Physico-chemical interpretation of allelopathic interaction of vetiver with two non-edible oil yielding fence plants

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AIMS and OBJECTIVES

- Dry plant litter upon rainfall leaches out several allelochemicals which influence the growth of plants in the vicinity. Vetiver releases nootkatone, a sesquiterpene, known to have nematicidal and insecticidal properties.

- In India, *Vetiveria zizanioides* has to share the farm fences at many places with the two non-edible oil yielding plants due to an upsurge in the plantation of 'biofuel plant'-*Jatropha curcas*, as fence plant, and its commonly growing wild relative *Ricinus communis*;.

- Allelopathic interactions among these plants need to be explored and understood for the benefit of farmers and national revenue.

EXPERIMENTAL PLAN

Vetiveria zizanioides (L.) Nash. Plantlets of almost equal age, bearing 5-leaves, were selected after standardization of responsive age, from an experimental nursery set in the University Botanical Garden.

Plantlets were analyzed for initial biochemical status in terms of N, sugars, phenolics, peroxidase activity and total chlorophylls by standard methods besides measurements of root and shoot length.

J. curcas, R. communis seeds were surface sterilized and sown in sterilized preanalyzed sand irrigated with 1:10, 1:20 and 1:50 dilutions of the leachates of *V. zizanioides for 10 days*. Similarly, *V. zizanioides* plantlets were also raised in the leachates of *Jatropha*, *Ricinus* and *Vetiveria* litter till new leaf emergence, i.e. upto approximately 21 days. All biochemical analyses as mentioned above besides root length and shoot length changes as compared to DW grown controls, were recorded.

Preparation of leachate

150 gm senescent leaves of *J.curcas*, *R. communis*, *V. zizanioides* each

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Soaked in 1 l Double distilled water for 48 hs, RT±2^0C

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Decanted and made final volume with DD Water upto 1l stock

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Diluted all leachates 1:10, 1:20, 1:50 v/v

Leachates were analyzed for pH, phenolics, N, P, organic carbon, sugars

Sand was sterilized and analyzed for pH, phenolics, N, P, organic carbon & CEC

Vigour Index = % germination x total seedling length

(Abdul-Baki and Anderson, 1973)

Phytotoxicity percentage:

$$\frac{\text{Root or Shoot length of control - Root or Shoot length of treatment}}{\text{Root or Shoot length of Control}} \times 100$$

Table 1.Biochemical analyses of leachates

Samples	pH	% O.C.	Nitrogen (mg/g D.wt.)	Phosphorus (mg/g D.wt.)	Phenolics (mg cinnamic acid eq./g D.wt.)	R.S. (mg/g D.wt.)	NRS (mg/g D.wt.)	TS (mg/g D.wt.)
J.c	7.69	$6.08 \times 10^{-5} \pm 8.76 \times 10^{-6}$	$0.187 \pm 9 \times 10^{-3}$	$6.92 \times 10^{-4} \pm 3.27 \times 10^{-5}$	104.36 ± 4.9	0.240 ± 0.005	1.028	1.268 ± 0.011
R. c	6.97	$1.79 \times 10^{-4} \pm 1.63 \times 10^{-6}$	$0.238 \pm 2.8 \times 10^{-3}$	$5.84 \times 10^{-4} \pm 1.31 \times 10^{-5}$	293.65 ± 14.00	0.457 ± 0.012	0.469	0.926 ± 0.043
V.z	7.33	0.00	$0.188 \pm 1.4 \times 10^{-3}$	$8.69 \times 10^{-4} \pm 6.78 \times 10^{-5}$	53.60 ± 2.50	0.159 ± 0.006	0.808	0.967 ± 0.023

Table 2. Biochemical analysis of sterilized sand

Sand	pH	% O.C.	Nitrogen (mg/g D.wt.)	Phosphorus (mg/g D.wt.)	Phenolics (mg cinnamic acid eq./g D.wt.)	CEC (m.eq./100 g sample)
initial	7.82	$1.073 \times 10^{-5} \pm 1.01 \times 10^{-6}$	0.059 ±0.009	$3.075 \times 10^{-4} \pm 7.500 \times 10^{-6}$	13.48 ±8.83	33.58

Table 3.Increase in Shoot and Root length of *V. zizanioides* grown in different dilutions of *J. curcas*, *R. communis* and *V. zizanioides* leachates for 21 days

	J. curcas leachate		*R. communis* leachate		*V. zizanioides* leachate	
Dilutions	Shoot	Root	Shoot	Root	Shoot	Root
Control	15	2.66	15	2.66	15	2.66
1:10	**13.3**	2.7	2.66	3.67	3.34	**3.66**
1:20	**13**	3	3.34	3.33	3.67	**3.66**
1:50	**10.7**	3.7	3.66	3.66	4.67	**4.67**

Plate-1. Growth of vetiver plantlets in *J.curcas*, *R.communis* and *V. zizanioides* leachates

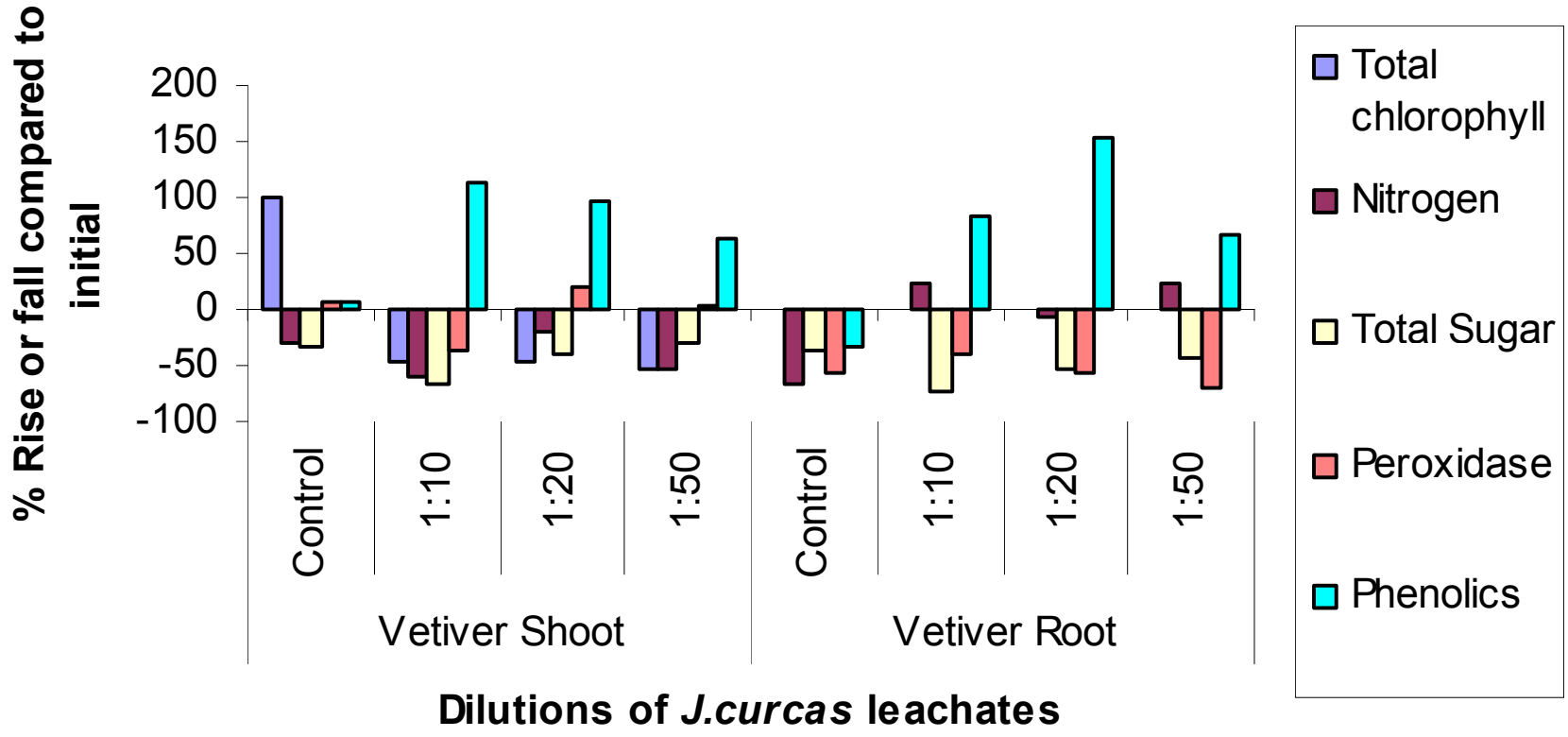
Vetiver-Control

Vetiver in J-1:10, J-1:20, J-1:50

Vetiver in R-1:10, R-1:20,R-1:50

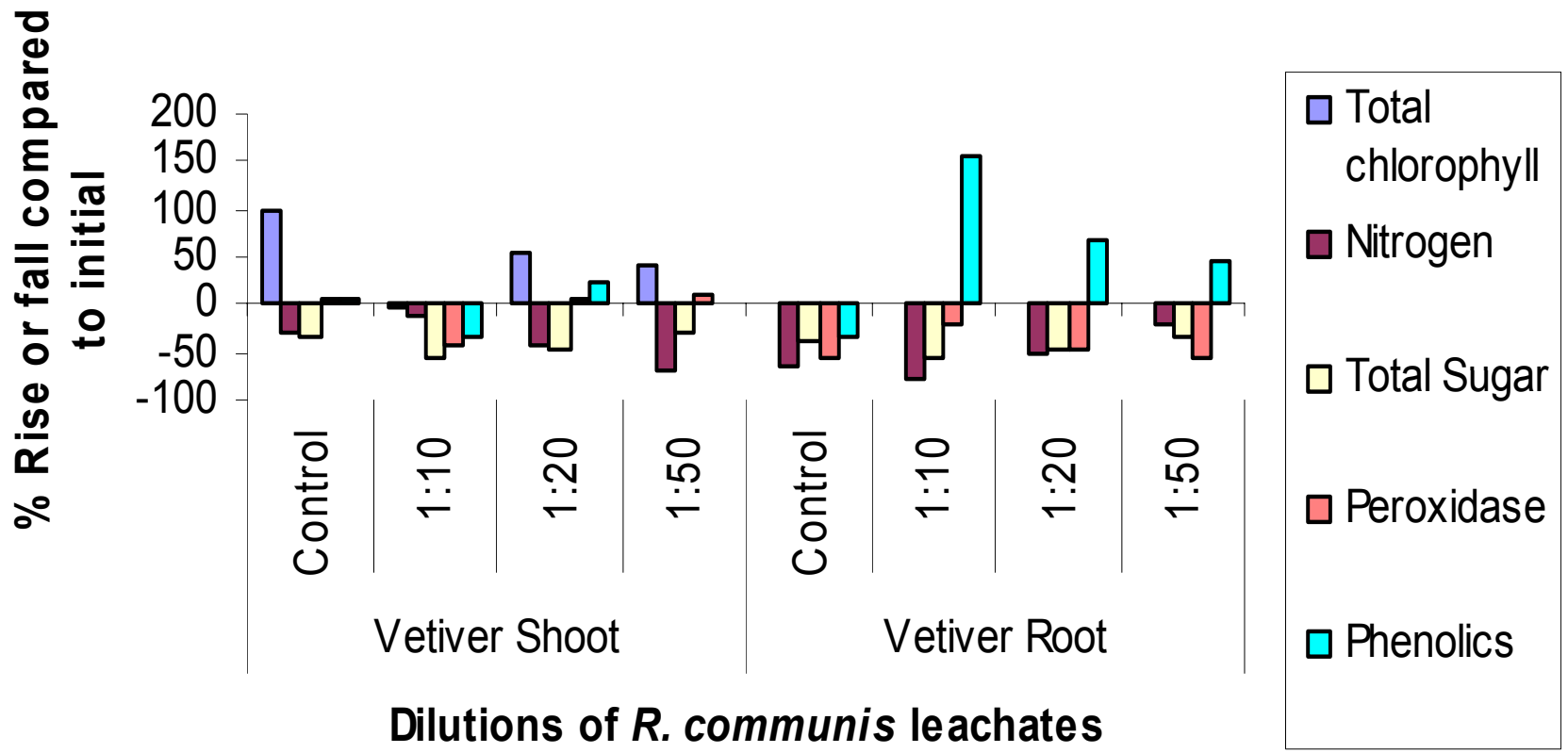
Vetiver in V-1:10, V-1:20, V-1:50

Fig 1.Percent rise or fall in biochemical attributes, as compared to initial levels, of Vetiver plantlets grown in different dilutions of *J.curcas* leachate



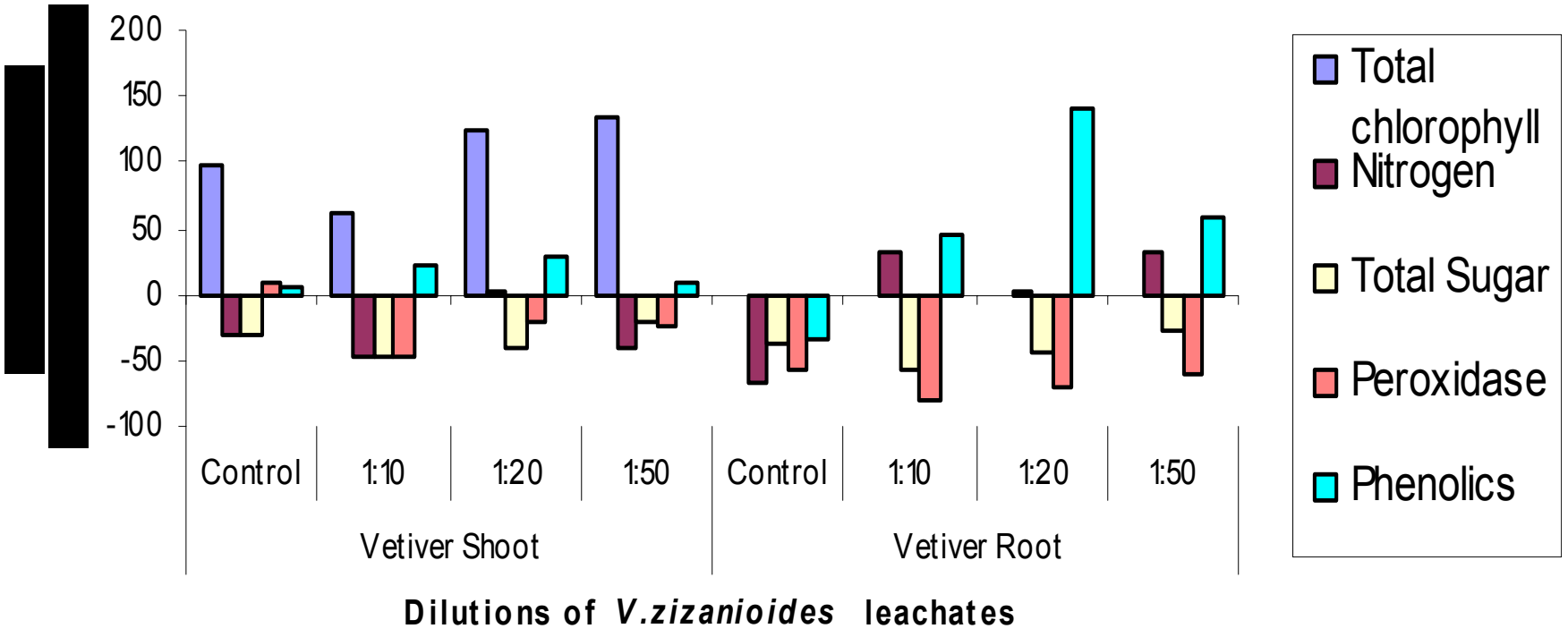
Vetiver plantlets grown in *J. curcas* leachates accumulated phenolics in both root and shoot. However, nitrogen content of the roots too improved as compared to the controls

Fig2. Percent rise or fall in biochemical attributes, as compared to initial levels, of Vetiver plantlets grown in different dilutions of *R.communis* leachate



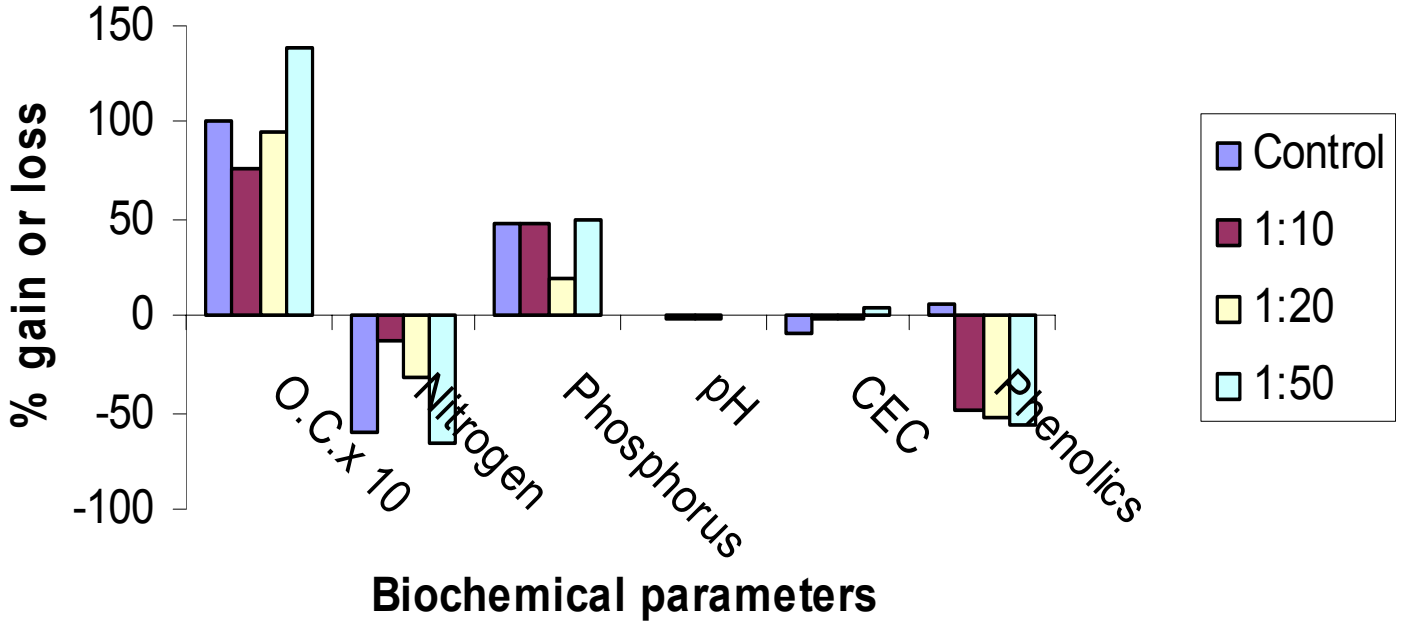
In *R. communis* leachates only total chlorophylls were retained to some extent in the shoots but the roots accumulated phenolics only. In all other biochemical attributes vetiver plantlets declined as compared to the initial plantlets

Fig3. Percent rise or fall in biochemical attributes, as compared to initial levels, of Vetiver plantlets grown in different dilutions of *V.zizanioides* leachate



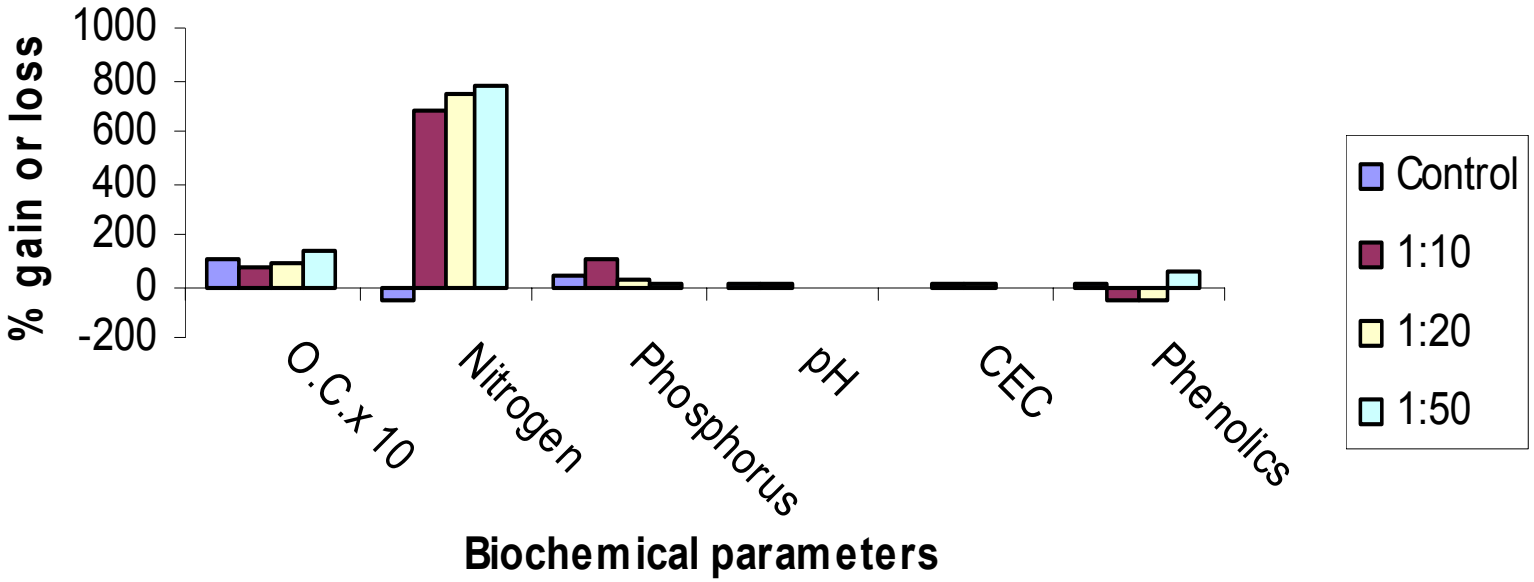
In its own leachates, *Vetiveria* plantlets exhibited increase in chlorophyll in the shoots with increasing dilutions of leachates, alongwith increase in phenolic content of the roots. Total nitrogen in the roots also increased as in case of vetiver root in *Jatropha* leachates

Fig 4. Percent rise or fall in biochemical attributes of soil as compared to initial level after vetiver plantlet growth for 21 days in different dilutions of *J. curcas* leachate added to sand (soil)



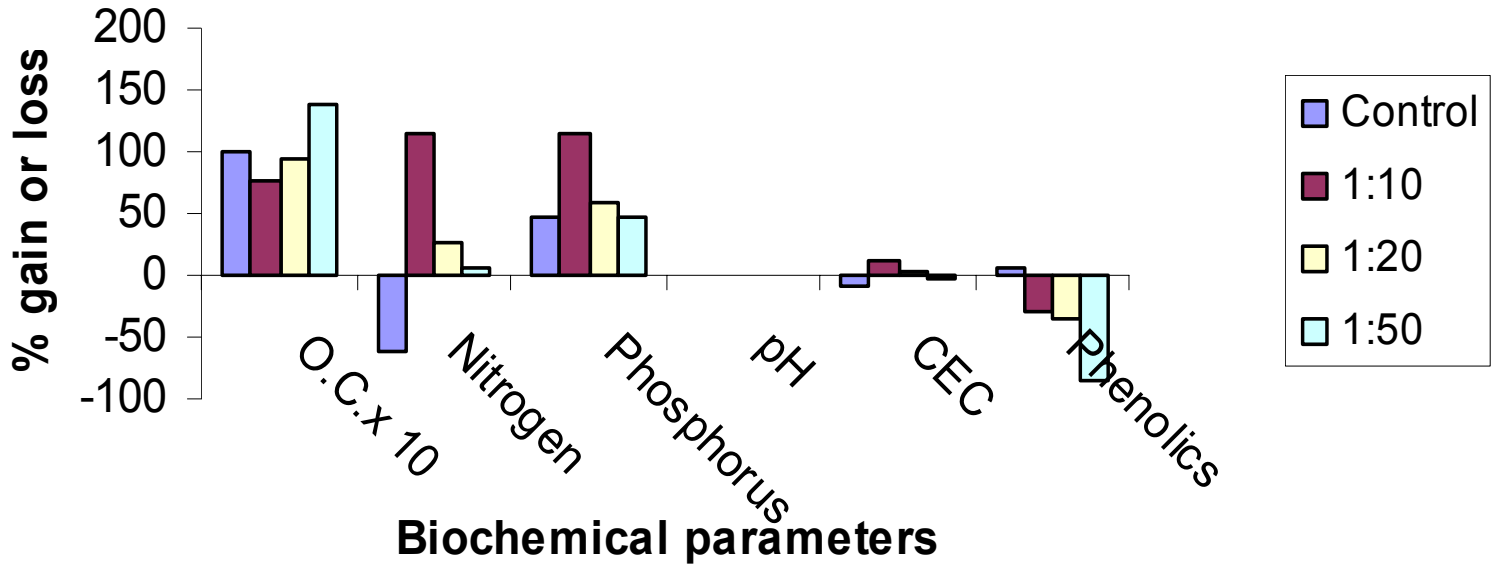
The soil (sand +leachate) in these sets also underwent certain changes during vetiver plantlet growth. In *J.curcas* leachate added soil, organic carbon (O.C.) and phosphorus (P) increased and nitrogen (N) and phenolics decreased with dilution of leachate

Fig 5. Percent rise or fall in biochemical attributes of soil as compared to initial level after vetiver plantlet growth for 21 days in different dilutions of *R. communis* leachate added to sand (soil)



In contrast, in *R.communis* leachate added soil, nitrogen too, increased, although increase in organic carbon and phosphorus was not as much

Fig 6. Percent rise or fall in biochemical attributes of soil as compared to initial level after vetiver plantlet growth for 21 days in different dilutions of *V. zizanioides* leachate added to sand (soil)



In vetiver leachate added soil, maximum increase in O.C., N and P occurred, although, with increasing dilution of leachates, nitrogen and phosphorus decreased.

CEC increased in J-1:50, V and R-1:10, 1:20 added soil. pH increased in R-1:10 and V-1:20 and 1:50 added soil.

Table 4. % Rise or fall in Shoot length, Root length and Vigour Index of *J. curcas* and *R.communis* seedlings in different dilutions of Vetiver leachate

	Shoot length		Root length		Vigour Index	
Dilution	*J.curcas*	*R.communis*	*J.curcas*	*R.communis*	*J.curcas*	*R.communis*
Control	***	***	***	***	***	***
1:10	1.76	4.17	-0.86	-34.61	-39.4	-32.1
1:20	2.59	**18.75**	**-14.26**	**-32.43**	-41.6	-20.5
1:50	**9.92**	-3.13	-38.37	-31.99	-43.1	-26.2

Plate-2. ***J. curcas*** **and** ***R. communis*** **Seedling growth in Vetiver leachates**

J. curcas -control

J. curcas in V-1:10,1:20,1:50

R. communis- control

R. communis in V-1:10, 1:20, 1:50

CONCLUSIONS

- The increase in phenolic content in the plants along with decrease of phenolics in the soil indicates positive interaction of vetiver in general, with oil yielding plants, reducing the amount of growth inhibiting phenolics, added through leachates, from the soil.

- Soil health maintenance with sustainable growth of Vetiver occurred with *J.curcas*, rather than with *R. communis*. Besides, the growth of *R. communis* is reduced in vetiver leachates as compared to *J. curcas*.


Thank You