Effect Of Organic Management on Growth, Yield and Economics of Greengram, Pigeon Pea and Sunflower Under Rainfed Conditions

Abstract

Field experiment was conducted during *kharif* season of 2021, to assess the effect of organic management on growth, yield and economics of greengram, pigeon pea and sunflower under rainfed conditions. Experiment was laid out in a randomized complete block design with three treatment combinations *viz.*, Organic (recommended 100 % N equivalent FYM), Integrated (recommended 25 % N equivalent FYM + 75 % N and 100 % P and K through chemical fertilizers) and Control (recommended 100 % NPK through chemical fertilizer) replicated nine times. Based on the results, it was found that the growth, yield attributes and yield were significantly higher with organic treatment.

Key words: Organic, Rainfed, Pigeon pea, Greengram, Sunflower

1. **Introduction**

Oilseeds are India's second most important agricultural product after grains. It accounts for 13% of the gross cropped area and contributes for around 3 % of the gross national product (GNP) and 10 % of all the agricultural commodities (DOD, 2021). Despite being one of the major producers of oilseeds, India, with its large population, is unable to supply the demand for edible oils. India is paying substantial foreign currency to import edible oils to meet domestic demand.

Sunflower (*Helianthus annuus* L.) is a popular oilseed crop in India due to its ability to adapt to a variety of agro-climatic zones and cropping patterns. Sunflower is grown on 2.25 lakh hectares in the country, with a yield of 2.28 lakh tonnes and a productivity of 1011 kg ha^{-1} (Indiastat, 2021). Karnataka is the country's most prolific producer. Telangana covers 7000 hectares, with yearly yield and productivity of 16390 tonnes and 2342 kg ha^{-1}, respectively (Indiastat, 2021).

Pulses are a strong source of protein in the diet and can help satisfy the demands of a rapidly rising population. The output of pulses is exceedingly low, which has become a difficult challenge in light of our country's rapidly rising population. Pulses contains approximately 21-25% protein and it also contains limited amount of essential amino acids such as tryptophan, methionine, lysine and cystine. (Tiwari and Singh, 2012). Pulses contain a significant quantity of lysine. Apart from its nutritional benefit, pulses have the potential to fix atmospheric nitrogen symbiotically in soil through root nodules, which helps them maintain and improve soil fertility.

Greengram (*Vigna radiata* L.) popularly known as mungbean is grown on 51.3 lakh hectares in India, with a total yield of 30.85 lakh tonnes and a productivity of 601 kg ha^{-1} (Indiastat, 2021). The top greengram producing states are Rajasthan, Maharashtra, Andhra Pradesh, Gujarat, Bihar, and Karnataka. Greengram covers 75000 ha in Telangana, with yield and productivity of 38050 tonnes and 507 kg ha^{-1}, respectively (Indiastat, 2021). It requires less water than other crops because of its shorter duration. In the *kharif* and summer seasons, it is commonly planted as an intercrop, mixed crop, or single crop. Among grain legumes, it is one of India's most important conventional pulse crops. It is only second to chickpeas in terms of productivity. Its seed is tastier, more nutritious, easier to digest, and less flatulent than other pulses growing in that particular region.

Pigeon pea (*Cajanus cajan*) is India's second most important pulse crop after chickpea, commonly known as redgram (Arhar or Tur) in local languages. It is grown on 4.72 million hectares in India, with a yield of 4.31 million tonnes and a productivity of 914 kg ha^{-1} (Indiastat, 2021). Telangana has a total area of 3.25 lakh hectares with an annual production and productivity of 2.52 lakh tonnes and 775 kg ha^{-1}, respectively (Indiastat, 2021). As it is an important nitrogen-fixing crop, it is widely grown for soil enrichment in rainfed areas. Its deep penetrating roots help move nutrients from deeper soil layers to the surface. Effective rhizobium nodulation can an average up to fix up to 160-200 kg nitrogen ha^{-1} $year^{-1}$.

Climate change and variability are a considerable threat to agricultural communities, particularly in India. This threat includes the likely increase of temperature, extreme weather conditions, increased water stress and drought, and desertification. Traditional crop production methods may be jeopardised by seasonal differences in weather events, either owing to a lack of water or

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a surplus of water, resulting in erosion. Soil stability will become increasingly important in order to store water in the soil profile, withstand extreme weather events, and reduce soil losses. These changes will bring new challenges to farmers. Farmers require new production system to assist them in adapting to these changing circumstances. Organic farming is one such alternative that has the potential to both mitigate and adapt to climate change, especially in rainfed agriculture. Organic agriculture is claimed to be the most sustainable approach in food production. It emphasizes recycling techniques and low external input and high output strategies. It is based on enhancing soil fertility and diversity at all levels and makes soils less susceptible to erosion (Niggli et al., 2007).

Scientific investigations are restricted in their capacity to reveal the productivity levels, stability, and profitability that may be obtained through pure organic sources of nutrient delivery in comparison to inorganic sources. It is critical to design robust feasible and compatible packages of nutrient management using organic sources for varied crops and cropping systems to fit local circumstances while being economically viable.

2. **Materials and Methods**

The field experiment was conducted in Gungal (around 43 km from Hyderabad) Research Farm (17.08°N latitude and 78.66°E longitude and 542 m above msl) of ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, India, during *kharif* 2021. The farm represents a semi-arid tropical region with a mean annual temperature of 25.58 ◦C and rainfall of 835.7 mm was received during the crop period in 52 rainy days. The soil of the experimental field was clay loam in texture, with soil pH 6.51, low in organic carbon (0.43%), available nitrogen (179.0 kg/ha), high in available P_2O_5 (24.7 kg/ha) and medium in available K_2O (218.1 kg/ha). Experiment was laid out in a randomized complete block design with three treatment combinations viz., Organic (recommended 100 % N equivalent FYM), Integrated (recommended 25 % N equivalent FYM + 75 % N and 100 % P and K through chemical fertilizers) and Control (recommended 100 % NPK through chemical fertilizer) replicated nine times. In the plots under organic management, farmyard manure was thoroughly incorporated into 15 cm surface soil on the recommended N equivalent basis to all the three crops at two weeks before sowing of crops and the P requirement was supplemented by rock phosphate. The initial available K status of experimental site was high hence no potassium was applied. In the plots under integrated management, 25% of equivalent recommended N was applied through farmyard manure. The remaining 75% N and 100% P and K is applied through chemical fertilizers. The plots under inorganic management applied with recommended dose of chemical fertilizers (20:50 kg N and P_2O_5 ha^{-1} for pigeon pea and greengram; 60:60:30 kg N, P_2O_5 and K_2O ha^{-1} for sunflower). The quantity of manure and fertilizer applied at field are represented at table. 1.The FYM used in the field were analysed for N, P, K and other micronutrients. On an average it contains 0.5% N, 0.27% P, 0.4% K, 452 ppm Fe, 228.7 ppm Mn, 143.1 ppm Zn and 27.9 ppm Cu. Further this FYM was treated with *Trichoderma viridae* at 2.5 kg ha^{-1} and incubated in the soil for about 20 days as prophylactic measure against various soil borne diseases. The sources of fertilizers for NPK were urea (46% N), SSP (16% P_2O_5, 12% S) and MOP (60% K_2O). Varieties used in experiment are WGG-37 (greengram), PRG-158 (pigeon pea) and DRSH-1 (sunflower). Sowing was done at first fortnight of July using healthy, well-filled, and matured seeds of pigeon pea, greengram, and sunflower at 15, 20, and 6 kg ha^{-1} seed rate. For pigeon pea, greengram, and sunflower, seeds were sown by hand dibbling @ two seeds $hill^{-1}$ at a depth of 3-5 cm, with 90 cm, 30 cm, and 60 cm between rows and 20 cm, 10 cm, and 30 cm between plants within the row, respectively. Thinning and gap filling were completed after 15 DAS, with one healthy seedling $hill^{-1}$ remaining. In conformity with organic standards, no chemical herbicides, insecticides, or fungicides were employed in the organically managed plots. Manual weeding was used once, followed by two hoeing using a manually driven wheel-hoe. As a preventative treatment Azadirachtin *(Azadirachta indica* - based formulation) was applied against insect pests at 20-25 days intervals during crop growth. Crop-specific prescribed herbicides and pesticides were applied in the control plots to manage weeds, insect pests, and diseases. Recommended integrated pest management (IPM) modules were applied in the integrated management plots. Greengram was harvested first due to its short duration, followed by sunflower, and finally pigeon pea. Sunflower is harvested by cutting the heads after the green base of the head has become yellow and eventually brown while pigeon pea and greengram are harvested by picking the pods when they are brown and dried. The data on growth and yield attributes were recorded from randomly selected five plants in each plot and seed and haulm/stalk yield recorded from net plot and converted on hectare basis.

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Table 1: Application rates of organic manure and mineral fertilizers in different treatments

Treatments	Crops	Manure ($t\ ha^{-1}$)	Chemical fertilizer ($kg\ ha^{-1}$)			Rock phosphate ($kg\ ha^{-1}$)
			N	P	K	
Organic	Greengram	4.4	0.0	0.0	0.0	167.0
	Pigeon pea	4.4	0.0	0.0	0.0	167.0
	Sunflower	13.3	0.0	0.0	0.0	0.0
Integrated	Greengram	3.3	15.0	50.0	0.0	0.0
	Pigeon pea	3.3	15.0	50.0	0.0	0.0
	Sunflower	10.0	45.0	60.0	30.0	0.0
Inorganic	Greengram	0.0	20.0	50.0	0.0	0.0
	Pigeon pea	0.0	20.0	50.0	0.0	0.0
	Sunflower	0.0	60.0	60.0	30.0	0.0

3. Results and Discussion

3.1. Growth Parameters

3.1.1. Plant height (cm)

In greengram, application of organic treatment has recorded significantly highest plant height at harvest stage (41.6 cm) compared to rest of the treatments which was followed by integrated treatment (37.7 cm) and it was found be at par with control (37.1 cm). In pigeon pea under organic plots being on par with those under integrated plots (132.6 cm) recorded significantly higher plant height (137.6 cm) compared to control (127.1 cm). However, the integrated treatment is in turn at par with control. In sunflower, application organic source of nutrient results in significantly highest plant height (152.3 cm) over the control and which is statistically at par with integrated treatment (143.9 cm). However, this integrated treatment was also statistically at par with the control (138.8 cm).

Significantly highest plant height was recorded with organic source of nutrient compare to integrated and control. Organically treated crops outperformed all other treatments because organic manure enhances cell division, cell elongation, and chlorophyll content of leaves, which improves photosynthetic activity and consequently plant height. While the plants with control were the smallest in stature, this might be owing to a lack of nutrients for crop growth. The present results were in accordance with the findings of Mishra et al. (2015), Mohbe et al. (2015) and Muhsin et al. (2021).

3.1.2. Number of branches

In greengram, highest number of branches at harvest (8.9) was recorded with organic treatment and it was at par with integrated treatment (8.8) and significantly highest over control (8.6). However, integrated treatment is statistically similar with the control. At harvest pigeon pea under organic source of nutrient being on par with those under integrated source of nutrient (14) recorded significantly highest number of branches (14.3) compared to control (13.9). however, the integrated treatment where statistically at par with the control.

Number of branches found be significantly highest in the organic treatment this is because increased availability of nutrients due to enhanced microbial activity with the application of organic manures results in increasing of cellular activity and cell division results in the greater number of branches. The similar results are found in Mishra et al. (2015), Rao et al. (2018) and Muhsin et al. (2021).

3.1.3. Dry matter accumulation ($kg\ ha^{-1}$)

In greengram, highest dry matter accumulation at harvest was recorded with organic treatment (2463.3 $kg\ ha^{-1}$) over control (2201.2 $kg\ ha^{-1}$) and however, this organic treatment was at par with integrated treatment (2343.3 $kg\ ha^{-1}$). At harvest, pigeon pea under organic source of nutrient being on par with those under integrated source of nutrient (4572.0 $kg\ ha^{-1}$) recorded significantly highest dry matter accumulation (4842.5 $kg\ ha^{-1}$) compared to control (4326.5 $kg\ ha^{-1}$). however, the integrated treatment where

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statistically at par with the control. Similar trend was observed with all other growth stages *viz.*, pod formation and at harvest. In sunflower application organic source of nutrient results in significantly higher dry matter accumulation at harvest (4666.4 Kg ha^{-1}) over the control and which is statistically at par with integrated treatment (4428.2 Kg ha^{-1}). However, this integrated treatment was also statistically at par with the control (4325.3 Kg ha^{-1}).

The total dry matter production is significantly higher in organic plots which is followed integrated and control. This could be mainly due to higher plant height and higher leaf area maintained throughout the crop phase resulting in enhanced carbohydrate synthesis, which finally led to higher dry matter production. The results are in close conformity with Daniel et al. (2013), Ullasa et al. (2013) and Rao et al. (2018).

3.2. Yield attributes

3.2.1. Number of pods plant^{-1}

Greengram has recorded significantly higher number of pods plant^{-1} in the plots where organic treatment was applied (22), which was on par with pod number resulted due application of integrated treatment (20). Lower number of pods was with unsprayed treatment (19.7). whereas, Pigeon pea under organic plots were recorded with significantly highest number of pods plant^{-1} (36.3) compared to crops under integrated plots (33.4) which is statistically at par. However, this integrated treatment is at par with control (32.4).

This might be due to an increase in the availability of nearly all plant necessary nutrients, which promotes vegetative growth and hence increases photosynthetic activity, as well as the translocation and storage of photosynthates in economic sinks. Our results are in consonance with findings of Mishra et al. (2015), Muhsin et al. (2021) and Rao et al. (2021).

3.2.2. Capitulum diameter (cm)

Data revealed that capitulum diameter of sunflower did not vary significantly due to the different production systems applied. Among all the treatments applied, organic treatment was recorded highest capitulum diameter (15.1 cm) which is statistically at par with both integrated treatment (14.9 cm) and control (13.9 cm).

Higher capitulum diameter was recorded with organic production system this is because organic manures are the store house of several macro and micronutrients that are released during the process of mineralization by stimulating the activity of microorganisms to make the plant nutrients readily available to crops therefore synthesis of more photosynthates may take place which might be resulted in better partitioning of photosynthates from source to sink and improved the yield attributes like capitulum diameter. This was supported by Chaithra and Sujith (2021) and Muhsin (2021).

3.2.3. Number of filled seeds pod^{-1}

There was no significant difference between the treatments. In greengram, among different treatments tried, higher number of filled Seeds Pod^{-1} was noticed in the plots where organic treatment was applied (11.22), which was on par with seed number resulted due application of both integrated treatment (11) and control (10.67). In pigeon pea, among different treatments tried, higher number of filled seeds pod^{-1} was noticed in the plots where organic treatment was applied (4.22), which was on par with seed number resulted due application of both integrated treatment (4) and control (3.89).

In sunflower, number of filled seeds head^{-1} differed significantly among different production systems. Crops under organic source of nutrient recorded higher number of filled seeds head^{-1} (630.3) compared to integrated source of nutrient and control. However, integrated source of nutrient (583.3) was on par with control (545.4).

Combined effect of improved growth parameters (plant height, leaf area and dry matter accumulation) through efficient metabolic activity, increased photosynthetic rate and steady supply of photosynthates from source to sink might have led to maximum expression of yield attributing characters. The similar results are found with Chaithra and Sujith (2021) and Muhsin (2021).

3.2.4. Test weight (g)

Application of different production systems on test weight among all the three crops are found to be non-significant. The highest test weight of greengram seeds was recorded in organic treatment (30.2 g) which remains at par with both integrated treatment (30 g) and control (29.6 g) and the highest test weight of pigeon pea seeds was recorded in organic treatment (81.6 g) which being on

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par with both integrated treatment (80 g) and control (80.6 g). In sunflower, among all the treatments, the higher test weight was recorded in organic treatment (44.6 g) which were statistically at par with both integrated treatment (44.4 g) and control (43.9 g).

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Table 2: Effect of different production systems on Greengram, Pigeon pea and Sunflower growth at harvest

	Plant height (cm)			No. of branches		Dry matter accumulation (kg ha^{-1})		
Treatments	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Greengram	Pigeon pea	Sunflower
Organic	41.6	149	152.3	8.9	14.3	2463.3	4842.5	4666.4
Integrated	37.7	142.9	143.9	8.6	14	2298.9	4572	4428.2
Control	37.1	138.7	138.8	8.3	13.9	2162.2	4326.5	4325.3
SEm±	1.1	3.3	3.9	0.2	0.4	97.3	129.7	109.6
CD (P=0.05)	3.1	9.9	11.6	0.6	1.1	291.7	388.8	329.0

Table 3: Effect of different production systems on yield attributes in Greengram, Pigeon pea and Sunflower

	Pods plant^{-1}		Capitulum diameter (cm)	Filled seeds pod^{-1} /head^{-1}			Test weight (g)		
Treatments	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower
Organic	22	36.3	15.5	11.22	4.2	630.3	30.2	81.6	44.6
Integrated	20	33.4	14.9	11	4	583.3	30	81	44.4
Control	19.7	32.4	13.8	10.67	3.9	545.4	29.6	80.6	43.9
SEm±	0.7	1.1	0.5	0.3	0.2	14.6	0.2	0.2	0.3
CD (P=0.05)	2.2	3.4	1.5	NS	NS	43.9	NS	NS	NS

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3.3. Yield

3.3.1. Grain yield (Kg ha^{-1})

The use of organic source of nutrient resulted in significantly highest grain yield of greengram (673 kg ha^{-1}) over control and remains at par with the integrated source of nutrient (661 kg ha^{-1}) and this integrated treatment was statistically at par with control (630 kg ha^{-1}). The use of organic treatment resulted in significantly highest seed yield of Pigeon pea (383 kg ha^{-1}) compared to integrated treatment (358 kg ha^{-1}). However, which remains at par with the integrated treatment. Lowest seed yield among the treatments was recorded with control (323 kg ha^{-1}). The higher seed yield in sunflower was recorded in organic treatment (944 Kg ha^{-1}) which was higher than remaining treatments which was however comparable with that resulted grain yield of integrated treatment (920 Kg ha^{-1}) but significantly higher than with control (835 Kg ha^{-1}).

Higher seed yield in organic treatment might be attributed to an increase in the availability of practically all plant necessary nutrients due to the transfer of photosynthates produced under the effect of the organic nutrient source. Furthermore, photosynthate translocation and accumulation in economic sinks improved yield characteristics, chlorophyll content, and nitrate reductase activity, resulting in higher seed production. The similar results are found by Pradeep et al. (2018), Chongre et al. (2019) and Muhsin et al. (2021).

3.3.2. Straw yield (Kg ha^{-1})

Greengram under organic plots being on statistically par with those under integrated plots (1879 kg ha^{-1}) recorded significantly higher plant height (1908 kg ha^{-1}) compared to control (1797 kg ha^{-1}). However, the integrated treatment is in turn at par with control. Pigeon pea under organic plots being on par with those under integrated plots (2521 kg ha^{-1}) recorded significantly higher stalk yield (2647 kg ha^{-1}) compare to crops under control (2402 kg ha^{-1}). However, the crops under the integrated treatment will be statistically at par with control. Among the different sources of nutrients tried, incorporation of organic treatment recorded the significantly higher stalk yield (2484 kg ha^{-1}) in sunflower which was however statistically at par with integrated source of nutrient (2434 kg ha^{-1}) and lowest stalk yield were recorded under control (2216 kg ha^{-1}).

The higher stalk yield due to application of organic treatment might be attributed to improved vegetative growth and greater dry matter production as a result of the availability of all plant nutrients and improved soil physical qualities. The present result was in accordance with the findings of Rekha et al. (2018), Pradeep et al. (2018) and Muhsin et al. (2021).

3.3.3. Harvest Index (%)

In greengram, among the different sources of nutrients tried, incorporation of organic treatment recorded the higher harvest index (26.1 %) which is at par with both integrated source of nutrient (26.0 %) and control (26.0 %). Similarly, at pigeon pea, incorporation of organic treatment recorded the higher harvest index (12.6 %) which is at par with both integrated source of nutrient (12.5 %) and control (11.9 %) and at sunflower, incorporation of organic treatment recorded the higher harvest index (27.6 %) which were with integrated treatment (27.5 %) and statistically at par with control (27.4 %).

3.4. Economics

3.4.1. Gross returns (Rs. ha^{-1})

In greengram, application of organic source of nutrients fetched highest gross returns (51160 Rs ha^{-1}) among all the treatment in comparison. The next best treatment was integrated treatment which resulted in gross returns of 50088 Rs ha^{-1}. The lowest gross returns were recorded with control (47750 Rs ha^{-1}). In pigeon pea application of organic source of nutrients fetched significantly highest gross returns (26818 Rs ha^{-1}) among all the treatment in comparison. The next best treatment was integrated treatment which resulted in gross returns of 25159 Rs ha^{-1}. The lowest gross returns were recorded with control (22772 Rs ha^{-1}). In sunflower application of organic source of nutrients resulted highest gross returns (58137 Rs ha^{-1}) among all the treatment in comparison. The next best treatment was integrated treatment which resulted in gross returns of 56635 Rs ha^{-1}. The lowest gross returns were recorded with control (51389 Rs ha^{-1}).

Since the organic produce grown purely under chemical free condition, the quality of the produce will be excellent compared to integrated and inorganic produce. So, to compensate the high cost of cultivation under organic due to high cost of FYM

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per kg of nutrient supply we would like add the premium of 15% for greengram and pigeon pea organic produce and 30% for sunflower organic produce and sold at fixed premium price. Therefore, the gross returns of organically produced greengram were increased by 15% and results in the gross returns of 58546 ₹ ha^{-1} compared to normal gross returns of 51160 Rs ha^{-1}. Similarly, in pigeon pea and sunflower gross returns had increased to 30443 and 75210 ₹ ha^{-1} respectively.

3.4.2. Net returns (Rs ha^{-1})

Among the treatments, application of integrated source of nutrient registered highest net returns (26614 Rs ha^{-1}) followed by inorganic source of nutrients (control) which gained a net return of 26135 Rs ha^{-1}. The lowest net returns were noticed in the treatment where organic source of nutrient applied (25075 Rs ha^{-1}). Among the different treatments in pigeon pea, application of integrated source of nutrient registered highest net returns (1885 Rs ha^{-1}) followed by inorganic source of nutrients (control) which gained a net return of 1357 Rs ha^{-1}. The lowest net returns were noticed in the treatment where organic source of nutrient applied (933 Rs ha^{-1}). Among the different treatment in sunflower, application of integrated source of nutrient registered highest net returns (30789 Rs ha^{-1}) followed by inorganic source of nutrients (control) which gained a net return of 30403 Rs ha^{-1}. The lowest net returns were noticed in the treatment where organic source of nutrient applied (22502 Rs ha^{-1}). The similar results are found by Arbad and Sayad (2011), Choudhary et al. (2013) and Verma et al. (2018).

Organically produced greengram which sold at 15% premium will have net returns of 32411 Rs ha^{-1} compared to normal gross returns of 25075 Rs ha^{-1}. Similarly, pigeonpea and sunflower net returns had increased to 4506 and 39543 Rs ha^{-1} respectively.

3.4.3. Benefit cost (B:C) ratio

In greengram, higher B:C was recorded with the control plots (2.21) followed by integrated plots (2.13). Whereas, lower B:C ratio was recorded with organic plots (1.96). In pigeon pea, higher B:C was recorded with the integrated plots (1.08) followed by control plots (1.06). Whereas, lower B:C ratio was recorded with organic plots (1.04). In sunflower, higher B:C was recorded with the control plots (2.45) which was followed by integrated plots (2.19). Whereas, lower B:C ratio was recorded with organic plots (1.63).

Organically produced greengram which sold at 15% premium, B: C ratio were increased to 2.24 compared to normally sold pigeonpea which is having 1.96 B: C ratio. Similarly, pigeon pea and sunflower have B: C ratio of 1.18 and 2.11 respectively. This was supported by Meena and Sharma (2013), Verma et al. (2018) and Somalraju et al. (2021).

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Table 4: Effect of different production systems on yield in Greengram, Pigeon pea and Sunflower

	Seed yield (kg ha^{-1})			Stalk yield (kg ha^{-1})			Harvest Index (%)		
Treatments	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower
Organic	673	383	944	1908	2647	2484	26.1	12.6	27.6
Integrated	661	358	920	1879	2521	2434	26	12.5	27.5
Control	630	323	835	1797	2402	2216	26	11.9	27.4
SEm±	14	9	25	36	61	65	0.5	0.3	0.8
CD (P=0.05)	42	29	74	108	184	196	NS	NS	NS

Table 5: Effect of different production systems on economics in Greengram, Pigeon pea and Sunflower

	Cost of cultivation (₹ ha^{-1})			Gross returns (₹ ha^{-1})			Net returns (₹ ha^{-1})			Benefit Cost ratio		
Treatments	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower
Organic	26085	25885	35635	51160	26818	58137	25075	933	22502	1.96	1.04	1.63
Integrated	23474	23274	25846	50088	25159	56635	26614	1885	30789	2.13	1.08	2.19
Control	21615	21415	20986	47750	22772	51389	26135	1357	30403	2.21	1.06	2.45

Table 6: Effect of different production systems on economics in Greengram, Pigeon pea and Sunflower when sold at premium for organic product:

	Cost of cultivation (₹ ha^{-1})			Gross returns (₹ ha^{-1})			Net returns (₹ ha^{-1})			Benefit Cost ratio		
Treatments	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower	Greengram	Pigeon pea	Sunflower
Organic	26085	25885	35635	58546	30443	75210	32411	4506	39543	2.24	1.18	2.11
Integrated	23474	23274	25846	50088	25159	56635	26614	1885	30789	2.13	1.08	2.19
Control	21615	21415	20986	47750	22772	51389	26135	1357	30403	2.21	1.06	2.45

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4. Conclusion

Climate change is affecting us severely all over the world and farming is one of the main victims. There is a need to find a solution on which scientists are working relentlessly. Organic farming could be one of the best possible solutions to minimize the impact of climate change on farming. There has been an increase in awareness about organic farming in our country which has resulted in enhancement in area under organic farming. Pulses and oilseeds have to be cultivated under organic management practices as it fetches a better price comparatively which ultimately benefits the farmers as well as our economy. This investigation was carried out to compare the impact of organic, inorganic and integrated management practices on growth, yield and economics of greengram, pigeon pea and sunflower under rainfed conditions. It is concluded that greengram, pigeon pea and sunflower under organic farming have performed well in terms of growth, productivity and economics compared to integrated as well as inorganic farming.

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