Physico-Chemical Study of Vetiver in Wetland Soil Reclamation

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Abstract: Vetiver is known to survive under diverse soil and water conditions. In order to test its potential to reclaim wet lands in north Indian conditions where vetiver occurs in wild state, its sustainability and survival prospects were tested to make comparisons with established wet land plant, such as *Rhizophora* that flourishes even under mangrove conditions.

The physicochemical parameters for growth, establishment and survival rates for vetiver vis-à-vis *Rhizophora* evaluated over monthly passage under five soil provenances reveal that initially both plant types survive, but *Rhizophora* died after three months, whereas *Vetiveria* could sustain the diverse soil conditions for the full growing period, and also controlled the Na^+ content (salinity). Physiological role of *Vetiver* in the light of better efficiency to survive even in soil with minimal organic carbon and moderate salinity has been studied in detail.

Key words: *Vetiveria zizanioides*, *Rhizophora*, Salinity, Sugar, Proline, Organic carbon, Nitrogen, pH

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1 INTRODUCTION

Vetiver grass is well known soil conserver besides being a drought and salt tolerant plant. Several studies have been made to find out its multifarious utilities, soil reclamation is one of them. In order to test its potential to reclaim wet lands in north Indian conditions, where vetiver occurs in wild state, its sustainability and survival prospects were tested to draw comparison with established wetland plant such as *Rhizophora*. *Rhizophora*, which flourishes under mangrove conditions and is a known salt excluding type halophyte.

2 MATERIALS AND METHODS

Vetiveria zizanioides, member of family Poaceae was procured from Lucknow. It was grown in soils from five provenances - RS (Road side), IS (Irrigated soil), BS (Barren soil), PS (Polluted soil) and its native soil under Uttar Pradesh(UP) climate. The response of the plants independently in these soils and also along with Rhizophora in the same, were tested.

Seedlings of *Rhizophora mucunata* (family Rhizophoraceae) were collected along with its native soil from mangroves of Godawari basin of peninsular India, namely, Pandipallam (Andhra Pradesh). Seedling of Rhizophora were similarly grown in soil of above mentioned provenances independently and also along with Vetiver under similar climatic conditions (5^0C to 40^0C temperature range during the whole year).

2.1 Soil Provenances of U.P

Polluted soil was collected from industrial effluents and civil waste water channel, Barren soil from eroded hills, Irrigated soil from University botanical garden, Road side soil from outside university campus and native from where the plant was naturally growing.

2.2 Analysis of plant and soil

Analysis of plant material as well as soils of all given provenances were carried out to draw proper comparison selecting a few parameters:

In plant material:

1. Na^+ content (Pratt and Fathi-Ettai, 1990)
2. Organic carbon (Datta *et.al*., 1962)
3. Nitrogen content (Snell and Snell, 1954)
4. Proline (Bates *et al*., 1973)
5. Total sugar (Nelson and Somogyii, 1944)

In soil samples:

1. Na^+ content (Pratt and Fathi-Ettai, 1990)
2. Organic carbon (Datta *et.al*., 1962
3. Nitrogen content (Snell and Snell, 1954)
4. Phosohate (Olsen *et al*., 1954)
5. pH

3 OBSERVATIONS

Rhizophora, grown on polluted soil, accumulated sodium, organic carbon total sugar and proline. It improved the N content of barren soil. On the other hand Vetiver also accumulated sodium and total sugar when grown in polluted soil, but reduced (utilized) organic carbon of all the soils and proline content of irrigated soil. However, Nitrogen content of the plants increased maximally when grown in polluted soil. (Fig 1)

When Vetiver is grown together with Rhizophora in the same set of soils from four provenances, Vetiver showed decline in Na^+ content in all the sets. However, a negligible increase in Na^+ was recorded in polluted soil grown plants. Organic carbon increased maximum in irrigated soil grown plants, whereas, N and proline content remained minimal in the same soil grown plants. Both N and proline besides total sugar accumulated in road side soil grown Vetiver. In polluted soil, Vetiver accumulated minimal total sugar in the presence of Rhizophora, although individually, it accumulated maximum in the same soil (Fig 2, 3).

Fig. 1 Variation in chemical content of Vetiver grown with Rhizophora

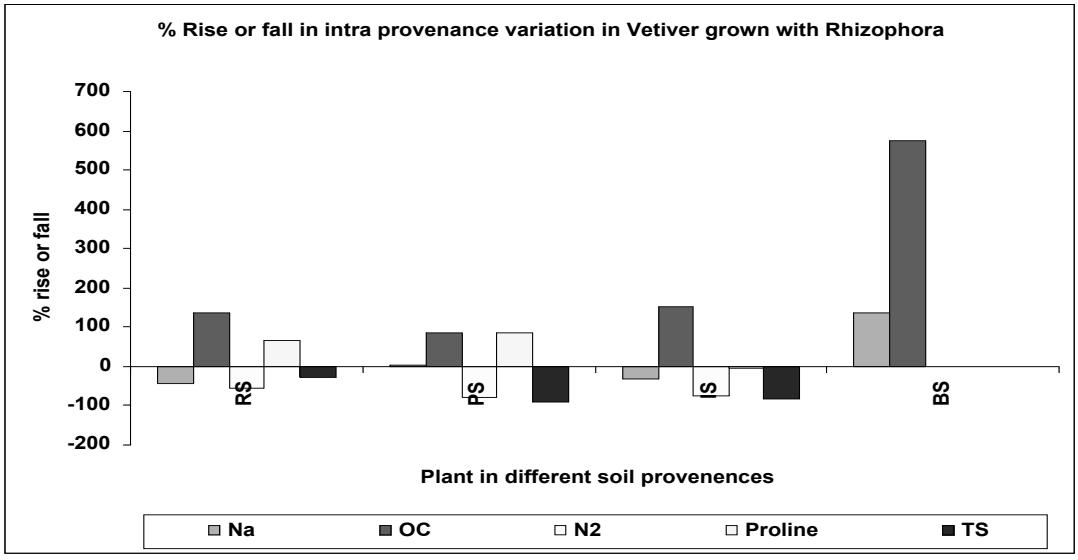


Fig. 2 Variation in biochemical content of Vetiver grown alone

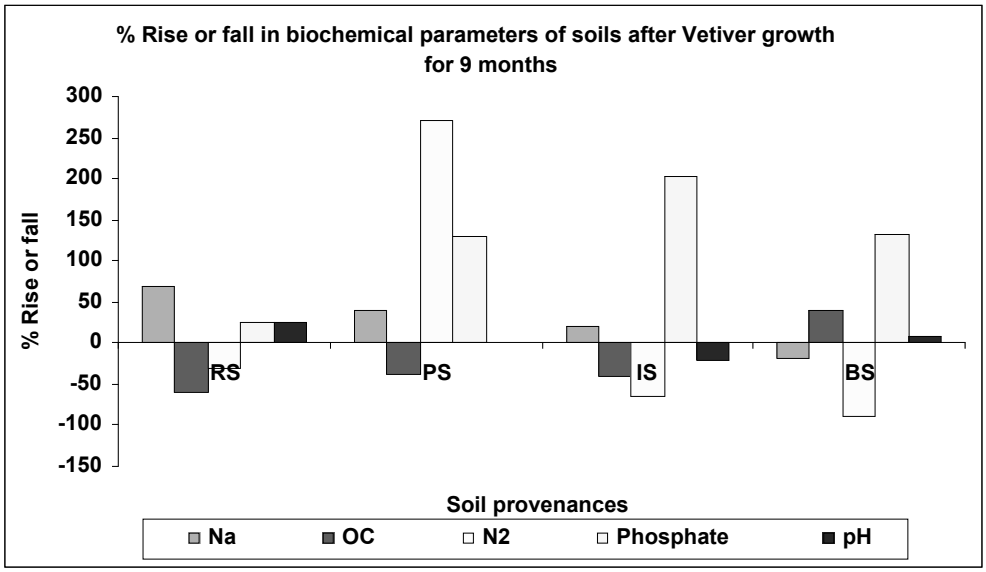
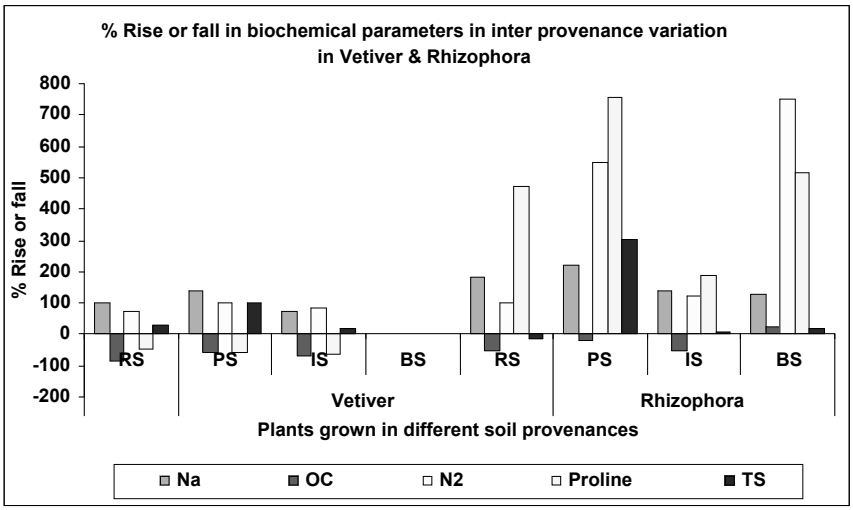
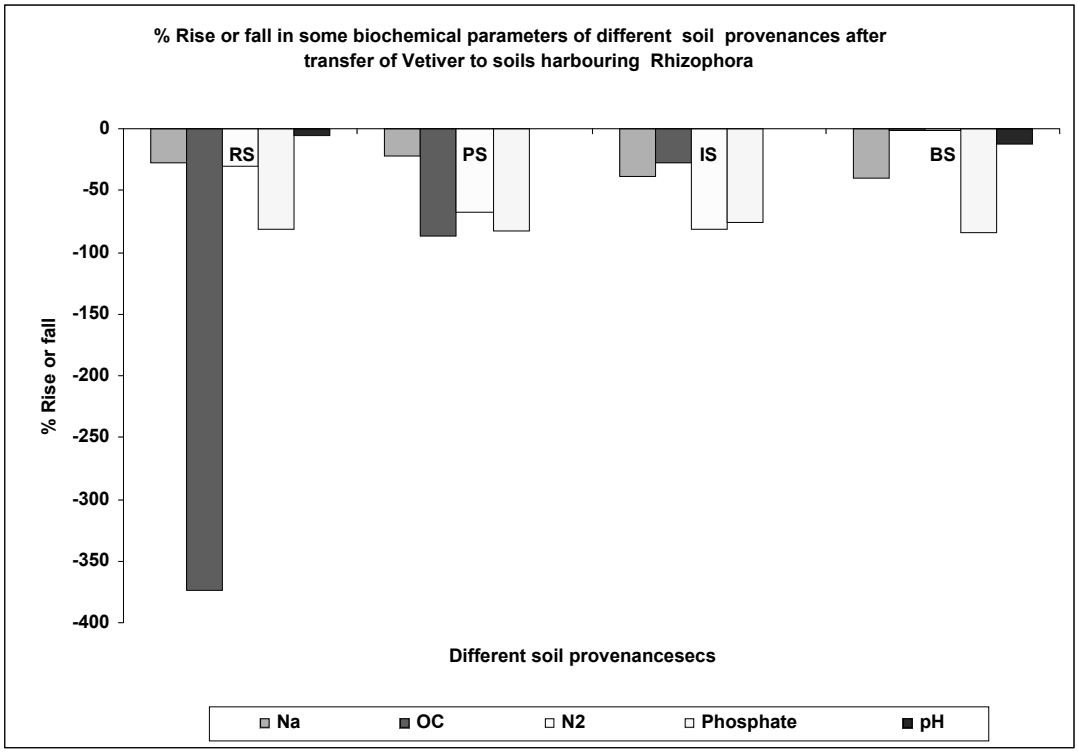


Fig. 3 Variations in biochemical contents of Vetiver and Rhizophora in different soil provenances



Polluted soils accumulated maximum Na^+ and organic carbon whereas barren soil accumulated minimal when *Vetiver* was grown alone. Along with *Rhizophora* also it maintained the same status of the soil with regard to Na^+ content. However, *Vetiver* in combination with *Rhizophora* resulted in minimal organic carbon in barren, but maximum in road side soil. *Vetiver* grown alone increased N_2 content of the roadside soil maximally, minimal increase being in polluted soil. Phosphate content too was recorded maximum in roadside soil in combination with *Rhizophora,* it increased phosphate of irrigated soil maximum and of barren minimal. Thus *Vetiveria* was recorded to improve the soil condition by reducing the total amount of Na^+ from barren soil, though it increased the organic carbon, N_2, phosphate of the same soil, when grown along with *Rhizophora*. The pH was considerably stabilized and brought to a range of 5.0-7.0 instead of alkaline. *Vetiver* itself grew vegetatively very well in polluted soil harbouring *Rhizophora* or even with out *Rhizophora*. Its reproductive growth along with vegetative growth was better in IS, BS, and RS soils holding *Rhizophora* plant. The *Rhizophora* plant did not survive due to cold climate of UP. region even after bearing 4-6 leaves . *Vetiver* with out *Rhizophora* did not grow to the some extent as it did with *Rhizophora* (Fig 4).

Fig. 4 Variations in chemical composition of soils after Vetiver and Rhizophora growth



4 CONCLUSION

Barren soil with minimal organic carbon and moderate salinity showing no plant growth improved in fertility status along with decrease in salinity by the growth of Vetiver in a Rhizophora induced soil environment.

Vetiver survived better than an established wetland plant Rhizophora in all soils. Thus proving itself a strong candidate for soil reclamation.

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A Brief Introduction to the First Author

Dr. Vimala Yerramilli is Professor of Botany at Chaudhary Charan Singh University, Meerut, specializing in Plant Physiology. He became interested in Vetiver due to its sustained growth on some of barren (eroded) soils, where it grew like a wonder grass on saline wetland soil. In India floods and other wetland conditions lead to increased salinity of the soil, which loses fertility in terms of cation exchange capacity and soil nutrients.