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Organic nutrient sources management response on Brinjal (*Solanum melongena* L) Production

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Abstract
The study was carried out at OFRC, ZAHRS, KSNUAHS, Shivamogga during 2018-2020 (three years) to study organic nutrient sources management response on brinjal (*Solanum melongena* L) production. Nine treatments combinations replicated thrice in randomized blocked design comprised organic nutrients. Among the treatments, FYM (25 t/ha) + 100 per cent N equivalent vermin-compost recorded significantly highest plant height (72.4 cm), number of branches per plant (8.0), number of leaves per plant (64.1), number of flowers per plant (22.4), number of fruits per plant (16.2), fruit yield per plant (1.45 kg/plant) and yield per hectare (28.20 tonnes). The highest gross return (Rs. 2,88,790 ha^{-1}) and net return (Rs. 1,91,790 ha^{-1}). FYM (25t/ha) + 100 per cent N equivalent vermi compost treatment was onpar with FYM (25 T/ha) + 100 per cent N equivalent FYM for growth, yield and economics attributes.

Keywords: Brinjal, organic, nutrient management, yield

Introduction
Poor man's crop brinjal (*Solanum melongena* L.) grows well in tropical and subtropical and also in temperate regions, In Karnataka brinjal grown majorly in Mysore, Davangere, Shivamogga, Chikmagaluru, Kolar, Bangalore during both rainy and warm season, but also respond well in dry regions with critical irrigation facilities. Hardy brinjal fruits are rich in dietary fibres (Zenia and Halina, 2008) [18]. And also a sources of antioxidants mainly ascorbic acid (Somawathi *et al.,* 2014) [15]. Several researchers revealed that different organic management practices that can boost organic eco-friendly brinjal production while yielding quality fruits.

Now a day's neglected management of chemical fertilizers in brinjal hinders eco-friendly healthy and quality brinjal fruits production (Singh *et al.,* 2017) [14]. Organic farming continuously haunt for nutritional sources and their applications to sustain the productivity among organic system (Christo *et al.,* 2011) [3]. Organic amendments would boost climate resilience sustainable agriculture practices (Sarhan *et al.,* 2011) [9]. Adoption of climate resilience practices along with optimizing biological productivity is an challenging tasks in front of us, Redeveloping sustainable nutrient management practices over long run is much needed prioritised task in organic production system in brinjal (Agbo *et al.,* 2012) [1]. Organic amendments supply all essential nutrient required for plant growth (Bhuma, 2001) [2], however, growth-promoting harmones were more preferential in obtaining quality products in organic brinjal production system.

Organic nutrient management practices plays pivotal role in healthy brinjal production. Apart from organic manures such as compost and Farm yard manures, vermicompost were principally used in organic brinjal production. Present investigation planned to study the response of organic nutrient management in brinjal production.

Material and Methods
Experiment conducted at OFRC plots at ZAHRS, Shivamogga, Karnataka (130 58' 30" N and 750 34' 37" E) for three consecutive years from 2018 to 2020, Before experimentation site pH 5.89, electrical conductivity 0.01 dS/m, Organic carbon content of 4.02 g/kg, nitrogen, phosphorus and potassium status of 211,112, 144 kg/ha respectively. Randomized block design replicated thrice with nine treatment combination. Standard experimental plot size of 4.5 x 4.2 m laid out and supplied recommended dose of FYM (25 t/ha^{-1}). Treatments details furnished in Table 1. Full dose mannure treatments applied 15 days before transplantation of

the brinjal and incorporated into the soil. Seedlings were transplanted at a line spacing of 90 x 60 cm. During the season's crop received optimum rainfall during entire growing period and lifesaving irrigations was provided at critical stages of the crop at each year. Two inter-cultivation operations and one hand weeding were carried out to suppress the weeds during all three years. Organic pest management practices choose by use of yellow traps and neem oil, green label insecticides like Spinosad. Regular soil samples collected from each plot before and after the experiment at 0-30 cm depth. The samples were dried in shade, sieved (2 mm sieve) and analyzed for pH, organic carbon, available nitrogen, available phosphorus and available potassium content. The pH (soil: water 1:2.5) was measured with the help of pH meter (Jackson, 1973) [7]; organic carbon by Walkley and Black chromic acid digestion method as described by Jackson (1973) [7]. Available nitrogen in soil was determined by using Kel-plus nitrogen distillation unit (Subbaiah and Asija, 1956) [16]. Phosphorus determined using Jackson (1973) [7] method and potassium by flame photometric method (Hanway and Heidel, 1952) [6]. The data collected were tabulated and analysed by standard statistical methods (Gomez and Gomez 1984) [5].

Table 1: Details of treatments and quantity of manures applied, total quantity of Nitrogen supplied through organic nutrition in each treatment

Treatments	Total quantity of FYM Applied (t ha^{-1})	Total quantity of vermicompost Applied (t ha^{-1})	Total N supplied (kg ha^{-1})
T_1 - Recommended FYM (25 t ha^{-1}) + 100% N equivalent FYM	25+25	0	250
T_2 - 75% N equivalent FYM	16.25	0	93.75
T_3 - 100% N equivalent FYM	25	0	125
T_4 - 125% N equivalent FYM	31.25	0	156
T_5 - Recommended FYM (25 t ha^{-1}) + 100% N equivalent vermicompost	25	10	250
T_6 - 75% N equivalent vermicompost	0	7.5	93.75
T_7 - 100% N equivalent vermicompost	0	10	125
T_8 - 125% N equivalent vermicompost	0	12.5	156
T_9 - 50% N equivalent FYM + 50% N equivalent vermicompost	12.5	5	125

Results and Discussion

Yield and Yield attributing characters

Quality and healthy toxic free brinjal vegetable production remains challenging task in India. Recently, promotion of organic farming over the decade pave a way for organic nutrient and pest management options. Different organic nutrient management practices not only keep soil productive but also increase soil available nutrients for healthy brinjal yield production. The data on brinjal fruit yield obtained were presented in (Table 2). Pooled over three seasons data indicated that brinjal fruit yield (t/ha) significantly differed among organic nutrient application. Application of recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost (T_5) has recorded significantly highest fruit yield (28.2 t/ha) and was on par with FYM (25 t/ha) along with 100% N equivalent FYM (27.4 t/ha). Both T5 and T1 treatments were recorded significantly superior fruit yield (t/ha) over all other treatments. Over the individual years also brinjal yield follows the same trend due to organic nutrient management practices. Manickam *et al.* (2021) [8] also reported similar yield increment results due to organic nutrient management practices. The yield data furnished in Table (2).

Table 2: Fruit yield of brinjal due to different organic nutrient management practices

Tr. No.	Treatments	Fruit yield t ha^{-1}			Pooled data of last 3 years
		2018	2019	2020	
T_1	FYM + 100% N equivalent FYM	36.4	18.4	27.6	27.4
T_2	75% N equivalent FYM	22.4	11.0	17.5	16.9
T_3	100% N equivalent FYM	26.3	13.0	21.0	2.1
T_4	125% N equivalent FYM	32.1	16.1	24.4	24.2
T_5	FYM + 100% N equivalent vermicompost	37.2	19.3	28.1	28.2
T_6	75% N equivalent vermicompost	23.1	11.6	18.7	17.8
T_7	100% N equivalent vermicompost	29.7	15.2	22.9	22.6
T_8	125% N equivalent vermicompost	32.8	16.5	25.1	24.8
T_9	50% N equivalent FYM + 50% N equivalent vermicompost	28.9	14.8	22.1	21.9
S. Em.±		0.63	0.6	0.88	0.7
C.D. at 5%		1.89	1.7	2.65	2.1

The number of fruits per plant significantly higher recorded with treatment receiving recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost (16.2 fruits/plant) and was on par with FYM (25 t/ha) along with 100% N equivalent FYM (15.8 fruits/plant). Whereas, significantly lower number of fruits per plant recorded by treatment receiving only 75 per cent Nitrogen equivalent FYM. Similar yield parameters increment results with organic nutrient sources were observed by Ullas *et al.* (2018) [17], Shilpashree *et al.* (2022) [12], Shwetha and Bablad (2008) [13], Dudhat *et al.* (1997) [4].

Fruit yield per plant also varies among nutrient management practices. T_5 treatment recorded significantly higher fruit yield per plant (1.45 kg/plant) and was on par with T_1 treatment (1.43 kg/plant). The data furnished in Table 3.

Table 3: Number of fruits per plant and Fruit yield of brinjal response due to different organic nutrient management practices

Tr. No.	Treatments	Number of fruits per plant	Fruit yield kg/plant
T_1	FYM + 100% N equivalent FYM	15.87	1.43
T_2	75% N equivalent FYM	10.00	0.90
T_3	100% N equivalent FYM	11.96	1.08
T_4	125% N equivalent FYM	13.98	1.26
T_5	FYM + 100% N equivalent vermicompost	16.22	1.45
T_6	75% N equivalent vermicompost	10.67	0.96
T_7	100% N equivalent vermicompost	13.13	1.18
T_8	125% N equivalent vermicompost	14.38	129
T_9	50% N equivalent FYM + 50% N equivalent vermicompost	1269	1.14
S.Em.±		0.41	0.04
C.D. at 5%		1.24	0.14

Growth characters

Plant height is an important phenomenon that is greatly influenced by a set of interaction factors involving genetic makeup, nutrition availability and crop environment. In this study the plant height at harvest was significantly higher (72.4 cm) in plots treated with recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost. It was onpar with FYM (25 t/ha) along with 100% N equivalent FYM (70.8 cm). The significantly lowest plant height was recorded with 75 per cent nitrogen equivalent farmyard application treatment (44.7 cm).

Number of leaves per plant directly related to chlorophyll formation and as an indicator of plant growth. In the current investigation, significantly higher number of leaves per plant recorded with recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost (64.1) and was onpar with FYM (25 t/ha) along with 100% N equivalent FYM.

Periodically number of branches per plant observations recorded in this experiment. At 120 Days after transplanting it was observed that treatment supplied with recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost recoded significantly more (8.0 branches per plant) and was onpar with FYM (25 t/ha) along with 100% N equivalent FYM.

Number of flowers per plant observation recorded during when brinjal crop attains more than 50 per cent flower initiation visually. Among the treatments, FYM (25 t/ha) along with 100% N equivalent vermicompost recoded more flowers (22.4) and was onpar with FYM (25 t/ha) along with 100% N equivalent FYM. The data furnished in Table 4.

Table 4: Growth parameters of brinjal as influenced by different organic nutrient management practices

Tr. No.	Treatments	Plant height (cm)	Number of leaves at 60 DAT	Number of branches per plant at 120 DAS	Number of flowers per plant
T_1	FYM + 100% N equivalent FYM	70.87	62.72	7.84	21.96
T_2	75% N equivalent FYM	44.74	39.50	4.93	13.84
T_3	100% N equivalent FYM	53.55	47.24	5.90	16.56
T_4	125% N equivalent FYM	62.43.	55.24	6.90	19.34
T_5	FYM + 100% N equivalent vermicompost	72.42	64.14	8.01	22.45
T_6	75% N equivalent vermicompost	47.83	42.18	5.27	14.78
T_7	100% N equivalent vermicompost	58.70	51.92	6.49	18.18
T_8	125% N equivalent vermicompost	64.20	56.81	7.10	19.89
T_9	50% N equivalent FYM + 50% N equivalent vermicompost	56.69	50.16	6.27	17.56
S.Em.±		1.61	1.59	0.19	0.53
C.D. at 5%		4.83	4.78	0.59	1.61

Soil Nutrient Status

The results of the soil samples collected from 0-15 cm depth after the harvest of brinjal indicates significant variation observed among treatments for available Organic carbon and available nitrogen, phosphorus and potash status. More organic input supplied treatments were found rich in organic carbon and other available nutrients while maintaining optimum pH and electrical conductivity level in the soil.

Among availability of secondary and micro nutrient status in soil, Organic nutrient management practices significantly enhance the availability of sulphur status in the soil.

Table 5a: Nutrient status of soil as influenced by different nutrient management practices in Brinjal at harvest

Tr.	Treatments details	pH (1:2.5)	EC (dSm^{-1})	OC (g/kg)	N (kg/ha)	P_2O_5 (kg/ha)	K_2O (kg/ha)
T_1	FYM + 100% N equivalent FYM	6.9	0.069	8.4	188.2	54.8	258
T_2	75% N equivalent FYM	6.8	0.072	9.2	167.3	52.8	274
T_3	100% N equivalent FYM	7.0	0.077	9.2	188.2	59.7	316
T_4	125% N equivalent FYM	7.2	0.089	9.8	250.9	55.2	355
T_5	FYM + 100% N equivalent vermicompost	6.8	0.081	8.8	209.1	56.8	334
T_6	75% N equivalent vermicompost	7.1	0.094	9.2	146.3	55.6	313
T_7	100% N equivalent vermicompost	6.88	0.077	9.5	230.0	56.2	324

T_8	125% N equivalent vermicompost	6.68	0.079	7.5	209.1	58.75	346
T_9	50% N equivalent FYM + 50% N equivalent vermicompost	7.08	0.087	7.2	188.2	58.8	337
	Initial	6.0	0.078	7.0	175.0	50.0	238.0
	S.Em.±	0.13	0.007	0.5	38.3	2.6	43.0
	C.D. at 5%	NS	NS	1.6	114.9	7.8	129.2

Table 5b: Secondary and micronutrients as affected by organic nutrients management practices in Brinjal

Tr. No.	Treatments	Ca	Mg	S	Zn	Fe	Mn	Cu
		Cmol(p+)/kg		mg/kg			mg/kg	
T_1	FYM + 100% N equivalent FYM	2.87	2.70	20.1	0.63	23.01	16.9	0.99
T_2	75% N equivalent FYM	3.12	3.01	14.5	0.61	24.09	15.9	0.96
T_3	100% N equivalent FYM	4.52	2.87	19.0	0.55	24.34	16.1	0.80
T_4	125% N equivalent FYM	3.01	2.35	21.2	0.54	22.16	16.3	1.07
T_5	FYM + 100% N equivalent vermicompost	3.22	3.26	24.2	0.76	24.40	17.2	0.97
T_6	75% N equivalent vermicompost	3.68	2.70	15.7	0.59	23.68	16.2	1.08
T_7	100% N equivalent vermicompost	4.06	3.12	19.0	0.66	23.33	16.8	1.14
T_8	125% N equivalent vermicompost	2.70	3.15	18.3	0.56	23.53	17.9	0.89
T_9	50% N equivalent FYM + 50% N equivalent vermicompost	3.22	3.71	18.3	0.50	21.3	17.5	1.07
	Initial	3.1	2.56	12.3	0.57	21.8	15.6	0.78
	S.Em.±	0.61	0.49	1.66	0.06	1.22	0.46	0.11
	C.D. at 5%	NS	NS	4.10	NS	NS	NS	NS

Soil Microbial Populations

Beneficial soil microbes are an indicator of healthy and productive fertile soils. In this current investigation treatments supplied more organic nutrients found rich in beneficial bacterial, fungal, actinomycetes and nitrogen fixers soil beneficial microorganisms.

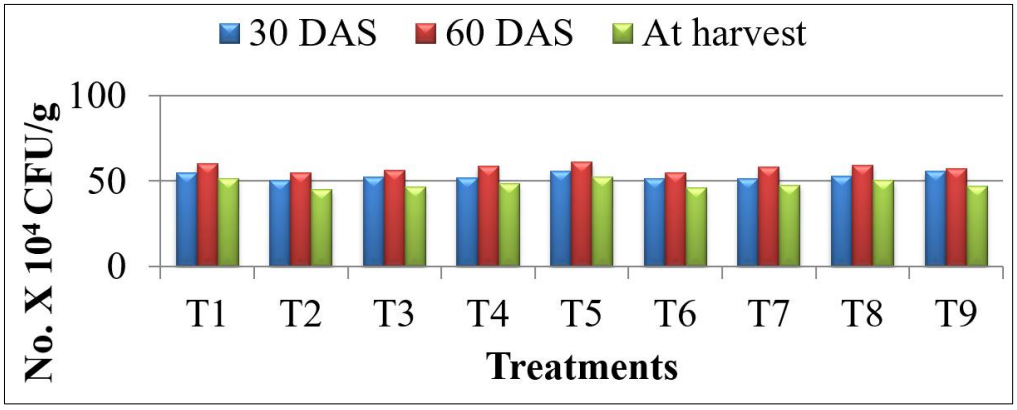

Fig 1: Bacterial population (cfu g-1 of soil) of Brinjal soil as influenced by different organic nutrient management practices.

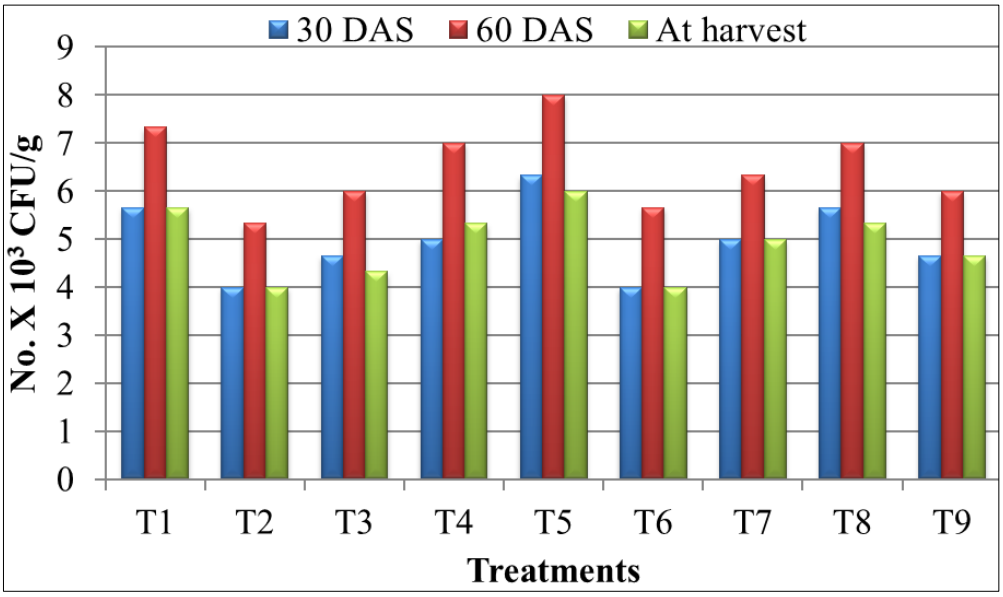

Fig 2: Fungal population (cfu g-1 of soil) of Brinjal soil as influenced by different organic nutrient management practices.

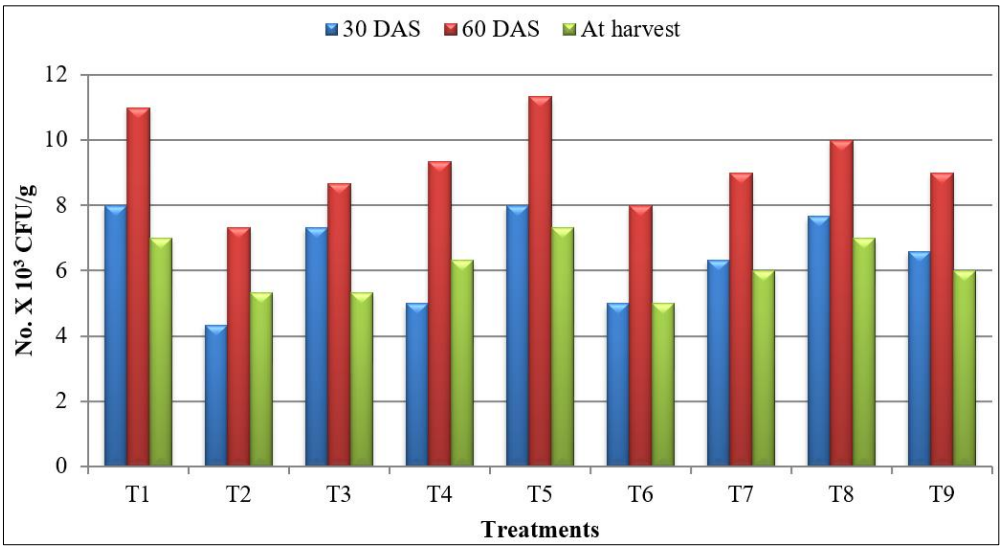

Fig 3: Actinomycetes population (cfu g-1 of soil) of Brinjal soil as influenced by different organic nutrient management practices.

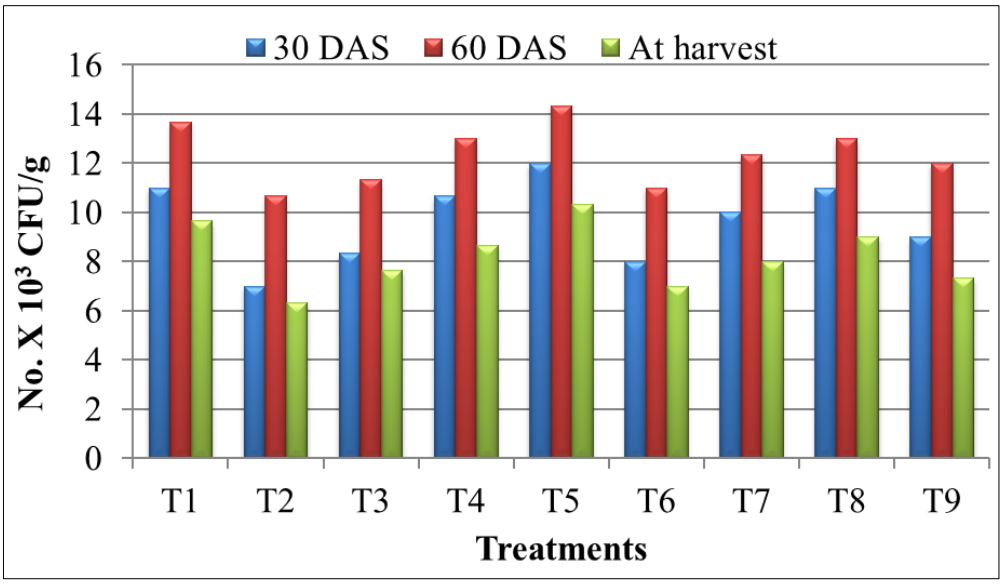

Fig 4: Nitrogen fixers population (cfu g-1 of soil) of Brinjal soil as influenced by different organic nutrient management practices.

Economics

The organic nutrient management practices showed large variation in the cost of cultivation due to the use of different inputs. The per hectare cost of cutivation was the highest (Rs. 1,02,000/ha) in plots treated with FYM+ 100 per cent Nitrogen equivalent FYM. This was due to the higher cost incurred towards farmyard manure when compared to other treatments. The lowest cost of cultivation is recorded with only 75 per cent Nitrogen equivalent vermicompost application (Rs. 67,000/ha) Table 6.

Application of recommended dose of Farm yard manure (25 t/ha) along with 100% N equivalent vermicompost recorded higher gross return of Rs. 2,88,790/ha and was onpar with FYM (25 t/ha) along with 100% N equivalent FYM.

Similar trend also noticed while obtaining highest net return from treatment T5 of Rs. 1,91,790/ha and was followed by FYM (25 t/ha) along with 100% N equivalent FYM (Rs.1,73,680/ha).

Table 6: Economics of organic nutrients management practices in Brinjal

Tr. No.	Treatments	Cost of cultivation (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)
T_1	FYM + 100% N equivalent FYM	102000	275680	173680
T_2	75% N equivalent FYM	70750	164400	93650
T_3	100% N equivalent FYM	77000	195538	118538
T_4	125% N equivalent FYM	83250	241400	158150
T_5	FYM + 100% N equivalent vermicompost	97000	288790	191790
T_6	75% N equivalent vermicompost	67000	173700	106700
T_7	100% N equivalent vermicompost	72000	227750	155750
T_8	125% N equivalent vermicompost	77000	247875	170875
T_9	50% N equivalent FYM + 50% N equivalent vermicompost	74500	222068	147568

Conclusion

From the above experiment it can be concluded that, For achieving higher brinjal yield among organic nutrient management practices, it was proposed that following application of recommended dose of FYM (25 t/ha) along with 100% N equivalent vermicompost or FYM (25 t/ha) along with 100% N equivalent FYM will be beneficial to farmers for getting highest fruit yield and net returns under organic production system.

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