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Decomposition of agriculture wastes by using microorganisms

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Abstract
An experiment was conducted at Plant Pathology Section, College of Agriculture, Nagpur during 2023-2024. A six main treatment i.e. Paddy straw, Cotton stalk, Tur stalk, Wheat straw, Soyabean straw and sugarcane bagasse. The enrichment of biofertilizers and their combinations i.e. *Mesorhizobium ciceri*, *Azotobacter chroococcum*, *Pseudomonas fluorescencs* was procure from Department of Plant Pathology, College of Agriculture, Nagpur. and it was to investigate their percent loss in weight after decomposition of agriculture wastes material. It was observed that the maximum loss of weight the treatment A_4B_2 (Wheat straw × *Azotobacter chroococcum*) at 30 and 60 days i.e. 23.50%, 58.17% and 141.00g, 349.02g and weight of straw after (30 and 60 days) 459.00g and 250.98g followed by treatment A_1B_5 (Paddy straw × *Mesorhizobium ciceri* + *Azotobacter chroococcum*) at 30 and 60 days 20.87%, 57.67% and 104.35g, 288.35 g and weight of straw after (30 and 60 days) 395.65 g and 211.65 g.

Keywords: Agriculture wastes, *Mesorhizobium ciceri*, *Azotobacter chroococcum*, *Pseudomonas fluorescencs*, decomposition

1. Introduction
The burning of agricultural residue has provided short-term gain for the removal of waste from the fields; however, it has drastically impacted the long-term losses in the form of soil health destruction, decreased soil fertility, deficiencies of essential minerals (in terms of C, N, P, K), reduced crop yield, productivity and addition to the non-cultivable lands. Previous studies remarked the adverse effects of agricultural residue burning with reference to air pollution due to the emission of toxic and hazardous nauseous gases (Gadde *et al*., 2009; Sahu *et al*, 2015; Andini *et al*., 2018) [15, 27, 5]. Decomposition of organic residues of either plant or animal origin has been essentially a microbiological process. The decomposition brings about various changes. The decomposed organic matter leads to the formation of humic substances, which appreciably influence the soil fertility.

2. Materials and Methods
During the present investigation, experiments were carried out on "Decomposition of Agriculture Wastes by Using Microorganisms'' Materials used and methods adopted are described in this chapter. The present investigation was carried out during 2023 at Plant Pathology Section, College of Agriculture, Nagpur. The experiment was undertaken in CRD (Completely Randomized Design) with treatments and six replications and FCRD (Factorial Completely Randomized Design) with treatments and three replications. In this experiment carried out in polythene bag. Agriculture wastes materials i.e. main treatments A_1 - paddy straw, A_2 - cotton stalk, A_3 - tur stalk, A_4 - wheat straw, A_5 - soyabean straw and A_6 - sugarcane bagasse was cut into pieces up to 1-2 inches and sterilized with autoclave. At first this substrate was added in to Nagpur bio-decomposer, and after two months decomposition then enrichment of biofertilizer i.e. sub-treatments B_1 - *Mesorhizobium ciceri*, B_2 - *Azotobacter chroococcum*, B_3 - *Pseudomonas fluorescence*, B_4 - *Mesorhizobium ciceri* + *Pseudomonas fluorescencs*, B_5 - *Mesorhizobium ciceri* + *Azotobacter chroococcum*, B_6 - *Azotobacter chroococcum* + *Pseudomonas fluorescencs*.

In this culture (Department of Plant Pathology, College of agriculture, Nagpur). At 30 and 60 days the observations on loss in weight.

2.1 Percent loss in weight of substrates

The organic material in the polythene bag were used to estimate the loss in weight of an organic matters. The loss in weight was determined by subtracting the final weight from initial weight.

3. Results and Discussion

3.1 Estimation of loss in weight: Decomposition of agriculture wastes by inoculum of fungal culture (Nagpur Bio-decomposer)

The data revealed in Table 1 and 2. and depricted in figure no.1. revealed that the treatment A_1 (i.e. Paddy straw + Nagpur Bio-decomposer) were found effective over all other treatments. It was observed that the treatment A_1 (i.e. Paddy straw + Nagpur Bio-decomposer) showed maximum loss in weight of agriculture wastes of all other treatments after 30 and 60 days of decomposition i.e. 20%, 46.42% and 0.56g, 1.30g followed by treatment A_5 (i.e. Soyabean straw + Nagpur Bio-decomposer) 18.92%, 44.64% and 0.53g, 1.25g. The reduction in weight was more significant during the first 45 days. Andrea et al. (1998) [6], measured a weight loss 29%, and Gautam et al. (2010) [19] observed weight loss over a 45 days period. These results confirm the finding of Somani *et al*., (1982) [28], Bhasme *et al*. (2006) [8], Gade *et al.* (2010) [16].

Table 1: Percent loss in weight of substrates after 30 days of inoculation of fungal culture during decomposition of agriculture wastes

Treatment No.	Treatments	Initial weight (kg)	Loss in weight at 30 days (kg)	Loss in weight at 30 days (%)	Weight of straw after 30 days (kg)
A_1	Paddy straw + Nagpur Bio-decomposer	2.80	0.56	20	2.24
A_2	Cotton stalk + Nagpur Bio-decomposer	2.70	0.40	14.82	2.30
A_3	Tur stalk + Nagpur Bio-decomposer	2.80	0.43	15.36	2.37
A_4	Wheat straw + Nagpur Bio-decomposer	2.80	0.52	17.85	2.28
A_5	Soyabean straw + Nagpur Bio-decomposer	2.80	0.53	18.92	2.27
A_6	Sugarcane bagasse + Nagpur Bio-decomposer	2.70	0.29	10.75	2.41
'F' Test		-	-	Sig	-
SE(m) ±		-	-	0.15	-
CD (P=0.05)		-	-	0.44	-

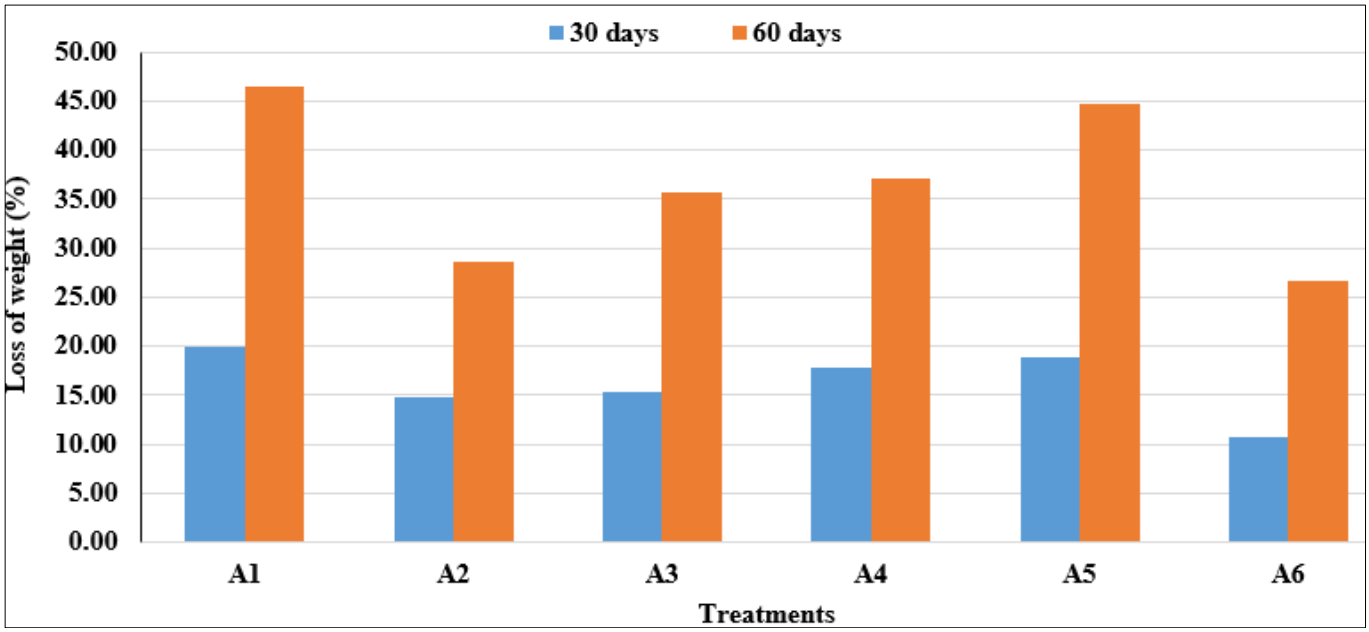

Fig 1: Percent loss in weight of substrates after 30 and 60 days of fungal culture inoculation.

Table 2: Percent loss in weight of substrates after 60 days of inoculation of fungal culture during decomposition of agriculture wastes.

Treatment No.	Treatments	Loss in weight at 60 days (kg)	Loss in weight at 60 days (%)	Weight of straw after 60 days (kg)
A_1	Paddy straw + Nagpur Bio-decomposer	1.30	46.42	1.50
A_2	Cotton stalk + Nagpur Bio-decomposer	0.80	28.57	1.90
A_3	Tur stalk + Nagpur Bio-decomposer	1.00	35.71	1.80
A_4	Wheat straw + Nagpur Bio-decomposer	1.05	37.50	1.75
A_5	Soyabean straw + Nagpur Bio-decomposer	1.25	44.64	1.55
A_6	Sugarcane bagasse + Nagpur Bio-decomposer	0.72	26.67	1.98
'F' Test		-	Sig	-
SE(m) ±		-	0.15	-
CD (P=0.05)		-	0.46	-

3.2 Decomposition of agriculture wastes by inoculum of bacterial culture

The data revealed in Table 3, 4, 5 and 6. and figure no. 2 and 3. revealed that in paddy straw the treatments A_1B_5 (i.e. Paddy straw × *Mesorhizobium ciceri* + *Azotobacter chrooccocum*) were found effective over all other treatments. The treatment A_1B_5 (i.e. Paddy straw × *Mesorhizobium ciceri* + *Azotobacter chrooccocum*) showed maximum loss in weight of all other treatments at all intervals (30 and 60 days) i.e. 20.87%, 57.67% and 104.35 g, 288.35 g and weight of straw after (30 and 60 days) 395.65 g and 211.65g followed by treatment A_1B_4 (i.e. Paddy straw × *Mesorhizobium ciceri* + *Pseudomonas fluorescencs*) i.e. 20.80%, 57.62% and 104.00 g, 288.10g and weight of straw after (30 and 60 days) 396.00 g and 211.90 g respectively.

In Cotton stalk the treatment A_2B_4 (i.e. Cotton stalk × *Mesorhizobium ciceri* + *Pseudomonas fluorescencs*) were found effective over all other treatments. The treatment A_2B_4 (i.e. Cotton stalk × *Mesorhizobium ciceri* + *Pseudomonas fluorescencs*) showed maximum loss in weight of all other treatments at all intervals (30 and 60 days) i.e. 18.61%, 44.55% and 117.80g, 282.00g and weight of straw after (30 and 60 days) 515.20g and 351.00g followed by treatment A_2B_5 (i.e. Cotton stalk × *Mesorhizobium ciceri* + *Azotobacter chrooccocum*) i.e. 18.53%, 44.46% and 117.29 g, 281.43 g and weight of straw after (30 and 60 days) 515.71 g and 368.09 g respectively.

In Tur stalk the treatment A_3B_4 (i.e. Tur stalk × *Mesorhizobium ciceri* + *Pseudomonas fluorescencs*) were found effective over all other treatments. The treatment A_3B_4 (i.e. Tur stalk × *Mesorhizobium ciceri* + *Pseudomonas fluorescencs*) showed maximum loss in weight of all other treatments at all intervals (30 and 60 days) i.e. 18.28%, 48.17% and 109.68 g, 289.02 g and weight of straw after (30 and 60 days) 490.32 g and 310.98 g followed by treatment A_3B_6 (i.e. Tur stalk × *Azotobacter chroococcum* + *Pseudomonas fluorescencs*) i.e. 18.20% 48.11% and 109.20 g 288.65 g and weight of straw after (30 and 60 days) 490.80 g and 311.34 g respectively.

In Wheat straw the treatment A_4B_2 (i.e. Wheat straw × *Azotobacter chroococcum*) were found effective over all other treatments. The treatment A_4B_2 (i.e. Wheat straw × *Azotobacter chroococcum*) showed maximum loss in weigh of all other treatments at all intervals (30 and 60 days) i.e. 23.50%, 58.17% and 141.00 g, 349.02 g and weight of straw after (30 and 60 days) 459.00 g and 250.98 g followed by treatment A_4B_6 (i.e. Wheat straw × *Azotobacter chroococcum* + *Pseudomonas fluorescencs*) i.e. 22.80%, 58.12% and 136.80 g 348.72 g and weight of straw after (30 and 60 days) 463.20 g and 251.28 g respectively.

In Soyabean straw the treatment A_5B_2 (i.e. Soyabean straw × *Azotobacter chroococcum*) were found effective over all other treatments. The treatment A_5B_2 (i.e. Soyabean straw × *Azotobacter chroococcum*) showed maximum loss in weight of all other treatments at all intervals (30 and 60 days) i.e. 20.48%, 49.18% and 87.04 g, 209.01 g and weight of straw after (30 and 60 days) 337.96 g and 215.99 g followed by treatment A_4B_5 (i.e. Soyabean straw × *Mesorhizobium ciceri* + *Azotobacter chrooccocum*) i.e. 18.40%, 49.13% and 78.20 g, 208.80 g and weight of straw after (30 and 60 days) 346.80 g and 216.20 g respectively.

In Sugarcane bagasse the treatment A_6B_6 (i.e. Sugarcane bagasse × *Azotobacter chroococcum* + *Pseudomonas fluorescencs*) were found effective over all other treatments. The treatment A_6B_6 (i.e. Sugarcane bagasse × *Azotobacter chroococcum* + *Pseudomonas fluorescencs*) showed maximum loss in weight of all other treatments at all intervals (30 and 60 days) i.e. 20.00%, 48.71% and 133.00g, 323.92 g and weight of straw after (30 and 60 days) 532.00g and 341.08 g followed by treatment A_6B_3 (i.e. Sugarcane bagasse × *Pseudomonas fluorescencs*) i.e. 19.88%, 48.67% and 132.20 g, 323.65 g and weight of straw after (30 and 60 days) 532.80 g and 341.35 g respectively.

The data revealed in table no 3, 4, 5 and 6. and depricted in figure no. 2 and 3. revealed that the treatment was found effective over other treatments. Treatment A_4B_2 (Wheat straw × *Azotobacter chroococcum*) recorded maximum loss of weight at 30 days 23.50%, 141.00 g, and 60 days 58.17%, 349.02 g and weight of straw after (30 and 60 days) 459.00g and 250.98 g as it was found significantly superior over all other treatments. It was followed by treatment A_1B_5 (Paddy straw × *Mesorhizobium ciceri* + *Azotobacter chrooccocum*) at 30 days 20.87%, 104.35g and 60 days 57.67%, 288.35g and weight of straw after (30 and 60 days) 395.65g and 211.65 g respectively. These results confirm the finding of Bahatkar *et al*., (2023) [9], loss in weight in cotton straw is 36.65%. Osama *et al*., (2013), loss in weight in cotton straw is 36.65%. Loss in weight in rice straw at 30 days is 38% Rupela *et al*., (2003) [25].

Table 3: Percent loss in weight of substrate after 30 days inoculation of bacterial culture during decomposition of agriculture wastes.

Treatments	Initial weight (g)	Loss in weight at 30 days (g)	Loss in weight at 30 days (%)	Weight of straw after 30 days (g)	Initial weight (g)	Loss in weight at 30 days (g)	Loss in weight at 30 days (%)	Weight of straw after 30 days (g)	Initial weight (g)	Loss in weight at 30 days (g)	Loss in weight at 30 days (%)	Weight of straw after 30 days (g)
	A_1				**A_2**				**A_3**			
B_1	500	88.35	17.67	411.65	633	97.03	15.33	535.97	600	92.34	15.39	507.66
B_2	500	86.35	17.27	413.65	633	107.04	16.91	525.96	600	95.70	15.95	504.30
B_3	500	90.00	18.00	410.00	633	90.70	14.33	542.30	600	103.08	17.18	496.92
B_4	500	104.00	20.80	396.00	633	117.80	18.61	515.20	600	109.68	18.28	490.32
B_5	500	104.35	20.87	395.65	633	117.29	18.53	515.71	600	100.68	16.78	499.32
B_6	500	91.35	18.27	408.65	633	99.82	15.77	535.18	600	109.20	18.20	490.80
Mean	-	94.06	18.81	405.93	-	104.94	16.58	528.38		101.78	16.96	509.11
	A				B				A×B			
'F' Test	Sig				Sig				Sig			
SE(m) ±	0.084				0.084				0.253			
CD (P=0.05)	0.238				0.238				0.715			

Table 4: Percent loss in weight of substrate after 30 days inoculation of bacterial culture during decomposition of agriculture wastes.

Treatments	Initial weight (g)	Loss in weight at 30 days (g)	Loss in weight at 30 days (%)	Weight of straw after 30 days (g)	Initial weight (g)	Loss in weight at 30 days (g)	Loss in weight at 30 days (%)	Weight of straw after 30 days (g)	Initial weight (g)	Loss in weight at 30 days (g)	Loss in weight at 30 days (%)	Weight of straw after 30 days (g)
	A_4				**A_5**				**A_6**			
B_1	600	99.00	16.50	510.00	425	75.01	17.65	349.99	665	117.37	17.65	547.66
B_2	600	141.00	23.50	459.00	425	87.04	20.48	337.96	665	115.11	17.31	549.89
B_3	600	108.72	18.12	491.28	425	77.01	18.12	347.99	665	132.20	19.88	532.80
B_4	600	102.00	17.00	498.00	425	69.02	16.24	355.98	665	116.37	17.50	548.63
B_5	600	116.04	19.34	483.96	425	78.20	18.40	346.80	665	112.85	16.97	552.15
B_6	600	136.80	22.80	463.20	425	72.03	16.95	352.97	665	133.00	20.00	532.00
Mean	-	117.26	19.54	500.08	-	76.38	17.97	364.95	-	121.15	18.21	462.12
	A				B				A×B			
'F' Test	Sig				Sig				Sig			
SE(m) ±	0.084				0.084				0.253			
CD (P=0.05)	0.238				0.238				0.715			

Table 5: Percent loss in weight of substrate after 60 days inoculation of bacterial culture during decomposition of agriculture wastes.

Treatments	Loss in weight at 60 days (g)	Loss in weight at 60 days (%)	Weight of straw after 60 days (g)	Loss in weight at 60 days (g)	Loss in weight at 60 days (%)	Weight of straw after 60 days (g)	Loss in weight at 60 days (g)	Loss in weight at 60 days (%)	Weight of straw after 60 days (g)
	A_1			**A_2**			**A_3**		
B_1	266.00	53.20	234.00	259.02	40.92	373.98	249.00	41.50	351.00
B_2	251.65	50.33	248.35	257.06	40.61	375.94	254.70	42.45	343.30
B_3	272.00	54.40	228.00	267.69	42.29	365.31	271.20	45.20	328.80
B_4	288.10	57.62	211.90	282.00	44.55	351.00	289.02	48.17	310.98
B_5	288.35	57.67	211.65	281.43	44.46	351.57	265.02	44.17	334.98
B_6	281.00	56.20	219.00	264.91	41.85	368.09	288.66	48.11	311.34
Mean	274.51	54.90	225.48	268.68	42.44	364.31	269.60	44.93	330.06
	A			B			A×B		
'F' Test	Sig			Sig			Sig		
SE(m) ±	0.053			0.053			0.160		
CD (P=0.05)	0.150			0.150			0.451		

Table 6: Percent loss in weight of substrate after 60 days inoculation of bacterial culture during decomposition of agriculture wastes.

Treatments	Loss in weight at 60 days (g)	Loss in weight at 60 days (%)	Weight of straw after 60 days (g)	Loss in weight at 60 days (g)	Loss in weight at 60 days (%)	Weight of straw after 60 days (g)	Loss in weight at 60 days (g)	Loss in weight at 60 days (%)	Weight of straw after 60 days (g)
	A_4			**A_5**			**A_6**		
B_1	317.04	52.84	282.96	191.03	44.95	233.97	273.38	41.11	391.62
B_2	349.02	58.17	250.98	209.01	49.18	215.99	268.06	40.31	396.94
B_3	328.92	54.82	271.08	199.66	46.98	225.34	323.65	48.67	341.35
B_4	323.52	53.92	276.48	193.03	45.42	231.97	306.03	46.02	358.97
B_5	314.04	52.34	285.96	208.80	49.13	216.20	300.04	45.12	364.96
B_6	348.72	58.12	251.28	201.02	47.30	223.98	323.92	48.71	341.08
Mean	330.21	55.03	269.79	200.42	47.16	224.57	299.51	44.99	365.82
	A			B			A×B		
'F' Test	Sig			Sig			Sig		
SE(m) ±	0.053			0.053			0.160		
CD (P=0.05)	0.150			0.150			0.451		

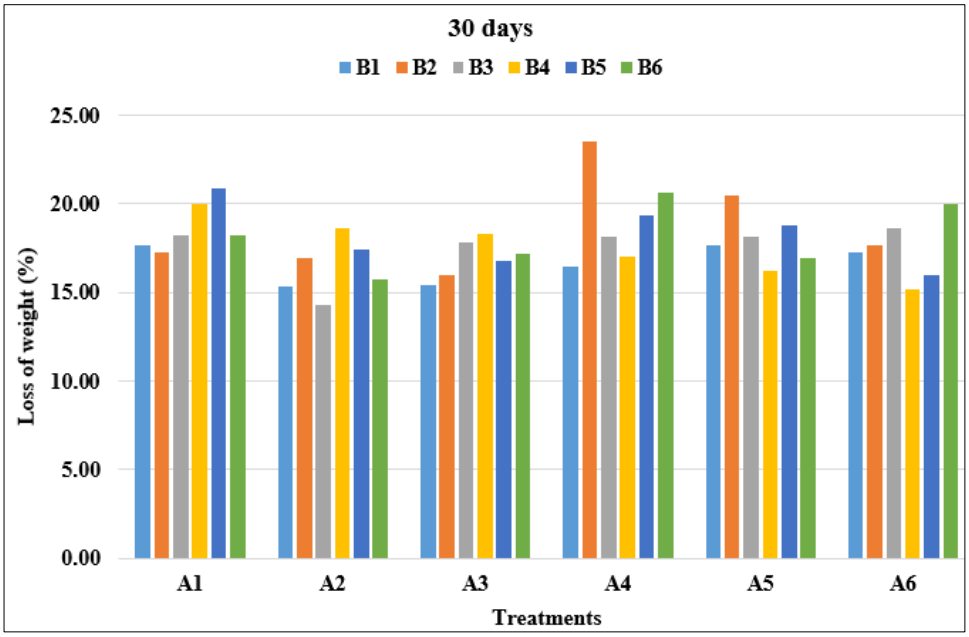

Fig 2: Percent loss in weight of substrate after 30 days of bacterial culture inoculation.

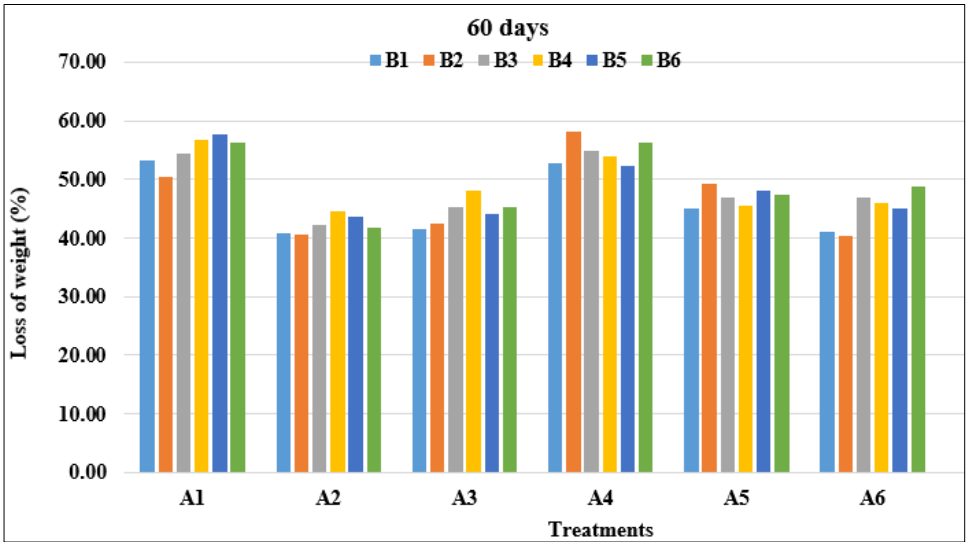

Fig 3: Percent loss in weight of substrate after 60 days of bacterial culture inoculation.

4. Conclusion

It is concluded from the present study evident that all the treatments of wheat straw were significantly effective over all the other treatments. They were significantly proficient to maximum loss in weight treatment A_4B_2 (Wheat straw × *Azotobacter chroococcum*) at 30 and 60 days.

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