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Soil health, Cane Productivity and Juice quality Improvement through Sugarcane trash Management in Plant-ratoon system grown in Calcareous soil

Rajendra Bairwa[1*], C.K. Jha[1], S.K. Thakur[1] and Vipin Kumar[2]
[1]Department of Soil Science, Sugarcane Research Institute
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), India.
[2]Post Graduate College of Agriculture, RPCAU, Pusa Samastipur (Bihar), India.

(Corresponding author: Rajendra Bairwa)*
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ABSTRACT: Sugarcane trash mulching treated with inorganic (Urea)/ organic sources (Vermicompost/ FYM) and microbial inoculants (*Trichoderma viride / Azotobacter* + PSB) improved soil health parameters significantly in terms of physical, chemical and biological properties of soil after harvest of sugarcane ratoon crop (two years). The organic carbon, soil respiration and soil microbial biomass carbon enhanced due to sugarcane trash mulching treated with urea or FYM/ vermicompost/ *Trichoderma* and *Azotobacter* + PSB treated plots as compared to control (No trash). Among various mulching treatments improvement was significantly more in plots treated with *Trichoderma viride.* The trash mulching treatments also reduced soil resistance, bulk density and improved water holding capacity of soil. The mean sugarcane plant height (185.43cm - 232.87cm) and ratoon crop's height (175.56cm - 220.65cm) varied significantly at 280 days old sugarcane crop. The highest dry matter production was recorded in *Trichoderma* inoculated trash mulching treatment (Plant 26.64 t ha^{-1} and Ratoon 24.94 t ha^{-1}). Sugarcane trash mulching resulted in enhanced number of millable cane, cane yield and sugar yield of plant and ratoon crop over no trash treatment. The brix percent of cane juice for plant (18.80-20.07) and ratoon crop (17.91-19.31) varied significantly in the treatment of *Trichoderma* inoculated trash only. The quality of juice in terms of brix, pol and purity were comparatively better in trash treated plots over no trash treatment. Sugarcane trash mulching (10 t ha^{-1}) either treated with urea (N 25 kg ha^{-1}) / FYM (5 t ha^{-1})/ vermicompost (2.5 t ha^{-1}), or inoculated with *Trichoderma viride* (500gm t^{-1} of trash)/ *Azotobacter* + PSB (5 kg ha^{-1}) improved soil heath in terms of soil organic carbon, soil microbial biomass carbon, soil respiration, water holding capacity, bulk density and soil resistance with significant improvement in yield and juice quality of sugarcane plant - ratoon system in calcareous soil.

Keywords: Trash mulching, soil properties, cane yield, sugar yield

INTRODUCTION

Sugarcane trashes are plant parts that remain in the field after crops are harvested. Sugarcane trash recycling has the advantage of converting surplus farm waste into a useful product for meeting the nutrient requirements of succeeding crops. Crop residues are the source of carbonaceous material and food for soil microorganisms while also contributing to plant nutrients (Bisen and Rahangdale 2017 and Dar and Sahu 2017). Sugarcane trash burning is common in north India, resulting in nutrient losses and may cause air pollution that will be endangers for human health. To mitigate straw burning, crop residue management innovations should aid in achieving sustainable productivity, allowing farmers to reduce nutrient and water inputs and reduce risk from climate change. Crop residues contain significant amounts of plant nutrients, and their judicious application will improve soil physical environment and nutrient recycling in cropping system. Crop residue retention on the soil surface reduces run-off and soil erosion while lowering soil evaporation and land preparation costs. Around 550 million tonnes (Mt) of crop residues are produced in India. Sugarcane trash consisting of tops and leaves generate 12 Mt, *i.e.*, 2% of the crop residues in India. The crop residue generated, residue surplus and burnt annually indicates that about 140.84 Mt. of crop residue are surplus and about 92.81 Mt. of crop residues are being burnt across the India annually (Pandey, 2018). The application of sugarcane trash found beneficial for sustaining productivity of sugarcane in calcareous soil (Jha *et al.*, 2019).

Sugarcane accounts for more than 60% of global sugar production. Because the demand for white sugar is constantly growing, cane productivity and sugar recovery must be increased in tandem. Sugarcane trash mulching treatments with either furrow irrigation increased the microbial properties. Trash mulch plots result in reduced bulk density, increased soil porosity and maximum water holding capacity, while un-mulched treatment was inferior for all the above parameters (Mathew and Varughese 2008). The application of trash has a significant impact on the organic status of the soil. When organic matter is added to the soil through biomass production, it undergoes microbial degradation and releases plant nutrients. Soil bulk density and penetration resistance were influenced by *in situ* trash mulching and bio-intensive modulation of the sugarcane ratoon rhizosphere, followed by harvest of the second ratoon crop (Tayade *et al*., 2018). The bio-intensive sugarcane ratoon rhizosphere modulation treatments were found to be very effective in lowering soil bulk density and compaction. In contrast, value of soil penetration resistance lies within the "low resistance class" (Canarache, 1990). Soil mulching with crop residue plays an important role in the sugarcane ecosystem. It acts as insurance for the productivity of the sugarcane plant-ratoon system. Hence, the current study was carried out to investigate the Improvement in soil health, productivity and Juice quality of sugarcane plant-ratoon system grown in Calcareous soil.

METHODS AND MATERIALS

The sugarcane plant–ratoon system was implemented in the field trial using a randomized block design at the Crop Research Centre, RPCAU, Pusa, Bihar as a part of Ph.D. programme. The farm is located at an elevation of 52.0 m above mean sea level and at 25.58° N, latitude 85.40° E long. Under the Ustic moisture regime, the climate in the area was subtropical. During the crop growth period of 2020-2021, the average annual rainfall was 1883.60 mm, and the average yearly temperature was 29.90 (Maximum) and 19.3 °C (Minimum). The sugarcane trash mulching treatments treated with urea (N25Kg ha^{-1}) FYM (5 t ha^{-1}), vermicompost (2.5 t ha^{-1}) and inoculated *Trichoderma* (500 gm^{-1} t of trash)/ *Azotobacter* + PSB (5 kg ha^{-1}). The sugarcane trash was applied 10 t ha^{-1}. CoP 2061 a mid-late variety of Sugarcane was planted during March, 2020 with the beginning of ratooning in February, 2021. Sugarcane trash mulch was applied 10 t ha-^{1} along with urea, *Trichoderma viride* was applied 500 gm t^{-1} of trash along with FYN slurry (200 kg FYM ha $^{-1}$) *Azotobacter* + PSB was applied 5 Kg ha^{-}1 each along with FYM slurry in moist condition. The sugarcane trash was applied between row to row spacing of plant, and it was treated with urea, FYM, vermicompost, and *Trichoderma*/ *Azotobacter* + PSB as per technical details. All treatments received the recommended fertilizer dose of fertilizer for sugarcane plant (150 kg N, 85 kg P_2O_5, and 60 kg K_2O ha^{-1}) and ratoon crops (170 kg N, 60 kg P_2O_5, and 60 kg K_2O ha^{-1}). Recommended practices were adopted for the sugarcane plant ratoon crop. Surface soil sample (0-15cm) was collected from the experimental area at starting and also after harvest of the sugarcane ratoon crop. The soil samples were analysed for organic carbon by using the chromic acid digestion method (Walkley and Black 1934). Bulk density determined by core method (Blake, 1965). Penetration resistance was measured with the help of a cone penetrometer for surface and sub-surface soils. The water holding capacity was measured by the keen box Rockzowski method. The soil microbial biomass carbon (SMBC) was determined by fumigation with ethanol-free chloroform method (Jenkinson and Ladd 1981). Soil respiration at the harvest stage was determined by trapping the evolved CO_2-C in NaOH followed by addition of few drops of saturated $BaCl_2$ solution and using phenolphthalein indicator and titrated with 1N HCl (Page *et al.*, 1982). The data were analyzed statistically.

RESULT AND DISCUSSION

Growth and yield attributes. Plant height, dry matter (DM) production and number of millable cane (NMC) were significantly higher in sugarcane trash mulched treatments than the treatment without trash (control). The sugarcane plant height (185.43 - 232.87 cm) and ratoon crop height (175.56 - 220.65 cm) varied significantly due to trash treatments at 280 days crop growth stage (Table 1). Dry matter production was maximum in *Trichoderma i*noculated trash mulched treatments for sugarcane plant (26.64 t ha^{-1}) and ratoon crop (24.94 t ha^{-1}), which was 20.37 % (sugarcane plant crop) and 20.44 % (ratoon crop) more over the control. Number of millable cane (NMC) was significantly higher in *Trichoderma* inoculated trash mulched treatments than in control. However, NMC was found lower in ratoon crop as compared to sugarcane plant crop. The trash mulching activated with urea/ FYM /VC/ *Trichoderma/ Azotobacter* + PSB, and direct trash incorporation improved soil environment and supplement the plant nutrition after decomposition. *Trichoderma* also release plant growth promoting substances which stimulates the root system and enhance plant growth. These results were in agreement with Shukla *et al.* (2008); Yedidia *et al*., (2001); and Harman, (2000), who reported that *Trichoderma* inoculated trash influences the sugarcane plant growth and yield attributing characters.

Cane and sugar yield. The results indicated that trash mulching activated with urea (N 25 kg N ha^{-1}), or organics viz. FYM (5 t ha^{-1}), VC (2.5 t ha^{-1})/microbial inoculated (*Trichoderma* / *Azotobacter* + PSB) was found superior over the trash incorporated plots. Trash mulching was found beneficial over trash incorporation (Table 1). Sugarcane trash mulching / incorporation treatments enhanced the yield of cane and sugar as compared to no trash. Cane yield was recorded significantly highest in *Trichoderma* inoculated trash mulch treatment for plant (85.31 t ha^{-1}) and ratoon crop (71.99 t ha^{-1}) followed by trash activated with FYM/VC/ *Azotobacter* + PSB and lowest in control (65.96 t ha^{-1} plant crop and 54.20 t ha^{-1} for ratoon crop).

Table 1: Effect of trash mulching methods on crop growth attributes, cane yield and sugar yield after sugarcane plant and ratoon crop.

Treatments	Plant Height (cm) 280 DAR		DM (t ha^{-1}) Harvest Stage		NMC (×10^{-3} ha^{-1}) Maturity Stage		Cane Yield (t ha^{-1})		Sugar Yield (t ha^{-1})	
	P	**R**	**P**	**R**	**P**	**R**	**P**	**R**	**P**	**R**
Control	185.43	175.56	19.63	18.43	100.79	85.12	65.96	54.20	7.22	5.78
Trash	192.97	197.17	20.92	18.89	109.05	89.85	74.72	58.61	8.64	6.59
Trash + Urea	206.13	203.26	24.02	21.61	113.79	93.53	78.12	62.27	9.15	7.24
Trash + FYM	212.19	213.86	25.73	23.49	115.71	96.51	81.82	67.41	9.64	7.89
Trash + VC	208.91	210.45	25.09	22.70	114.85	95.23	81.68	65.02	9.66	7.58
Trash + *Trichoderma*	232.87	220.65	26.64	24.94	116.79	99.96	85.31	71.99	10.21	8.58
Trash + Azoto. + PSB	207.63	208.78	24.79	22.10	114.96	94.49	79.77	64.15	9.35	7.46
Trash incorporation	201.95	207.10	22.65	21.75	111.53	93.91	78.05	62.96	9.15	7.01
SEm (±)	8.78	8.28	1.50	1.36	3.26	2.77	3.53	3.29	0.59	0.50
CD (P=0.05)	26.62	25.12	4.56	4.11	9.89	8.41	10.71	9.97	1.80	1.50

Sugarcane Trash: 10 t ha^{-1}applied in all treatments except control**; DM:** Dry matter production; **NMC:** Number of millable cane

Sugar yield was also significantly higher in *Trichoderma* inoculated trash compared to the control. In general cane yield and sugar yield were higher for sugarcane plant crop than ratoon crop. Results obtained were similar to Jat *et al*. (2019), who reported that yield was increased in crop residue retention treatments than the residue removal treatment which might be due to trash mulching, leading to enhanced soil plant nutrition. Padian *et al.* (2020) and Das *et al.* (2014) also reported that crop residue releases the plant nutrition by decomposition increasing the cane yield.

Juice quality and juice recovery. The brix percent of cane juice for plant (18.80-20.07) and ratoon crop (17.91-19.31) varied significantly in the treatment of *Trichoderma* inoculated trash. The quality of juice in terms of brix, pol and purity were comparatively better in trash treated plots over control. The quality of cane juice was also superior for plant crop as compared ratoon crop (Table 2). Juice recovery was resulted significantly higher in all trash mulching plots activated with FYM/VC/*Trichoderma* / *Azotobacter* + PSB plots than control plot. Juice recovery ranged from 47.45 - 63.69 % (Plant crop) and 45.33 - 60.44 % for (Ratoon crop). Over all the juice recovery was more in plant crop as compared to ratoon and being the highest in *Trichoderma* inoculated trash plot. The trash mulching with urea, FYM /VC/ *Trichoderma/Azotobacter* + PSB, accelerate the decomposition of trash and supplement the plant nutrition. Moreover, improvement in soil physical environment due to trash mulching resulted in better root system and promotes proper nutrition of sugarcane crop. Moreover, *Trichoderma* also release plant growth promoting substances which stimulates the root system and enhance plant growth. Yadav *et al.* (2009) and Shukla *et al.* (2008) recorded similar findings.

Soil health. Soil organic carbon (SOC) improved significantly either by sugarcane trash incorporation or sugarcane trash mulching treated with urea/ FYM/VC, *Trichoderma* and *Azotobacter* + PSB, over the control. Among various mulching treatments SOC was significantly higher (0.73%) in plots treated with *Trichoderma viride* (Table 3). The sugarcane trash mulch treated with *Trichoderma viride* capably and quickly degraded trash. The trash inoculated with *Trichoderma viride* degraded fast and quickly released nutrients (Shukla *et al*., 2008). Modak *et al.* (2020) and Tayade *et al.* (2018), also observed that the crop residue mulching reduced in soil bulk density and improved in soil penetration.

Table 2: Effect of sugarcane trash mulching on juice quality of sugarcane plant (P) - ratoon (R) crops.

Treatments	Juice quality							
	Brix		Pol		Purity		Juice Recovery (%)	
	P	R	P	R	P	R	P	R
T_1-Control	18.80	17.91	16.15	15.53	86.13	84.25	47.45	45.33
T_2-Trash	19.27	18.95	16.87	16.46	86.63	86.27	57.16	54.21
T_3-Trash + Urea	19.33	18.96	17.00	16.73	87.72	87.00	58.11	57.09
T_4-Trash + FYM	19.57	19.31	17.21	16.96	88.23	87.85	62.42	59.38
T_5-Trash + VC	19.37	19.01	17.12	16.85	87.93	87.27	60.95	59.06
T_6-Trash + *Trichoderma*	20.07	19.73	17.44	17.28	88.99	88.30	63.69	60.44
T_7-Trash + Azo+PSB	19.43	19.00	17.01	16.81	87.77	87.07	57.24	58.52
T_8-Trash incorporation	19.33	18.98	17.00	16.57	87.13	86.89	57.63	54.33
SEm (±)	0.51	0.39	0.54	0.4525	0.66	0.77	2.70	3.23
CD (P=0.05)	1.51	1.20	NS	NS	NS	NS	8.19	NS

Note: Sugarcane Trash: 10 t ha^{-1}, **Urea** (25 kg N ha^{-1}), **FYM** (5 t ha^{-1}), **VC**- Vermicompost (2.5 t ha^{-1}), and ***Trichoderma*** (500 g^{-1} t of trash)/ ***Azotobacter* + PSB** (5 kg ha^{-1})

Table 3: Effect of sugarcane trash mulching methods on soil properties of soil after ratoon crop harvest.

Treatments	Organic Carbon (%)	Bulk Density (g cm^{-3})	Soil Resistance (MPa)		WHC (%)	Soil Respiration (mg CO_2-C kg^{-1} soil day^{-1})	SMBC (mg kg^{-1})
			(0-15 cm)	(15-30 cm)			
Control	0.49	1.56	1.40	4.09	36.43	20.00	110.73
Trash	0.63	1.47	1.31	3.82	41.09	26.20	194.27
Trash + Urea	0.65	1.45	1.29	3.76	41.94	27.00	225.36
Trash + FYM	0.69	1.42	1.26	3.68	43.22	27.70	248.75
Trash + VC	0.68	1.42	1.27	3.71	42.53	27.40	240.54
Trash + *Trichoderma*	0.73	1.41	1.21	3.54	44.94	31.10	265.16
Trash + Azoto. + PSB	0.65	1.43	1.27	3.72	42.13	26.50	231.35
Trash incorporation	0.64	1.44	1.30	3.79	41.38	26.30	203.18
SEm (±)	0.01	0.03	0.03	0.10	1.17	0.67	5.24
CD (P=0.05)	0.04	0.09	0.09	0.30	3.54	2.02	15.88

Sugarcane Trash: @10 t ha^{-1} applied in all treatments except control**; WHC:** Water holding capacity; **SMBC:** Soil microbial biomass carbon

Bulk density and soil resistance were reduced by applying sugarcane trash mulch treated with organic materials/ urea and microbial inoculants as compared to control after ratoon crop harvest. The mean bulk density ranged from 1.56 - 1.41 Mg m^{-3}, while penetration resistance of surface soil (0-15 cm) reduced as compared to the lower layer of soil (15-30 cm). On the other hand, it also increased the water holding capacity of soil in sugarcane trash mulch treatment as compared to treatment without trash. The data indicated that addition of activated sugarcane trash improved soil physical, chemical and biological environment. These results were similar to the findings of Yadav *et al*. (1994) and Yadav *et al*. (2009), who reported that trash mulching reduced soil compaction and bulk density of soil. Crop residue retention was reduced soil bulk density (Das *et al*., 2020). Soil respiration was significantly lower in control as compared to all other trash treatments. Soil respiration was maximum in *Trichoderma* inoculated trash (31.10 mg CO_2-C kg^{-1} soil day^{-1}) followed by trash with FYM, trash with VC, trash inoculated with *Azotobacter* and PSB, and trash incorporation into the soil over the control (20.00 mg CO_2-

C kg^{-1} soil day^{-1}). Similar results were observed by Yadav *et al*. (2009), who reported that soil basal respiration in the treatment with *Trichoderma* inoculated trash was more compared to other treatments. Soil microbial biomass carbon (SMBC) was higher in sugarcane trash mulched treatments compared to control (without trash). SMBC at harvest of ratoon was lowest in no mulch treatment (110.73 mg kg^{-1}) and highest in sugarcane trash inoculated with *Trichoderma viride* (265.16 mg kg^{-1}). However, SMBC result was found statistically at par in trash applied with FYM/VC/ *Trichoderma* and *Azotobacter* + PSB. These results might be due trash mulching which favours the induced microbial activity of soil and improvement in overall soil health for better crop production. Results agreed with findings of Yadav *et al.* (2009), who found that SMBC was higher in *Trichoderma* inoculated trash mulching.

CONCLUSIONS

Sugarcane trash mulching (10 t ha^{-1}) either treated with urea (N 25 kg ha^{-1})/ FYM (5 t ha^{-1}) /vermicompost (2.5 t ha^{-1}), or inoculated with *Trichoderma viride* (500gm t^{-1} of trash)/ *Azotobacter* + PSB (5 kg ha^{-1}) significantly improved soil heath in terms of soil organic carbon, soil microbial biomass carbon, soil respiration, water holding capacity, bulk density and soil resistance with significant improvement in yield and juice quality of sugarcane plant - ratoon system in calcareous soil.

FUTURE SCOPE

Sugarcane trash mulching can reduce or replace the fertilizers dose and sustain soil health to produce the quality produces for future increasing population. It can also be helpful in cut the atmosphere pollution and save living life health.

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Conflict of Interest. We, the authors, declare that we have no conflict of interest.

REFERENCES

Bisen, N. and Rahangdale, C. P. (2017). Crop residues management option for sustainable soil health in rice-wheat system: A review. *International Journal of Chemical Studies, 5*(4): 1038-1042.

Blake, G. R. (1965). Bulk Density in Methods of Soil Analysis. *Agronomy, 9*(1): 374-390.

Canarache, A. (1990). PENETR-A generalized semi-empirical model estimating soil resistance to penetration. *Soil and Tillage Research, 16*: 51-70.

Dar, D. A. and Sahu, P. (2017). Assessment of Soil Organic Carbon Stock in Five Forest Types of Northern Kashmir and Himalaya. *International Journal of Theoretical and Applied Sciences*, *10*(1): 86-92.

Das, A., Layek, J., Gandhiji, R., Idapuganti, Basavaraj, S., Lal, R., Rangappa, K., Yadav, G. S., Babu, S. and Ngachan, S. (2020). Conservation tillage and residue management improves soil properties under a upland rice–rapeseed system in the subtropical eastern Himalayas. *Land Degradation and Development*, 1–17.

Das, A., Lal, R., Patel, D. P., Ramkrushna, G. I., Layek, J., Ngachan, S. V. and Kumar, M. (2014). Effects of tillage and biomass on soil quality and productivity of lowland rice cultivation by small scale farmers in north eastern India. *Soil and Tillage Research*, *143*, 50-58.

Harman, G. E. (2000). Myth and dogmas of biocontrol changes in perceptions derived from research on *Trichoderma harzianum* T-22. *Plant Disease, 84*: 377-393.

Jat, S. L., Parihar, C. M., Singh, A. K., Nayak, H. S., Meena, B. R., Kumar, B., Parihar, M. D. and Jat, M. L. (2019). Di-erential response from nitrogen sources with and without residue management under conservation agriculture on crop yields, water-use and economics in maize-based rotations. *Field Crops Research*, *236*: 96-110.

Jenkinson, D. S. and Ladd, J. N. (1981). Microbial biomass in soil: Measurement and turnover. E. A. Paul and J. N. Ladd, eds. Marcel Dekker, New York. *Soil Biochemistry*, p415-471.

Jha, C. K, Kumar, V. and Thakur, S. K. (2019). Integrated effect of sugarcane trash mulch, pressmud and Zn nutrition on soil fertility and productivity of sugarcane in Calcareous Soil. *Journal of Agri Search*, *6*: 4-7.

Mathew, T. and Varughese, K. (2005).Effect of methods of irrigation and mulching on the quality and productivity of sugarcane. *Sugar Technology, 7*(2): 84-86.

Modak, K., Biswas, D. R., Ghosh, A., Pramanik, P., Das, T. K., Das, S., Kumar, S., Krishnan, P. and Bhattacharyya, R. (2020). Zero tillage and residue retention impact on soil aggregation and carbon stabilization within aggregates in subtropical India. *Soil and Tillage Research*, *202*(10): 46-49.

Page, A. L., Miller, R. H. and Keeney, D. R. (1982). In method of soil analysis. Madison: ASA Inc. Part2, eds. 949-1008.

Pandey, C. (2018). Management of Crop Residue for Sustaining Soil Fertility and Food grains Production in India. *Acta Scientific Agriculture*, *3*: 188-195.

Pandian, K., Subramaniayan, P., Gnasekaran, P. and Chitraputhirapillai, S. (2020). Effects of crop residue mulch and seedbed preparation methods on soil properties and rainfed groundnut production in Alfisols of semi-arid India. *Soil Use Manage*., *00*: 1-15.

Shukla, S. K., Yadav, R. L., Suman, A., & Singh, P. N. (2008). Improving rhizospheric environment and sugarcane ratoon yield through bioagents amended farm yard manure in udic ustochrept soil. *Soil and Tillage Research*, *99*(2), 158-168.

Tayade, A. S., Geetha, P., Anusha, S., Dhanapal, R., & Hari, K. (2019). Bio-intensive modulation of sugarcane ratoon rhizosphere for enhanced soil health and sugarcane productivity under tropical Indian condition. *Sugar Tech.*, *21*(2), 278-288.

Tayade, A. S., Geetha, P., Dhanapal, R. and Hari, K. (2016). Effect of in situ trash management on sugarcane under wide row planting system. *Journal of Sugarcane Research, 6*(1): 35-41.

Walkley, A. and Black, C. A. (1934). An experimentation of digestion method for determining soil organic matter and proposed modification of chronic acid method. *Soil Science, 37*: 29-38.

Yadav, R. L., Prasad, S. R., Singh, R. and Srivastava, V. K. (1994). Recycling sugarcane trash to conserve soil organic for sustaining yields of successive ratoon crops in sugarcane. *Bioresource Technology, 49*: 231-235.

Yadav, R. L., Shukla, S. K., Suman, A., Singh, P. N. (2009). *Trichoderma* inoculation and trash management effects on soil microbial biomass, soil respiration, nutrient uptake and yield of ratoon sugarcane and subtropical condition. *Biology and Fertility of Soils*, *45*: 461-468.

Yedidia, I., Srivatka, A., Kapulnik, Y. and Chet, I. (2001). Effect of *Trichoderma harzianum* on uptake of microelements and increased growth response of cucumber plants. *Plant Soil, 235*: 235-242.

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