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Effect of land management options and manurial application on growth, yield and quality and nutrient uptake of American cotton (*Gossypium hirsutum* L.) cultivation

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Abstract
A field experiment was conducted at the Agricultural Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi on sandy-clay loam soil during kharif 2017 to study the effect of land management options and manurial application on growth, yield, quality and nutrient uptake of American cotton (*Gossypium hirsutum* L.) cultivation. The results of this experiment revealed that there was significant difference in quality parameter, nutrient uptake and relative economics with different land management options and manurial application. Raised bed sowing method recorded significantly higher plant height (81.64 cm) leaf area index (042 dm^{-2}/m^{-2}), chlorophyll content (41.40 µ mol m^{-2}), number of monopodial (6.83) and sympodial (10.81) branches $plant^{-1}$, dry matter accumulation (87.02 g) $plant^{-1}$, like number of boll (21.23), boll weight (4.59 g), seed cotton yield (1257.72 kg ha^{-1}), stalk yield (2526.58 kg ha^{-1}), harvest index (32.92%), cotton seed yield (759.78 kg ha^{-1}), lint yield (498.06 kg ha^{-1}), seed index (6.95 g), lint index (4.58 g) fiber strength (24.40 g tex^{-1}), oil content (20.10%) and oil yield (257.10 kg ha^{-1}), nitrogen (76.56 kg ha^{-1}), phosphorus (20.31 kg ha^{-1}), potassium (77.38 kg ha^{-1}) uptake, gross return (₹ 57870.62 ha^{-1}), net return (₹ 36087.35 ha^{-1}) and B: C ratio (1.37) over furrow, mulch and conventional sowing method. Among the manurial application of pressmud 2 t ha^{-1} was recorded significantly higher plant height (82.02 cm) leaf area index (0406 dm^{-2}/m^{-2}), chlorophyll content (41.08 µ mol m^{-2}), number of monopodial (7.05) and sympodial (11.16) branches $plant^{-1}$, dry matter accumulation (85.50 g) $plant^{-1}$, number of boll (20.88), boll weight (4.72 g), seed cotton yield (1315.40 kg ha^{-1}), stalk yield (2713.50 kg ha^{-1}), harvest index (32.61%), cotton seed yield (799.93 kg ha^{-1}), lint yield (515.47 kg ha^{-1}), seed index (7.25 g), lint index (4.68 g) fiber strength (24.58 g tex^{-1}), oil content (19.73%) and oil yield (261.09 kg ha^{-1}) and nitrogen (78.60 kg ha^{-1}), phosphorus (20.85 kg ha^{-1}), potassium (79.59 kg ha^{-1}) uptake, gross return (₹ 57976.90 ha^{-1}), net return (₹ 34858.90 ha^{-1}) and B: C ratio (1.50) compare to vermicompost, farmyard manure and control. Among the interactions significantly higher oil yield, nitrogen, phosphorus, potassium (kg ha^{-1}) uptake, gross return, net return (₹ ha^{-1}) and B: C ratio in raised bed sowing with application of pressmud 2 t ha^{-1} as compared to other treatment combinations.

Keywords: American cotton, land management options, manurial application, quality, growth, yield and yield attributes, nutrient uptake and economics

Introduction
Cotton (*Gossypium* spp.) is one of the most important fibre and cash crop of India and plays an important role in the industrial and agricultural economy of the country. India has emerged as the second largest producer of cotton in the world and occupies the first position. Land management options including the alteration of shape of seed bed and land surface among the various methods the broad bed, raised bed and furrow sowing, furrow sowing, tied ridge sowing, ridge with mulches, on ridge, alternate furrow sowing, ridge sowing are adopted by the crop grower for cotton and other crops for obtaining the better yield over the flat bed or conventional method of sowing. Better conditions for plant growth are provided in furrow planting due to higher soil moisture, higher salt leaching and reduction in evaporation from the soil surface (Zhang *et al.*, 2007; Li *et al.*, 2010) [30, 7, 22]. Land management options such as raised bed and furrow system and mulch sowing results in speedy and safe disposal of excess rain water and reduction in soil and water losses, stabilizing cotton production in rain fed areas (Gupta *et al.*, 1978) [16]. Land management options plays an important role in conservation of maximum possible rainwater in the soil. Ridge furrow and bed furrow land management systems have emerged as few of the most promising sustainable crop management technologies which increased input use efficiency and production (Yadav *et al.*, 2003) [29].

The furrow system of cultivation involve this is an effective land management options for maximizing rainfall infiltration, minimizing erosion, total runoff, facilitates drainage and ultimately improves water use efficiency. The raised bed and furrow system is better aerated with lower penetration resistance and favourable for deeper seed placement and better crop emergence (Jayapaul *et al*., 1996) [18]. Use of high doses of chemicals may become a major contributor to soil degradation, ground water as weir as environmental pollution. Further imbalance use of chemicals limit the crop yield (Khaddar *et al.*, 2002) [19] therefore, it has become imperative to substitute fertilizers and pesticides by some other cheap sources like manures less harmful effect on survival of soil microorganisms as well as predators and parasites of cotton. Thus efforts should be made to boost up the production of cotton through organic manures. Organic cotton production is expected to expand in response to increased demand for organic fibre. Organic cotton is the production system, which can bring back the cotton cultivation on sustainable basis without affecting environment. Organic cotton production system involves practices through organics like, manurial application i.e. FYM, vermicompost, pressmud, *etc*. Organic soil conditioners supply plant nutrients in available form and also enhance the nutrient availability by improving the physical environment of soil. Organic farming preserves the ecosystem. Symbiotic life forms are cultured ensuring weed and pest control and optimum soil biological activity, which maintain fertility. Organic farming neither demands the use of synthetic fertilizers nor the harmful chemicals (pesticides and fungicides) for controlling weeds, insects and pests. Organic farming relies on large• scale application of animal or farmyard manure (FYM), compost, crop rotation, residues, green manuring, vermicompost, and biopesticides. FYM is known to play an important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition. It improves the structure and water holding capacity of soil.

Materials and methods

Field experiments were conducted during Kharif of 2017 at at the Agricultural Research Farm, Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh (India). The geographical situation of the farm lies in the Northern Gangetic Alluvial plain at 25°18' North latitudes, 83°03' East longitude and at an altitude of 80.71 meters above the mean sea level. The predominant soil in the experimental field was sandy-clay loam classified as Inceptisol having pH of 7.3 and 0.35 percent organic carbon. The experimental field was well drained with uniform topography and assured source of water supply. The experiment was laid out in a split plot design replicated thrice. The experiment was laid out in split plot design. Main plot treatment comprises of four land management options (1) conventional sowing method (O_1), (2) mulch sowing method (O_2), (3) furrow sowing method (O_3) and (4) raised bed sowing method (O_4)) whereas, sub plot treatments consists of four manurial application (control (M_0), farmyard manure (M_1), vermicompost (M_2), and pressmud (M_3)). The experimental soil was low in available available nitrogen (195.50 kg ha-1), medium in available phosphorus (17.88 kg ha-1 and medium in available potassium (207.15 kg ha-1)_ Cotton variety SR 270 (160-180 days duration) was raised for the study. The seeds of cotton were sown at a spacing of 90 X 45 cm with two seeds per hill. Other cultivation practices normally recommended for the cotton crop were followed. Different sources of manurial application *viz.*, pressmud (2 t ha^{-1}), vermicompost (2.5 t ha^{-1}), farmyard manure (10 t ha^{-1}), applied before 30 days of sowing as well decomposed. Well decomposed manures were analyzed for the nutrient content. The nutrient content and the quantity of manures applied are given in Table 1. Observation recorded like Plant height was recorded at 40, 80,120,160 and harvest. The plant height measured from the surface of the soil to the tip of the top most leaf at harvest. LAI was estimated at 40 and 80 DAS. Chlorophyll content was estimated at 40 and 120 DAS with the help of SPAD mete. The number of monopodial and sympodial branch recorded at 50% square emerg. Dry matter production was recorded at 40, 80, 120,160 DAS and harvest stage. Yield and yield attributes like Number of boll $plant^{-1}$ were counted from three tagged plants in each plot and was averaged to get the number of boll plant. 20 randomly selected open bolls in each plot were picked, weighed and averaged to get the weight $boll^{-1}$. Seed cotton yield from pickings were weighed separately and were added to get plot" seed cotton yield. Seed cotton yield was expressed in kg ha-1. Cotton seed yield from three pickings were weighed separately and were added to get plot" cotton seed yield. Cotton seed yield was expressed in kg ha^{-1}. Stalk yield from three pickings were weighed separately and were added to get plot and stalk yield was expressed in kg ha^{-1} Lint yield from three pickings were weighed separately and were added to get plot 1 yield. Lint yield was expressed in kg ha-1 The harvest index was calculated by dividing the economic (grain) yield by total biological yield (grain+ straw) and multiplying the fraction by 100. Seed index is the weight in g of 100 seeds of cotton obtained after ginning. 100 seeds were picked at random after ginning the seed cotton and their weight was recorded in gram.

quality parameter like ginning percentage All the seed cotton picked from individual plot was mixed and a composite sample weighing 100 g was taken for ginning. The samples were ginned and weight of lint was recorded. The ginning percentage was computed by using the formula.

$$\text{Ginning percentage} = \frac{\text{Weight of lint}}{\text{weight of seed cotton}} \times 100$$

Fibre strength (g tex^{-1}) Fibre strength is measured by breaking the fibres held between clamp jaws. It's reported as grams per tex, which is the force in grams required to break a bundle of fibres one tex unit in size. Oil content in seed was eastimated by soxhlet method given by sankaran (1966). The oil content was computed by using the formula.

$$\text{Oil content (\%)} = \frac{\text{Weight of oil (g)}}{\text{weight of seed sample (g)}} \times 100$$

Oil yield Oil yield was obtained from oil content multiplied by seed yield and expressed in kg ha^{-1}. The oil yield was computed by using the formula.

$$\text{Oil yield (kg ha}^{-1}) = \frac{\text{Oil content (\%) in seed} \times \text{seed yield } (\frac{\text{kg}}{\text{ha}})}{100}$$

Plant analysis for estimation of nitrogen, phosphorus and potassium content, representative samples of plant were taken at the time of threshing. Each dried plant sample was ground fine powder in Willey mill for estimating the nutrient content. For estimating the nutrient content in plant, each sample was ground by an electric grinder. Nutrient content in plant were

determined by using standard methods. Determination of nitrogen by Kjeldhal method. Determination of phosphorous Taking the aliquot from the stock solution P content was estimated by the vanado molybdo phosphoric acid. Yellow colour method in nitric acid system by Koeing and Johnson (1942) [20]. The K content in extract was estimated by flame photometer. Economics The economics of various treatments was worked out separately by taking into account the existing price of inputs and produce. The investment on fertilizers, labour, and power for performing different operations such as ploughing, weeding, irrigation, harvesting, threshing etc were worked out as per rate prevalent at the Agriculture Research Farm, Institute of Agricultural Sciences, B.H.U, Varanasi. The cost of cultivation was taken 42 in to account for calculating economics of treatments and expressed as net return and output: input ratio.

Result and Discussion

There was a significant effect of raised bed sowing on growth characters viz., plant height (81.64 cm) leaf area index (042 dm^{-2}/m^{-2}), chlorophyll content (41.40 µ mol m^{-2}), number of monopodial (6.83) and sympodial (10.81) branches $plant^{-1}$, dry matter accumulation (87.02 g) $plant^{-1}$ of cotton was significantly increased by raised bed sowing method (M_4) at all growth parameter of cotton at all the physiological stages of crop growth as compared to rest sowing method has been reported by Kuotsu *et al.*, (2014) [6], Parihar *et al.*, (2010) [10, 25], Parihar *et al.*, (2012) [11] and Om *et al*., (2013) [9, 24]. A significantly increase in all the growth parameter *viz*., plant height (82.02 cm) leaf area index (0406 dm^{-2}/m^{-2}), chlorophyll content (41.08 µ mol m^{-2}), number of monopodial (7.05) and sympodial (11.16) branches $plant^{-1}$, dry matter accumulation (85.50 g) $plant^{-1}$ of cotton application pressmud compare to other manorial application (Table 2, 3, 4) has been reported by Meena *et al*., 2014 [8]

The significantly higher yield and yield attributes like number of boll (21.23), boll weight (4.59 g), seed cotton yield (1257.72 kg ha^{-1}), stalk yield (2526.58 kg ha^{-1}), harvest index (32.92%), cotton seed yield (759.78 kg ha^{-1}), lint yield (498.06 kg ha^{-1}), seed index (6.95 g), lint index (4.58 g) raised bed sowing method compare to other treatments (furrow, mulch and conventional sowing method) has been reported by Chiroma *et al*. (2006), Rathore *et al*. (2010) [12], Kumar and Meena (2018) [4, 5] and Kumar and Meena (2018) [4, 5]. The application of pressmud significantly higher yield and yield attributes like number of boll (20.88), boll weight (4.72 g), seed cotton yield (1315.40 kg ha^{-1}), stalk yield (2713.50 kg ha^{-1}), harvest index (32.61%), cotton seed yield (799.93 kg ha^{-1}), lint yield (515.47 kg ha^{-1}

seed index (7.25 g), lint index (4.68 g) (Table 3) compare to vermicompost, farmyard manure and control has been reported by Suman and Poonia, (2007) [13], Venugopalan and Blaise, (1999) [14], Channaveerswami, (2005) [2], Arsalan *et al*. (2016) [1].

quality parameter, nutrient uptake and economics of cotton. Quality parameter like fiber strength (24.40 g tex^{-1}), oil content (20.10%) and oil yield (257.10 kg ha^{-1}). Similar results were reported by (Morgan *et al*., 1998), Parihar *et al*. (2010) [10, 25], Dhange *et al*. (2010). Raised bed sowing method significantly higher nitrogen (76.56 kg ha^{-1}), phosphorus (20.31 kg ha^{-1}), potassium (77.38 kg ha^{-1}) uptake compare to other sowing method. Similar results were reported by Om *et al*. (2013) [9, 24] and Jat *et al*. (2012) [17]. The economic analysis revealed that maximum Gross return (₹ 57870.62 ha^{-1}), net return (₹ 36087.35 ha^{-1}) and B: C ratio (1.37) was achieved when cotton was sown under raised bed method compare to furrow sowing, mulch sowing and conventional sowing method. This is in conformity with the findings of Om *et al*. (2013) [9, 4] and Parihar *et al*. (2010) [10, 25]

Application of pressmud (2 t ha^{-1}) significantly improved the quality parameter fiber strength (24.58 g tex^{-1}), oil content (19.73%) and oil yield (261.09 kg ha^{-1}) and nitrogen (78.60 kg ha^{-1}), phosphorus (20.85 kg ha^{-1}), potassium (79.59 kg ha^{-1}) uptake compare to vermicompost, farmyard manure and control. Similar results were reported by Rakkiyappan *et al*. (2001) [27], Rangraj *et al*. (2007) and Kumar and Verma (2002). The economic analysis revealed that maximum Gross return (₹ 57976.90 ha^{-1}), net return (₹ 34858.90 ha^{-1}) and B: C ratio (1.50) was achieved when cotton application of pressmud compare to vermicompost, farmyard manure and control. Similar results were reported by Reddy *et al*. (1992) [28], Rajkhowa *et al*. (2002) [26]

Table 1: Effect of land management options and manurial application on growth parameter of American cotton

Treatment	Plant height (cm)		Leaf area index (dm^{-2}/m^{-2})		Chlorophyll content (µ mol m^{-2})		No of Monopodial branch		No of Sympodial branch		Dry matter accumulation (g)	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Land management options												
O_1- Conventional sowing method	67.32	74.54	0.350	0.354	35.12	36.75	5.12	5.34	8.12	8.46	70.80	73.33
O_2- Mulch sowing method	69.22	77.83	0.352	0.358	37.01	38.25	5.15	5.83	9.14	9.23	73.14	77.83
O_3- Furrow sowing method	71.25	80.71	0.391	0.394	38.11	39.80	6.01	6.32	9.80	10.01	76.76	82.38
O_4- Raised bed sowing method	75.57	81.64	0.422	0.428	40.72	41.40	6.23	6.83	10.21	10.81	81.01	87.02
SEm±	0.31	0.29	0.065	0.071	0.31	0.35	0.03	0.04	0.03	0.05	0.34	0.99
CD (p=0.05)	1.11	1.01	NS	NS	1.20	1.24	0.10	0.12	0.13	0.18	3.02	3.42
Manurial application												
M_0-Control	69.39	70.80	0.329	0.334	34.65	35.25	3.10	3.90	6.01	6.18	67.13	70.80
M_1-Farmyard manure	71.15	79.41	0.390	0.393	37.98	39.58	6.05	6.57	10.03	10.40	78.34	81.01
M_2-Vermicompost	74.45	81.49	0.399	0.402	39.35	40.30	6.11	6.81	10.05	10.78	78.36	83.25
M_3-Pressmud	76.62	82.02	0.401	0.406	40.02	41.08	6.79	7.05	11.00	11.16	80.56	85.50
SEm±	0.31	0.17	0.061	0.064	0.31	0.38	0.02	0.02	0.03	0.04	0.31	0.38
CD (p=0.05)	1.00	0.48	NS	NS	1.00	1.09	0.05	0.07	0.09	0.11	1.01	1.10

Table 2: Effect of land management options and manorial application on yield and yield attributes of American cotton

Treatment	No. of boll (plant^{-1})		Boll weight (g)		Seed cotton yield (kg ha^{-1})		Stalk yield (kg ha^{-1})		Harvest index (%)		Cotton seed yield (kg ha^{-1})		Lint yield (kg ha^{-1})	
Year	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Land management options														
O_1- Conventional sowing method	14.01	14.25	3.50	3.52	865.35	876.44	1870.12	1879.25	31.63	31.64	570.31	576.36	305.04	300.08
O_2- Mulch sowing method	16.09	16.25	3.71	3.75	999.13	1001.31	2116.87	2124.92	32.06	32.04	631.43	636.40	361.7	364.91
O_3- Furrow sowing method	17.45	18.60	4.22	4.28	1120.01	1128.12	2299.65	2306.75	32.75	32.81	692.32	697.38	427.69	430.74
O_4- Raised bed sowing method	20.29	21.23	4.51	4.59	1249.71	1257.78	2513.52	2526.58	33.20	32.92	750.69	759.72	493.02	498.06
SEm±	0.31	0.57	0.09	0.10	34.57	34.77	32.51	36.55	0.45	0.47	15.95	15.98	13.81	13.90
CD (p=0.05)	1.03	1.97	NS	NS	119.13	120.33	123.41	126.48	NS	NS	55.23	55.29	48.01	48.11
Manurial application														
M_0-Control	10.22	11.25	3.00	3.11	498.41	504.44	1078.34	1087.42	31.60	31.74	355.98	359.98	142.43	144.46
M_1-Farmyard manure	16.67	18.60	4.02	4.15	1178.12	1190.95	2450.56	2465.92	32.46	32.48	735.08	740.09	443.04	450.86
M_2-Vermicompost	18.56	19.60	4.11	4.23	1235.09	1252.86	2556.61	2570.67	32.50	32.59	761.82	769.86	473.27	483.01
M_3-Pressmud	19.81	20.88	4.60	4.72	1301.02	1315.40	2698.40	2713.50	32.53	32.61	791.90	799.93	509.12	515.47
SEm±	0.44	0.41	0.13	0.10	23.23	22.10	25.76	27.88	0.36	0.37	9.07	9.09	8.71	8.74
CD (p=0.05)	1.11	1.19	NS	NS	66.22	64.52	78.23	81.38	NS	NS	26.50	26.53	25.45	25.52

Table 3: Effect of land management options and manorial application on quality and nutrient uptake of American cotton

Treatment	Fiber strength (g tex^{-1})		Oil content (%)		Oil yield (kg ha^{-1})		Seed index (%)		Lint index (%)		Ginning percentage	
Year	**2016**	**2017**	**2016**	**2016**	**2017**	**2016**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Land management options												
O_1- Conventional sowing method	22.01	22.50	18.21	18.74	160.91	162.95	4.87	4.96	2.50	2.58	33.40	33.49
O_2- Mulch sowing method	23.03	23.25	18.42	18.92	188.96	191.01	5.30	5.61	3.03	3.23	35.10	35.21
O_3- Furrow sowing method	23.26	23.80	19.23	19.60	223.21	224.27	6.01	6.27	3.65	3.89	36.56	36.65
O_4- Raised bed sowing method	24.00	24.40	20.00	20.10	252.18	257.10	6.76	6.95	4.12	4.58	37.70	37.84
SEm±	0.21	0.25	0.53	0.57	6.91	6.97	0.02	0.04	0.06	0.08	0.23	0.33
CD (p=0.05)	NS	NS	NS	NS	24.01	24.12	0.05	0.15	0.17	0.27	1.10	1.15
Manurial application												
M_0-Control	21.02	21.25	18.05	18.65	92.18	94.10	2.90	3.01	1.19	1.21	28.50	28.63
M_1-Farmyard manure	23.31	23.83	19.09	19.35	230.12	232.51	6.43	6.60	3.78	4.03	37.32	37.46
M_2-Vermicompost	24.03	24.30	19.13	19.63	245.09	247.62	6.70	6.92	4.01	4.35	38.11	38.27
M_3-Pressmud	24.23	24.58	19.25	19.73	260.01	261.09	7.00	7.25	4.23	4.68	38.50	38.83
SEm±	0.11	0.18	0.33	0.39	5.22	5.27	0.06	0.03	0.06	0.05	0.12	0.18
CD (p=0.05)	NS	NS	NS	NS	15.32	15.39	0.14	0.10	0.16	0.14	0.34	0.53

Table 4: Effect of land management options and manurial application on nutrient uptake by American cotton

Treatment	N content (%)		P content (%)		K content (%)		N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		K uptake (kg ha^{-1})	
Year	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**	**2016**	**2017**
Land management options												
O_1- Conventional sowing method	0.85	0.98	0.015	0.017	0.44	0.48	58.12	63.06	11.13	12.50	61.05	62.71
O_2- Mulch sowing method	1.01	1.05	0.016	0.020	0.51	0.54	63.42	67.48	12.35	14.05	63.14	67.52
O_3- Furrow sowing method	1.16	1.21	0.012	0.023	0.63	0.67	67.18	71.97	14.02	15.90	69.98	72.39
O_4- Raised bed sowing method	1.27	1.32	0.023	0.027	0.74	0.76	70.11	76.56	15.08	17.88	73.34	77.38
SEm±	0.12	0.22	0.003	0.006	0.19	0.22	1.13	0.32	0.42	0.08	1.01	0.32
CD (p=0.05)	NS	NS	NS	NS	NS	NS	4.01	1.11	1.56	0.27	2.01	1.10
Manurial application												
M_0-Control	0.89	0.93	0.012	0.015	0.39	0.41	48.12	49.89	9.56	10.25	47.85	48.41
M_1-Farmyard manure	1.12	1.14	0.019	0.022	0.61	0.64	68.15	74.11	13.82	15.88	70.46	74.81
M_2-Vermicompost	1.13	1.17	0.021	0.025	0.63	0.68	71.34	76.47	14.01	16.63	74.13	77.19
M_3-Pressmud	1.29	1.34	0.023	0.027	0.69	0.72	73.01	78.60	15.21	17.58	76.23	79.59
SEm±	0.10	0.11	0.021	0.028	0.12	0.14	0.31	0.23	0.31	0.06	0.71	0.25
CD (p=0.05)	NS	NS	NS	NS	NS	NS	1.00	0.66	1.01	0.18	2.03	0.72

Table 5: Effect of land management options and manurial application on relative economics by American cotton

Treatment	Gross return (₹ ha^{1})		Net return (₹ ha^{-1})		B:C ratio	
Year	2016	2017	2016	2017	2016	2017
Land management options						
O_1- Conventional sowing method	36484.12	38715.06	15235.13	16397.06	0.65	0.71
O_2- Mulch sowing method	42082.01	44204.37	20123.35	21686.37	0.86	0.93
O_3- Furrow sowing method	47100.05	49697.89	25111.45	26879.89	1.10	1.13
O_4- Raised bed sowing method	52501.92	55375.66	31123.65	32557.66	1.34	1.37
SEm±	379.11	335.51	234.67	339.06	0.02	0.01
CD (p=0.05)	1359.19	1161.05	1130.34	1173.33	0.09	0.05
Manurial application						
M_0-Control	21023.82	22289.66	3001.34	3171.66	0.15	0.17
M_1-Farmyard manure	49590.72	52502.48	27110.23	28384.48	1.16	1.17
M_2-Vermicompost	51974.27	55223.94	30125.35	31105.94	1.27	1.29
M_3-Pressmud	54754.3	57976.90	33234.34	34858.90	1.48	1.50
SEm±	298.13	268.65	270.56	268.46	0.04	0.01
CD (p=0.05)	1101.13	784.18	984.56	783.61	0.13	0.03

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