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Influence of different rates of trash application with waste decomposer on N, P, and S mineralisation of soil under ratoon crop of sugarcane

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ABSTRACT

Sugarcane crops are a source of income for the rural people, but the residue of sugarcane is burnt by them, which causes harmful effects on the soil and atmosphere. Apart from this, if sugarcane residue is retained on the soil as mulch, it conserves soil moisture, improves the soil properties, and inhibits the growth of weeds. Addressing this issue, an experiment was conducted to find out the effect of trash management practices on the chemical properties of soil under sugarcane ratoon cultivation. The results revealed that a significantly higher [133.92 kg ha^{-1}] mean value of available N was recorded with the application of trash mulch with waste decomposer in alternate rows compared to the control. Application of trash mulch with waste decomposer in continuous rows reported a significantly higher [22.03 kg ha^{-1}] mean value of available P compared to the control. The application of trash mulch in alternate rows with waste decomposers shows the highest available S of soil [5.93 kg ha^{-1}] and is significantly higher than the control [5.20 kg ha^{-1}]. This study mainly emphasises the main effect of the trash residue of sugarcane on the physico-chemical properties of soil. It also helps in to enhance the soil health and soil fertility of soil.

Keywords: *Sugarcane, Trash, Burning, Mulching, Waste Decomposer, Management.*

Introduction

Sugarcane [*Saccharum officinarum*] is a widely grown commercial crop in the world and is cultivated in more than 105 countries. It belongs to the family Gramineae and has its centre of origin in New Guinea. *Saccharum officinarum* and its hybrids account for about 70% of the sugar produced globally. Sugarcane is the main source of sugar in India and holds a prominent position as a cash crop. India is the world's largest consumer and the second-largest producer of sugar, topped only by Brazil. It employs about one million people directly or indirectly. Additionally, it contributes significantly to the national economy through the export of sugarcane processed products, especially white sugar. In the year 2016-17, India exported 2542 thousand metric tons of sugar worth 8639 crore rupees [2], proving its pivotal role in India's economy. Sugarcane crop is the cash crop and good source of income for the farmers, but the trash burnt by farmers cause many harmful effects on soil environment and the atmosphere. Traditionally, Sugarcane residues are burnt after harvest which contributes to a decline in fertility and productivity of the soil. Usually farmers burn sugarcane residues due to a scarcity of labour to remove trash from the field and lack of knowledge regarding the use of trash as a source of organic carbon and nutrients.

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When sugarcane is retained on the soil as mulch, it improves the soil properties and inhibits the growth of weeds. The incorporation of residues elevates the level of organic matter and, may decrease the pH of soil by releasing hydrogen ions [20]. Burning of crop residue is often criticised because it deteriorates the fertility as well as soil health with the loss of soil organic matter, destabilisation of the soil aggregates, reduction of soil microbial activity and causing intense air pollution by emitting large amounts of carbon into atmosphere [10, 20]. If organic carbon is decreased, it affects the properties of soil and richly affects the productivity of the soil.

During burning, significant loss of nitrogen can occur from residues due to high temperature volatilisation [29]. In the burnt system, >70% of the organic matter and nutrients in the trash are lost to the atmosphere. On the other hand, retention of crop residues showed increase in soil organic matter and soil nutrient contents in other cropping systems [27]. Therefore, in situ trash management can be a good alternative to mitigate these problems. The retention of trash as a mulch can reform the soil organic matter content compared to the traditional burnt trash practices. Trash preserves the soil moisture, carbon, and nitrogen into the soil and provides energy to the plant for its growth. The trash application keeps the nutrients in the soil, also aids their availability to the plant which reduces the fertiliser requirements through recycling of nutrients in the soil from residue. Organic mulches also create better physical, chemical and biological environment of soils and in turn, improves crop productivity [16]. Use of trash as mulch also reduces the soil temperature in the topsoil and favor macro and microflora and fauna growth in the soil [33, 14].

The soil pH decreased in green trash blanketing treatment related to burnt [23]. The application of trash for a long period did not brought any significant change in EC and pH however, in the unfertilized plot, the pH was 3.5 at top of the soil [0-15 cm] and 4.5 [10-30 cm] at depth. Application of mulch with fertilizer lowered the pH [3.4] compared with the burnt plot [3.5]. The application of trash in soil decreased the soil pH and increased the macro and micronutrients in the soil [32, 21, 31]. The soil organic carbon and nitrogen were 21% more under trash blanketing than burning on top 0 to 25 cm depth. The soil net mineralization did not change significantly, but the post-analysis of different treatments at a different time of experiments revealed net mineralisation to be lower in green cane trash blanketing treatments than burnt treatment [17]. The sugarcane trash applied as mulch increased the available N and available P by 37 kg $ha^{-1,}$ and 10 kg $ha^{-1,}$ respectively, over control and it helps in the conservation of the nutrients in the soil. The trash burning reduced the available N by 15 kg ha^{-1} and available P by 16 kg ha^{-1}over control [37]. With the application of trash there was decrease in available N [261-246 kg ha^{-1}] and available P [55-39 kg ha^{-1}] [38]. On the other side increase in P from 161 to 168 kg ha^{-1} was observed in trash application plot and available N, P, and K all three nutrients were increased from 261-299, 55-65, and 161-165 kg ha^{-1}, respectively. The trash recovered and recycling the soil N [40 kg N ha^{-1}] and yielding [65.5 kg N ha^{-1}] from the trash. In the second cycle 62 kg N ha^{-1}, yielding a total of 127.5 Kg N ha^{-1}. And in the second cycle, the total N increased 168.8 kg N ha^{-1} in the long-term experiment after the adding of sugarcane residue in the soil [34]. A significant increase in available N content in 0 to 7.6 and 7.6 to 15 cm and available P content in 0 to 15 cm soil depth, respectively after four crop fallow cycles and one year fallow and this increase was directly proportional to quantity of crop residue added throughout the experiment [4].

The addition of surface mulch gave higher values of available P and total N in soil as compared to the control [18]. When harvest sugarcane residue is returned to the soil, nutrients and organic matter increase and soil structure improves [13]. This management system allows the return of an important quantity of crop residues to the soil, favouring nutrient recycling, reducing both water and wind erosion, diminishing soil water evaporation, increasing infiltration and allowing a better conservation of soil moisture. The straw blanket also reduces evaporative losses of water and also creates a beneficial environment for plants and soil biota, decrease in soil temperature and improve soil structure.

Thus, it becomes strategic to manage the sugarcane trash so that we can control environmental pollution and conserve soil health, soil quality and soil ecosystem.

2 Material and Methods

2.1 Soils sampling and preparation

One representative soil sample [0-15cm] was collected from the experimental site [Regional Research Station, Uchani Karnal, CCS Haryana Agricultural University] Hisar was analyzed for initial chemical and physical properties of the soil such as texture, pH, EC, Organic carbon, available N, P, K and S using the standard procedure. The composite soil sample from the top of the soil [0-15cm] was taken randomly from at least 5 sites following the zigzag manner. The collected soil sample was mixed thoroughly to obtain a representative sample of the experimental field. For mechanical and chemical analysis of soil 2 mm air dried, grounded soil is used. The initial results of soil analysis described that soil experiment field were clay loam, low soil organic carbon with neutral soil pH, low in available N, medium in available P and K. The initial soil physico-chemical properties of the experiment field are given in Table 1.

Table 1: Initial physico-chemical properties of soil of the experimental site

Sr. No.	Parameter	Units	Value	Method of Analysis
1.	Texture	-	Clay Loam	International Pipette Method [26]
2	Bulk Density	Mg m^3	1.5	Core Method [6]
3.	EC $_{1:2}$	dS m^{-1}	0.18	Conductometric method [11] using 1:2 soil: water suspension]
4.	pH $_{1:2}$	-	8.08	The potentiometric Method [11] using 1:2 soil water suspension
5.	OC	%	0.40	Wet Oxidation Method [35]
6.	Available N	kg ha^{-1}	106.1	Kjeldahl -Distillation Method [30]
7.	Available P	kg ha^{-1}	18.1	$NaHCO_3$ Extraction and Colorimetry [25]
8.	Available K	kg ha^{-1}	204	1N NH_4OAC Extraction and Flame Photometry [11]
9.	Available S	kg ha^{-1}	5.3	$CaCl_2$ Extractable Sulphur [35]

2.2 Waste decomposer

Waste decomposer was purchased from National Centre for Organic and Natural Farming, Ghaziabad, Uttar Pradesh, India. The waste decomposer helps in to enhance the spoil microorganism and with the decomposition of leaves/ plant/crop residue it releases the nutrients to the soil.

2.3 Characteristics of waste decomposer

The waste decomposer is a group of helpful bacteria, taken from cow dung in India, that can be easily grown by farmers using jaggery. This waste decomposer has a wide range of uses in farming, including in-field composting of plant leftovers, rapid decomposition of organic materials, coating seeds, acting as a soil conditioner, controlling pests, enriching soil with nutrients, and more. It is known for its low cost, ease of multiplication, fast growth, long shelf life, and effectiveness against plant diseases.

The waste decomposer grown with jaggery shows it can break down plant cellulose, release phosphorus and potassium, produce siderophores on specific media, and contain a lot of nitrogen-fixing bacteria like Azotobacter, Azospirillum, Rhizobium, Acetobacter, and Pseudomonas fluorescence. This group of bacteria also helps in reducing greenhouse gas emissions by breaking down plant residues. Its ability to control pests is thought to work through competition for nutrients and space, direct killing, production of extracellular enzymes, antibiotics, siderophores, secondary metabolites, and inducing plant resistance. Using the waste decomposer has led to an increase in crop yield due to its role as a biofertilizer, pest controller, and mineral solubiliser. It is considered the most cost-effective solution for a one-stop biofertilizer, biopesticide, and quick composting system, and has additional uses in gardening and agriculture.

Since its introduction, over 10 lakh farmers have adopted it, leading to the revival of their fields and no damage from pests, resulting in higher crop yields. Farmers often report that their costs have dropped to zero and their profits have doubled with the use of Waste Decomposer, leading to widespread satisfaction among users.

2.4 Experimental design treatment

The presented investigation was conducted at the Regional Research Station, Karnal of Chaudhary Charan Singh Haryana Agricultural University during the Spring Season 2019-20, and 2020-21. The details of material used and methods adopted to carry out the present study were described as the climate is sub-tropical with a mean maximum temperature ranging between 34-39 °C in summer and a mean minimum temperature ranging between 6-7 °C in winter. Most of the rainfall is received from July to September and few showers from December to late spring. The experiment used a completely randomised design with 3 replicates to evaluate the trash application effect on the soil's physiochemical properties. There are eight treatments T1[removal of trash], T2 [trash mulching in continuous rows @10 t ha^{-1}], T3 [trash mulching in alternate rows @ 10t ha^{-1}], T4 [trash mulching in continuous rows @ 10t ha^{-1} + waste decomposer], T5 trash mulching in alternate rows @ 10 t ha^{-1} + waste decomposer, T6 [trash mulching in continuous rows @ 10 t ha^{-1} by trash chopper], T7 [trash mulching in alternate rows @ 10 t ha^{-1} by trash chopper] and T8 [trash burning]. The ratoon crop was raised in sequence following all the state recommendation of fertilizer and practices. The experimental plot was divided into three equal parts for replication Then these three plots were divided into eight subplots [6 x 8 m^{-2}] for different treatments and thus a total of 24 plots were laid out.

2.5 statistical analysis

The data recorded for each parameter under different treatments was statistically analyzed in RBD. The means of the replicates for the physiochemical properties were one- way ANOVA. The critical difference [CD] was worked out for comparing the effect of treatments on soil, growth, yield, and quality parameters at a 5 % level of significance according to the protocol defined by [28] using OPSTAT software.

3 Results and Discussion

3.1 Available N

The data relevant to available N was recorded at 0, 15, 30, 60, 90 and 120 days after initiation of ratoon crop [DAP] is presented in Table No 2. The statistical analysis of data was carried out which confirmed that available N was significantly affected both by different trash management practices and the number of days in both crop years.

Table 2: Effect of different trash management practices on available N of soil during crop growth Stage in 1st year

		Available N [kg ha^{-1}]						
	Treatments	**0 DAP**	**15 DAP**	**30 DAP**	**60 DAP**	**90 DAP**	**120 DAP**	**Mean**
T1	Removal of trash [control]	107.7	113.3	117.2	123.1	128.8	136.5	121.1
T2	Trash mulch in continuous row @10 t ha^{-1}	106.4	118.8	126.3	135.2	147.9	153.2	131.3
T3	Trash mulch in alternate row @10 t ha^{-1}	106.1	115.4	124.7	133.6	138.6	149.9	128.0
T4	Trash mulch in continuous row@10 t ha^{-1} + waste decomposer	107.8	119.7	129.2	137.9	151.7	157.2	133.9
T5	Trash mulch in alternate row@10 t ha^{-1} + waste decomposer	108.5	117.8	127.3	136.5	149.7	152.7	132.0
T6	Trash mulch in continuous row@10 t ha^{-1} by trash chopper	109.1	117.1	127.9	132.8	144.2	126.4	126.2
T7	Trash mulch in alternate row@10 t ha^{-1} by trash chopper	110.60	118.6	126.2	135.2	139.9	154.5	130.8
T8	Trash burning	109.6	121.7	125.2	124.8	131.5	153.3	127.6
	Mean	108.2	117.8	125.5	132.4	141.5	148.0	
	CD [p=0.05]	A=7.16 B=N.S AxB=NS						

In the first year, significantly higher [133.92 kg ha^{-1}] mean value of available N was recorded with application of trash mulch with waste decomposer in alternate rows [T4] compared to control [T1] and chopped trash mulch in continuous rows [T6] while it was statistically at par with application of trash mulch with waste decomposer in alternate rows [T5], trash mulch in continuous rows [T2], chopped trash mulch in alternate rows [T7], trash mulch in alternate rows [T3] and trash burning [T8]. The T4 was followed by T5 [132.08 kg ha^{-1}], T2 [131.30 kg ha^{-1}], T7 [130.83 kg ha^{-1}], T3 [128.05 kg ha^{-1}], T8 [127.68 kg ha^{-1}] and T6 [126.25 kg ha^{-1}] and T1 [121.10 kg ha^{-1}]. Available N showed an increasing trend with the number of days, with the lowest [107.70 kg ha^{-1}] and highest [133.92 kg ha^{-1}] mean values of available N were recorded initially at sowing and 120 DAP. This might be due to the greater losses of nitrogen when it was applied on the trash mulching top and the availability of nitrogen increased because of the carbon produced by the burning which formed an organic complex with the nutrients and increased its availability in soil [7].

Interaction between different trash management practices and the number of days was not significant in influencing available N content in soil. Similar findings were elucidated by [9] who showed that the incorporation of crop residue help to conserve the soil moisture during the crop growth stages and moisture effect on organic residue increased the microbial activity and subsequently available N content in soil. The incorporation of crop residue on the soil surface increased the organic matter which resulted in the increased available nitrogen. Retention of crop residue provides moisture and favorable conditions for the microbial activity that can help in the higher the availability of soil nitrogen. Residue retention maintained the favorable temperature and moisture which regulates the process of decomposition of organic matter and nutrients cycling resulting in higher available N [15]. The application of residue, microorganisms utilized the native carbon and nitrogen increasing the rate of mineralization few days after incorporation and thereafter microorganisms get lesser carbon and nitrogen. This is reason behind the slow rate of mineralisation in different growth stage of sugarcane crop [12].

Table 3: Effect of different trash management practices on available N of soil during crop growth Stage in 2nd year

		Available Nitrogen [kg ha-1]						
	Treatments	**0 DAP**	**15 DAP**	**30 DAP**	**60 DAP**	**90 DAP**	**120 DAP**	**Mean**
T1	Removal of trash [control]	126.3	127.3	132.2	135.8	140.1	141.6	133.8
T2	Trash mulch in continuous row @10 t ha-1	145.7	147.6	149.4	151.8	153.7	156.8	150.8
T3	Trash mulch in alternate row @10 t ha-1	140.3	142.4	145.9	149.6	151.2	153.3	147.2
T4	Trash mulch in continuous row@10 t ha-1 + waste decomposer	143.2	145.8	147.9	150.3	154.8	158.7	150.1
T5	Trash mulch in alternate row@10 t ha-1 + waste decomposer	141.3	142.6	146.4	149.5	154.2	161.2	149.2
T6	Trash mulch in continuous row@10 t ha-1 by trash chopper	144.2	147.2	148.7	151.3	152.8	156.7	150.1
T7	Trash mulch in alternate row@10 t ha-1 by trash chopper	142.6	144.5	147.9	150.1	124.2	156.2	144.2
T8	Trash burning	144.9	145.1	147.5	148.4	149.2	152.3	147.9
	Mean	141.1	142.8	145.7	148.4	147.5	154.6	
	CD [p=0.05]	A= 4.58 B= N.S AxB = 11.22						

In the second year [Table No 3], T2 reported significantly higher [150.83 kg ha^{-1}] mean value of available N compared to T1[133.88 kg ha^{-1}] and T7 [144.25 kg ha^{-1}] while it was statistically at par with T6 [150.65 kg ha^{-1}], T4 [150.12 kg ha^{-1}], T5 [149.20 kg ha^{-1}], T8 [147.90 kg ha^{-1}] and T3 [147.12 kg ha^{-1}] while T1recorded significantly lower mean value of available N [133.88 kg ha^{-1}] compared to all the other treatments. In treatment, T5 in soil increased with the number of days except at 90 DAP, and the highest [154.60 kg ha^{-1}] and lowest [141.06 kg ha^{-1}] mean values of available N were recorded at 0 DAP and 120 DAP respectively. These findings are consistent with [22] who recorded an increase in N availability with the application of organic matter, and crop residue retention increased N in nodulation at the roots of plant at early stages of crop growth and their subsequent decomposition at later stages increased the available N. Similar results were observed by Dhaiya et al. [2002] deduced that the incorporation of trash as a mulch increased the soil N due to the addition of organic material which triggered the multiplication of microbes. They convert organically bound N to inorganic form. The C:N ratio of sugarcane residue is 100:1 which increased the N immobilisation and only a small amount of N was mineralized through increase in microbial activity that was indirectly associated with the organic matter. Under favorable conditions, mineralization occurs after decomposition of organic matter and released the organic form of N to inorganic form and increased the availability of N in soil [21]. The trash mulch. Trash mulch builds up the microbial activity in soil due to addition of high organic matter, and converts the organically bound N to inorganic form that can help in to enhancing the N mineralization in soil [5]. Crop residue application as a mulch help in the immoblisation and the crop residue with high C:N ratio affect the decomposition of organic matter [1]. It increased the high demand of N by microorganism and reduced the available N in soil.

3.2 Available Phosphorous

The data relevant to available P was recorded at 0, 15, 30, 60, 90 and 120 days after planting [DAP], is presented in Table No 4 and the statistical analysis of data was carried out which confirmed that available P was significantly affected both by different trash management practices and number of days during both crop years

Table 4: Change in available nitrogen content of soil after the application of waste decomposer and trash application during crop growth stage in 1st Year

		Available Phosphorus [kg ha-1]						
	Treatments	**0 DAP**	**15 DAP**	**30 DAP**	**60 DAP**	**90 DAP**	**120 DAP**	**Mean**
T1	Removal of trash [control]	19.1	19.3	19.3	20.4	20.5	21.1	20.0
T2	Trash mulch in continuous row @10 t ha-1	19.7	20.4	21.0	22.1	23.8	24.0	21.8
T3	Trash mulch in alternate row @10 t ha-1	19.1	19.2	19.3	20.4	21.7	22.9	20.5
T4	Trash mulch in continuous row@10 t ha-1 + waste decomposer	19.2	21.1	21.8	22.0	23.6	24.1	22.0
T5	Trash mulch in alternate row@10 t ha-1 + waste decomposer	20.0	20.4	21.7	22.0	23.4	23.9	21.9
T6	Trash mulch in continuous row@10 t ha-1 by trash chopper	19.8	20.7	20.9	21.9	22.2	23.8	21.6
T7	Trash mulch in alternate row@10 t ha-1 by trash chopper	19.9	20.8	21.0	22.0	23.5	24.4	21.9
T8	Trash burning	19.3	19.7	20.0	20.3	20.7	21.1	20.2
	Mean	19.3	20.3	20.7	21.4	22.5	23.2	
	CD [p=0.05]	A= 0.78 B= N.S AxB=1.93						

In the first year, application of trash mulch with waste decomposer in continuous rows [T4] reported significantly higher [22.03 kg ha^{-1}] mean value of available P compared to control [T1], trash burning [T8], trash mulch in alternate rows [T3] while it was statistically at par with chopped trash mulch in continuous rows [T6], trash mulch in continuous rows [T2], chopped trash mulch in alternate rows [T7] and application of trash mulch with waste decomposer in alternate rows [T5]. Similar result was observed by the [8], who stated that the crop residue increased the native and added P and which increased with the decreasing of pH value of soil. The P availability was increased due to addition of crop residue as mulch, which increased the organic acids during decomposition of, and complex metal cations like Ca, Al and Fe helped in the solubilizing of native P and reduction in P sorption. The recycling of the nutrients and decomposition of organic matter formed a stable complex of P fixing Ca, Fe and Al ions which increased the available P content in soil. The availability of P depends on the C:P ratio, and the organic acids released during the decomposition of native and insoluble P, result in increased the P mineralization [12]. There was no loss of P during the burning of trash and little P was lost by ash flow due to wind and runoff. The total and resin extractable P was greater in burn than in mulch treatment. But due to decomposition of organic matter the total and resin extractable P concentration was higher in the leash deposited on the surface, which increased the available P in soil [3]. Available P in soil increased non-significantly with the number of days and highest [19.91 kg ha^{-1}] and lowest [20 kg ha^{-1}] mean values of available N were recorded at 0 DAP and 120 DAP, respectively. Interaction between different trash management practices and number of days was significant in influencing available P content in soil and minimum [19.16 kg ha^{-1}] and maximum [24.42 kg ha^{-1}] values of available P were recorded in T1 initially at the time of sowing and in T7 at 120 DAP.

Table 5: Effect of different trash management practices on available P of soil during crop growth Stage in 2nd year

	Treatments	Available Phosphorus [kg ha-1]						
	Treatments	**0 DAP**	**15 DAP**	**30 DAP**	**60 DAP**	**90 DAP**	**120 DAP**	**Mean**
T1	Removal of trash [control]	19.8	20.1	21.3	21.4	21.5	22.7	21.2
T2	Trash mulch in continuous row @10 t ha-1	21.3	21.3	22.5	23.9	23.8	23.5	22.7
T3	Trash mulch in alternate row @10 t ha-1	20.1	20.3	21.8	22.0	23.8	21.8	21.7
T4	Trash mulch in continuous row@10 t ha-1+ waste decomposer	21.8	21.4	21.9	22.7	22.8	23.4	22.3
T5	Trash mulch in alternate row@10 t ha-1 + waste decomposer	20.0	20.6	20.7	21.0	21.8	23.8	21.3
T6	Trash mulch in continuous row@10 t ha-1 by trash chopper	20.9	21.1	22.3	23.4	24.8	25.0	22.9
T7	Trash mulch in alternate row@10 t ha-1 by trash chopper	20.6	21.0	22.1	22.3	23.5	24.0	22.3
T8	Trash burning	20.4	20.6	20.86	21.1	22.3	23.9	22.5
	Mean	20.7	20.9	21.7	22.3	23.1	23.6	
	CD [p=0.05]	A=1.06 B=N.S AxB=N.S						

In the second year [Table No 5], T7 reported significantly higher [22.97 kg ha-1] mean value of available P compared to T1[21.20 kg ha-1], T5 [21.36 kg ha-1], T8 [21.56 kg ha-1], T3 [21.71 kg ha-1] while it was statistically at par with T7 [22.31 kg ha-1], T4 [22.37 kg ha-1] and T7 [22.77 kg ha-1]. Significantly lower mean value [21.20 kg ha-1] was recorded in T1 [21.20 kg ha-1] than all the other treatments except T5, T8, and T3 which were significantly at par with it. The organic anions produced by the decomposition of organic matter which compete with the binding sites on the soil particles. The Al, Fe and Ca chelates binds the P and decreased its precipitation. Due to this, it increased the available P in soil. The crop residue incorporation reduced the adsorption of P on the soil particles and increased the P availability in soil [22]. Crop residue also reduced the water soluble P fixation and increased organic P mineralization [15]. The organic matter constitutes the higher portion of the exchange complex and have negative charge, and it binds the cations after the dissociation of bonds it helps in the P availability in soil and increasing pH also enhance the solubility of inorganic P and P level in soil [24]. The trash mulch it build up the microbial activity in soil due to additions of high organic matter, and convert the organically bound P to inorganic form that can help in to enhance the P mineralisation in soil [6].

Available P in soil increased non-significantly with number of days while interaction between different trash management practices and the number of days was non-significant in influencing available P content in soil.

4.4.1.3 Available S

The data presented in Table No 6 revealed that the impact of trash mulching on available sulfur. Available S was significantly affected by the sugarcane trash mulch practices at 0-120 DAP. In whole season, 0-120 days the highest available S content [7.05 kg ha-1] was observed in trash mulch in continue row by chopper [T6] and lower in [4.89 kg ha-1] in [T1] control. Initial value of the available S varied from [4.89 to 5.40 kg ha-1]. The application of trash mulch in alternate row with waste decomposer [T5] shows highest available S of soil [5.93] and significantly higher over the control [5.20]. The following finding is in accordance with the S mineralization in soil is the done by the biological and biochemical processes [19]. The microbes are finding their energy and released S as byproduct. This biological process is defined as the release of S from ester sulphates, through extracellular enzymatic hydrolysis. The availability of S is also dependent on the C:S ration, due to immobilisation the S availability increases in soil. [32] found the similar results which might be due to the release of S that is assimilated in plant proteins, nucleic acids and other compound and precursors during the decomposition of this trash residue occurs by the microbial activity.

Table 6: Effect of different trash management practices on available S of soil during crop growth Stage 1st Year

	Treatments	Available S [kg ha-1]						
	Treatments	**0 DAP**	**15 DAP**	**30 DAP**	**60 DAP**	**90 DAP**	**120 DAP**	**Mean**
T1	Removal of trash [control]	4.89	5.03	5.19	5.30	5.35	5.43	5.20
T2	Trash mulch in continuous row @10 t ha-1	4.97	5.12	5.27	5.48	6.51	7.15	5.75
T3	Trash mulch in alternate row @10 t ha-1	4.97	5.13	5.30	5.51	5.87	6.16	5.49
T4	Trash mulch in continuous row@10 t ha-1 + waste decomposer	5.34	5.44	5.46	6.02	6.07	6.56	5.82
T5	Trash mulch in alternate row@10 t ha-1 + waste decomposer	5.40	5.53	5.70	6.16	6.22	6.58	5.93
T6	Trash mulch in continuous row@10 t ha-1 by trash chopper	5.00	5.15	5.32	5.72	6.94	7.05	5.86
T7	Trash mulch in alternate row@10 t ha-1 by trash chopper	5.31	5.24	5.33	5.48	5.97	6.09	5.57
T8	Trash burning	4.97	5.11	5.23	5.38	5.70	5.88	5.38
	Mean	5.11	5.22	5.35	5.63	6.08	6.36	
	CD [p=0.05]	A=0.22 B=0.19 AxB=0.55						

But at 90 DAP, 6.94 kg ha-1 available S in the trash mulch in a continuous row by trash chopper [T6] was observed which was statistically found 29.71% higher over the control. At 120 days significantly higher available S was found in T6 over all treatment combinations. The T2, T4 and T6 were statistically found at par with T6. The mean of available S was significantly higher in T5 [5.93 kg ha-1] and significantly 14.03% increase over control. The T2, T4 and T6 were significantly found at par with T5. The treatments T6, T5 and T2 were statistically found at par with T4. The T5 was 14.03, 3.13, 8.01, 1.89, 1.19, 6.48, and 10.22% higher compared to the control. According to the numbers of days, the available S of soil was observed to be highest [6.36 kg ha-1] at 120 DAP. It shows the available S was continuously increasing in trend upto 120DAP and significantly higher over the initial Soil sample. The interaction between trash treatments and the numbers of days statistically shows the significant results at the 5% level of significance.

Table 7: Effect of different trash management practices on available S of soil during crop growth Stage in 2nd year

		Available S [kg ha-1]						
	Treatments	**0 DAP**	**15 DAP**	**30 DAP**	**60 DAP**	**90 DAP**	**120 DAP**	**Mean**
T1	Removal of trash [control]	4.59	5.77	5.81	5.92	6.05	6.22	5.73
T2	Trash mulch in continuous row @10 t ha-1	6.09	6.25	6.56	6.73	6.98	7.26	6.65
T3	Trash mulch in alternate row @10 t ha-1	5.58	5.71	5.88	5.96	6.08	6.48	5.95
T4	Trash mulch in continuous row@10 t ha-1 + waste decomposer	5.89	5.98	6.47	6.56	6.67	6.98	6.43
T5	Trash mulch in alternate row@10 t ha-1 + waste decomposer	5.36	5.48	5.78	5.93	6.10	6.81	5.91
T6	Trash mulch in continuous row@10 t ha-1 by trash chopper	5.98	6.24	6.51	6.88	7.06	7.56	6.71
T7	Trash mulch in alternate row@10 t ha-1 by trash chopper	5.49	5.69	5.71	5.94	6.17	6.32	5.89
T8	Trash burning	4.97	5.27	5.49	5.63	5.97	6.11	5.57
	Mean	5.49	5.80	6.03	6.19	6.39	6.72	
	CD [p=0.05]	A=0.45 B=N.S AxB=1.10						

In 2nd year of season the data manifested in Table No 7 revealed that effect of trash mulching on available sulphur of soil. The available S was significantly higher in trash mulch in a continuous row [T2] up to 30 DAP. At 60 DAP trash mulch in a continuous row by trash chopper [T6] observed significantly higher [6.88 kg ha^{-1}] available sulphur over the control. It was found 16.22 and 22.20 % increase over the control and burning respectively. After harvest mean value of available sulphur of soil was significantly higher [6.71 kg ha^{-1}] in the T6 over the control. The T6 was statistically found at par with the T2 and T4. But the T6 was significantly 12.77, 13.33, 13.42, and 20.46% higher over the T3, T5, T7 and T8 respectively. The treatment T1, T3, T7, and T8 was statistically found at par with T5. The number of day's effect on available sulphur of soil was observed a non-significant result. The interaction of treatments and number of days was found significant at 5% level of significance. The addition of trash mulching significantly increased the available Sulphur of soil and continuously increased the available S status in soil upto 120 DAP. Because 120 DAP to 150 DAP sugarcane crops take more uptake of nutrients and more availability of nutrients due to high decomposition of organic matter.

Conclusion

Waste decomposers, also known as organic waste decomposers or microbial decomposers, are microorganisms that break down organic waste into simpler compounds, reducing waste volume and producing a nutrient-rich compost. Decomposed waste adds organic matter, which enhances the soil's water-holding capacity, aeration, and aggregation. It also introduces beneficial microorganisms, stimulating soil's biological activity. It also releases nutrients like N, P, K, and micronutrients, making them available to plants. With the use of waste decomposer, sugarcane yield is maximum [98.75 and 94.59 t/ha] in alternate rows with waste decomposer treatments [T5] during both years of experimentation.Nitrogen, Phosphorus and Sulphur mineralisation observed maximum at 120 DAP with waste decomposer treatment [T5] and lowest with the removal of trash treatment [T1].Effect of trash management was non-significant on soil organic carbon during both the year on all the sampling days. Decomposed waste improves soil's ability to retain and exchange nutrients.

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