



Trichoderma Induced Improvement in Growth, Yield and Quality of Sugarcane

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ABSTRACT

Trichoderma harzianum and *T. viride* were significantly effective in improving germination (6-14%), tiller population (21-78%), millable canes (5-30%), yield (6-38%) and CCS t/ha (30-34%) over the control in plant cane of CoS 94257. Metabolites of both the species @ 2.5% were found to be more efficient and significantly better than spore suspension (10^6 conidia/ml) and TMC containing *Trichoderma* @ 2 kg/ha in 20 kg sterilized farm yard manure (FYM). The metabolites improved tiller count (53-78%), millable canes (27-30%) and yield (34-38%). The yield boost up by the metabolites was up to 81.9 t/ha with *T. viride* and 79.8 t/ha with *T. harzianum* over 59.3 t/ha of control. The differences in yield due to both the species were significant. *T. viride* alone was tested for improving the yield of ratoon. The emergence of clumps was enhanced with spore suspension, TMC and metabolites of *T. viride*. The metabolites were, significantly superior for increasing the number of clumps (43.2%) than the other treatments (1.7-20.1%) and control. *T. viride* metabolites were also better for producing more tillers (75%) and millable canes (40%). The improvement in yield ranged from 53.16 t/ha to 76.31 t/ha with metabolites and 72.13 t/ha with double doze of TMC, half applied at clump emerging stage and half at tiller stage. CCS t/ha was also enhanced in ratoon crop by 40% with metabolites and 36% with double doze of TMC. Application of *T. harzianum* and *T. viride* was found to be economical, non hazardous and useful for soil health. The benefit cost ratio suggests that by expending *Rs. 1000/ ha on *Trichoderma* in sugarcane a benefit of Rs.11500/ in plant cane/ha and Rs.16500/ in ratoon /ha may be obtained.

Key words: Sugarcane-plant and ratoon, *Trichoderma harzianum*, *T. viride*, growth promotion, yield, CCS

INTRODUCTION

Efficacy of *Trichoderma* for improving the growth and yield of several short duration crops plants has been established by various workers (Chang *et al.*, 1996, Inbuar *et al.*, 1994, Harman *et al.*, 2004). However not much work has been done on sugarcane. Recently, several isolates of *T. harzianum* and *T. viride* were collected and maintained at Indian Institute of Sugarcane Research, Lucknow. Two potent isolates of *T. harzianum* and *T. viride*, were selected on the basis of higher efficacy against red rot pathogen *in vitro* (Singh *et al.*, 2004), were used for improving the growth and yield of sugarcane plant and ratoon.

Spore suspension containing 10^6 conidia/ ml, metabolites (spore free culture filtrate) @ 2.5% mixed with water and TMC containing 2 kg *Trichoderma* in 20 kg sterilized FYM were tried for plant and ratoon. The setts were dipped for 30 min at the time of planting and tillers were drenched in May. TMC was prepared by raising *Trichoderma* in 2 kg maize meal bran mixed with 20 kg sterilized FYM at least 7 days prior to use. Repeated doze of TMC was tried in ratoon at the time of clump emergence and at tiller stage. Juice from treated and untreated canes was analysed for pol, purity, CCS (%) and CCS t/ha. The experiments were conducted in field for two years in both plant and ratoon in RBD design and with three replications.

MATERIALS AND METHODS

T. harzianum (T 24) and *T. viride* (T 6) isolates were tested for growth promotion and enhancing the yield of CoS 94257.

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*1US \$ = 45 Indian Rs.

RESULTS AND DISCUSSION

It is evident from the data in Table 1-4 that both *T. harzianum* and *T. viride* were equally affective for plant cane. *T. viride* was highly effective for ratoon. *T. harzianum* could not be tested for ratoon. Metabolites of *T. viride* were established to be potent for improving the growth and yield of plant and ratoon.

Improvement in germination of plant cane: The average germination in control was 20.8-21.3% (Table 1) TMC of *T.harzianum* and *T. viride* improved the germination by 7.5% and 7.2%, respectively. Spore suspension of *T. harzianum* could enhance the germination 6.5% and *T.viride* by 4.1%. However, germination was improved up to 14.3% and 11.8% with the metabolites of *T. viride* and *T.harzianum*, respectively.

Improvement in tiller count: Tiller count (number) were higher by 21, 30 and 53%, respectively with spore suspension, TMC and metabolites of *T. harzianum* while with *T.viride* the increase was 24, 30 and 78%, respectively. Data (Table 1) indicated that the treatment with metabolite of *T.viride* was significantly better than *T.harzianum*.

Improvement in millable canes: *T.harzianum* produced 7, 15 and 27% higher no. of millable canes (NMC) with the application of spore suspension, TMC and metabolites, respectively, as compared to 5, 13 and 30% increase with *T. viride*. Data (Table 1) indicates that metabolite followed by TMC application was better for production of more NMC.

Improvement in yield: The average yield of CoS 94257 was 59.3 t/ha in control plots (Table 1). It was improved to 63.7, 68.3 and 81.9 t/ha, respectively with the use of spore suspension, TMC and metabolites of *T. viride*. *T. harzianum* improved the yield up to 63.7, 68.3 and 79.8 t/ha, respectively with spore suspension, TMC and metabolites.

T.harzianum and *T.viride* both produced significantly

higher yields with all the three methods of applications (Table 1).

Improvement in quality of cane: Application of *T. harzianum* and *T. viride* improved the CCS t/ha by 34 and 30%, respectively. Among the three treatments metabolites were significantly superior over spore suspension and TMC. However, differences in pol, purity and CCS (%) were not significant. Juice extraction (%) was improved by 10-12% with *T. harzianum* and *T. viride*. and it was significantly higher than the control (Table 2).

Improvement in ratoon: Spore suspension, TMC, metabolites, and TMC double doze (half at clump emergence and half at tiller stage) of *T. viride* were tested in ratoon.

Improvement in clump emergence: Ratoon clumps from treated plants were emerged significantly higher than the control. The emergence was higher up to 43 and 20% with metabolites and TMC (repeated doze) (Table 3). TMC and spore suspension alone did not produce significant difference.

Improvement in tiller count: Tillers were increased significantly in each treatment. However, metabolites were superior in inducing 75% increase in number of tiller over check (Table 3).

Improvement in millable canes: Metabolites, TMC and spore suspension of *T. viride* produced significantly higher NMC than the control (Table 3). The increase of NMC was as

Table 1. Trichoderma induced improvement in germination, tiller, NMC and yield of plant cane of CoS 94257

Character		Spore		TMC		Metabolite		CD at 5 %
		T6	T24	T6	T24	T6	T24	
Germination (%)	T	25.4*	27.4*	28.8*	28.3*	35.6*	32.6*	2.20
	C	21.3	20.8	21.3	20.8	21.3	20.8	
	%	4.1	6.5	7.2	7.5	14.3	11.8	
Tiller number	T	1,03,780*	1,04,166*	1,09,181*	1,11,342*	1,35,184*	1,31,789*	3362.60
	C	83,642	85,802	83642	85,802	83,642	85802	
	%	24.2	21.1	30.3	29.8	78.2	53.2	
NMC	T	68827*	71527*	73842*	77237*	85262*	84416*	2185.60
	C	65509	66975	65509	66975	65509	66975	
	%	5.08	7.6	13.5	15.3	30.1	27.2	
Yield	T	62.9*	63.7*	68.3*	68.3*	81.9*	79.8*	2.24
	C	59.3	59.3	59.3	59.3	59.3	59.3	
	%	6.0	7.4	15.1	15.1	38.1	34.5	

T6 = *T. viride*, T24 = *T. harzianum*, T = Treatment, C = Control

Table 2. Trichoderma induced improvement in juice extraction, pol, purity, CCS% and CCS t/ha in plant cane of CoS 94257

Character	<i>T. harzianum</i> (T24)				<i>T. viride</i> (T6)				CD at 5 %
	Spore	TMC	Metabolite	Control	Spore	TMC	Metabolite	Control	
Juice extraction (%)	56.82*	56.22*	61.04*	54.65	56.57*	58.01*	61.34*	52.70	0.87
Pol % in juice	17.89	17.64	17.71	17.83	18.12	17.75	17.76	17.74	NS
Purity (%)	86.15*	85.74	85.68	84.60	86.08*	85.97	87.93	84.23	1.43
CCS %	12.22	12.01	12.06	12.21	12.37	12.11	12.11	11.98	NS
CCS t/ha	7.78*	8.21*	9.68*	7.23	7.78	8.27*	10.01*	7.69	0.28

Table 3. *Trichoderma viride* induced improvement in clump emergence, tiller, NMC and yield of ratoon of CoS 94257

Character	T/C	Spore	Spore+ TMC	TMC	Double TMC	Meta.	CD at 5 %
Clump number	T	7453	8024	7867	8796	10494*	1907.72
	C	7330	7330	7330	7330	7330	
	%	1.7	6.3	7.3	20.1	43.2	
Tiller number	T	1,10,416*	89042*	119057*	129243*	140431*	112.70
	C	80092	80092	80092	80092	80092	
	%	37.8	11.1	48.6	61.3	75.3	
NMC	T	75771*	66500*	76851*	79860*	90277*	80.28
	C	59876	59876	59876	59876	59876	
	%	26.5	11.1	28.3	33.3	50.71	
Yield t/ha	T	66.12*	58.18	67.67*	72.13*	76.31*	6.86
	C	53.16	53.16	53.16	53.16	53.16	
	%	24.3	9.4	27.2	45.0	50.2	

T = Treatment, C = Control, Meta. = Metabolite

Table 4. *Trichoderma viride* induced improvement juice extraction, pol, purity and CCS t/ha in ratoon of CoS 94257

Character	Spore	Spore +TMC	TMC	Double doze TMC	Meta.	Control	CD at 5 %
Juice extraction (%)	51.11	49.91	49.29	51.79	54.41	52.64	7.28
Pol (%) in juice	17.80	18.05	17.49	18.05	17.84	18.25	0.70
Purity (%) in juice	86056	86.33	85.56	86.43	87.77*	86.33	1.34
CCs (%)	12.19	12.38	11.90	12.35	12.23	12.68	0.53
CCs t/ha	8.07*	7.20	8.05*	8.91*	9.32*	6.63	0.89

high as 50% with metabolites and 33.3% with TMC (repeated dose).

Improvement in ratoon yield: The ratoon of CoS 94257 yielded 76.31, 72.13, 67.67 and 66.12 t/ha with the application of metabolites, TMC (repeated doze), TMC (single doze) and spore suspension alone, respectively as against 53.16 t/ha in control. These yields were significantly higher than the control (Table 3).

Improvement in cane quality of ratoon: CCS t/ha was enhanced significantly with *T. viride* applied through metabolites, TMC and spore suspension (Table 4). The improvement was to the tune of 21-40%. However, differences in juice extraction (%), pol (%) in juice, purity (%) and CCS (%) were not significant.

Plant growth stimulatory effects of *Trichoderma* spp. in short duration crops viz., tomato, tobacco, pepper, periwinkle and chrysanthemum were reported since long (Chang *et al.*, 1986, Oasley *et al.*, 1994, Windham *et al.*, 1986) but for sugarcane the report of *Trichoderma* on growth promotion, yield and quality is new. *T. viride* has improved soil organic carbon from 0.47 to 0.67% and soil microbial carbon from 64.7 to 213.4 mg/kg. It has also improved initial available soil nitrogen from 179.0 to 208.0 mg/kg, and soil microbial nitrogen 8.8 to 18.4 mg/kg (Anon, 2004-05). Promotion in growth and yield may also be attributed to the increased efficacy of *T. harzianum* and *T. viride* on phosphorus solubilization and enhanced uptake of several micronutrients (Anusuya and Jayrajan, 1998, Yadidia *et al.*, 2001)

Cost benefit ratio of *Trichoderma* application.

Enhanced yield of plant cane from 59.31 to 70.75 t /ha ratoon from 53.16 to 69.74 t/ha may fetch an additional benefit of Rs.11500/ in plant cane and Rs.16500/ in ratoon if cane is sold @1000/ t. The cost of application of *Trichoderma* was Rs. 1000/ ha.

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