low cost natural farming and organic farming (Table 4). The reason for increased profit is due to maximum marketable yield due to healthy and better growth of plant resulting highest number of fruits per plant and higher net returns as compared to other farming systems. Maximum B:C ratio was found under conventional farming. Lower B:C ratio of the organic module might be due to higher cost of organics as well as comparatively lower yield. These results are in accordance with findings of Chaurasia *et al.* (2009) in sesame; Behera and Rautaray (2010) in wheat; Singh *et al.* (2018) in ground nut; Lyngdoh *et al.*

Table 3 : Effect of low cost natural farming, organic farming and conventional farming on soil parameters of papaya cv. GJP 1.

Treatments	Bulk density (Mg/m³)			Porosity (%)			Water holding capacity (%)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
LCNF 1.46	1.43	1.45	51.83	53.26	52.54	41.82	43.47	42.65	
OF 1.41	1.38	1.40	54.15	58.24	56.20	44.55	45.66	45.10	
CF 1.43	1.40	1.42	52.54	55.33	53.94	42.19	44.83	43.51	
S.Em.±	0.02	0.02	0.01	0.93	1.34	1.00	0.84	0.77	0.70
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
Y X T									
S.Em.±			0.02			1.41			0.99
C.D. at 5%			NS			NS			NS
C.V. %	2.90	2.77	3.48	4.32	5.89	6.29	4.82	4.24	5.58

Cont…

Treatments	Organic carbon (%)			Available N (kg/ha)			Available P_2O_5 (kg/ha)			Available K_2O (kg/ha)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
LCNF	0.55	0.58	0.57	203.57	207.19	205.38	20.88	22.66	21.77	213.89	217.52	215.71
OF	0.65	0.77	0.71	205.78	210.58	208.18	22.47	25.26	23.87	217.86	224.03	220.94
CF	0.61	0.66	0.64	231.76	251.71	241.74	29.11	34.96	32.04	238.12	254.53	246.32
S.Em.±	0.01	0.01	0.01	6.53	7.80	6.23	0.87	1.13	0.88	6.27	7.76	6.11
C.D. at 5%	0.05	0.04	0.04	19.67	23.51	18.37	2.63	3.42	2.58	18.91	23.38	18.02
Y X T												
S.Em.±			0.02			8.18			1.24			8.64
C.D. at 5%			NS			NS			NS			NS
C.V. %	6.05	5.29	6.89	7.48	8.56	9.87	8.84	10.04	11.55	6.88	8.19	9.34

Table 4 : Effect of low cost natural farming, organic farming and conventional farming on economic viability of papaya cv. GJP 1.

S. No.	Treatments	Fruit yield (t/ha)	Fixed cost (Rs./ha)	Variable cost (Rs./ha)	Total cost (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Benefit cost ratio
1	Low cost natural farming	63.9	172990	154895	327885	647657	319772	1.98
2	Organic farming	75.5	172990	290409	463399	754988	291589	1.63
3	Conventional farming	99.5	172990	259022	432012	995264	563252	2.30

Selling price of papaya fruit: Rs. 10/kg

(2019) in soybean and Ram *et al.* (2024) in sesame.

Conclusion

Based on the investigation results, it can be concluded that the conventional farming system outperformed both organic farming and low cost natural farming in cultivating papaya variety GJP 1. This system showed better results in terms of organoleptic qualities, soil health and economic feasibility. Conventional farming achieved higher scores for appearance, taste, flavor and color. Additionally, soil health indicators such as available nitrogen, phosphorus and potassium were more favorable in conventional farming, which also resulted in higher net returns and a better benefit cost ratio.

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