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Research Article

ECOLOGY IN RELATION TO RICE FIELD SOILS IN BHOR AND VELHE REGION OF PUNE DISTRICT, MAHARASHTRA STATE, INDIA

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ABSTRACT
Rice is grown in different agro climatic zones. Rice-growing environments drastically vary within and outside our country. Rice field soil is a complex ecosystem. Various microelements and micro-organisms in soil control these ecosystems and there is direct impact of these factors on the grain yield. The present study reports the studies on soil analysis, micro flora occurring at five sites each from Bhor and Velhe talukas, Pune district, Maharashtra which lies in Western ghats of Maharashtra and their interrelations contributing to rise field ecology.

Keywords: *Rice Fields, Soil Ecology, Bhor and Velhe Region, Pune District*

INTRODUCTION
Rice-growing environments are varying drastically within countries. Therefore, scientists and specialists from different disciplines and parts of the rice-growing world formed an international committee to determine terminology for rice growing ecosystems. Khush (1984) described the outcome, where the world rice land environments are classified into five major categories based on water regime, drainage, temperature, soil type and topography.

Rice field soil is a complex ecosystem, delimited by physicochemical parameters that hold enormous number of living organisms. Nevertheless, microbes are the least unstated mechanism of soil by both agronomists and soil practitioners. On the farm several soil organisms offer benefits to crop growing in an ecosystem, but are not well understood.

The soil microbes decompose the plant and animal residues entering the soil and convert them into soil organic matter, which influences on soil physical, chemical and biological properties and on creating a complimentary medium for biological reactions and life support in the soil environment (Olson *et al.*, 2000).

Large quantities of readily decomposable organic matter are added to agricultural soils every year as crop residues or animal wastes and have a significant outcome on soil microbial commotion. However, the rate at which organic matter is decomposed by the microbes is interrelated to the chemical composition of the substrate as well as environmental conditions.

There have been a number of studies on the distribution of soil microfungi in Agricultural field. Some studies dealt with the influence of plant community and impact of afforestation on soil health (Chung *et al.*, 2007, Ben *et al.*, 2014). Some with depth effects (Arunachalam *et al.*, 1997) and others attempted to examine seasonal trends (Kennedy *et al.*, 2005).

On the basis of a diagnostic survey conducted in several rice areas in South Asia. Fujisaka *et al.*, (1994) observed low yields in a rice crop are mainly due to deterioration in soil structure and the development of subsurface hardpans.

India is the largest rice growing country; over 43 per cent population has been depend on rice as food grain. Rice is grown under four different ecological zones, with the irrigated ecology accounting for the largest area and highest production and productivity closely followed by rain fed shallow lowlands. Rain fed up land, just one half of the rain fed lowland area, produces less than one fifth of it. Region-wise, the predominantly rain fed eastern zone accounts for the largest area and production but with the lowest productivity, while the largely irrigated north and south zones together accounting for slightly less area

produce one and a half times more than that of eastern India with a distinct yield edge. Western ghat region of Maharashtra is under rain fed conditions and its ecological parameters were not studied so far.
The present ecological study of weeds from rice field has been carried out in ten sites. Bhor and Velhe talukas of Pune district. Five localities were selected for soil sample collection namely Karanje, Kiwat, Nighudghar, Karnawad and Salekarvasti from Bhor & Similarly in Velhetaluka, Gujawani, Ambawane, Pabe, Wanjale & Dapode.

MATERIAL AND METHODS

Soil Analysis

After paddy harvest,1 kg soil sample (15 cm depth) was collected from each plot and used to determine soil Ph, organic matter content, nitrogen (N), Phosphorus (P) and potassium (K), electric conductivity (EC), zinc (Zn), copper (Cu), iron (Fe) and manganese (Mn). The soil pH was determined by using Fischor's Digital meter as well as pH paper. During the process 5 ml of distilled water was poured into 5g of sieved soil sample. It was allowed to dissolve for 25 minutes and the electrode was dipped to record Ph. Organic matter content was determined by Walkey and Black's method. Nitrogen in soil was determined by micro-Kjeldahl method in which the organic matter was oxidized by sulphuric acid and the nitrogen converted to ammonia which was determined by titration with HCL. Olsen's method was used to determine by atomic absorption spectrophotometer. All these methods of soil analysis have been described (Gupta, 2000).

Microbial Analysis of Soil Samples

Preliminary microbial study of soil samples were carried out. The soil samples were collected in clean polythene bags. At the time of collection the surface of the sampling site was cleaned by removing stones, pebbles and grasses etc. The soil up to depth of 5 to 10 cm from the surface was taken by using long forceps or scalpel. The bags were labelled properly and brought to the laboratory for further testing. Soil samples were dried under room temperature, sieved and stored. Culture of soil microbes prepared and serial dilutions of (10-1 to10-7) were made. These dilutions were spread on petriplates containing Luria Agar.

RESULTS AND DISCUSSION

Soil Sample Collection and Analysis

Agriculturally, soil is the region which supports the plant life by providing mechanical support and nutrients required for growth. It is the region where most of the physical, biological and biochemical reactions related to decomposition of organic weathering of parent rock take place. Soil is an admixture of five major components viz. organic matter, mineral matter, soil-air, soil water and soil microorganisms/living organisms.
The amount of these components varies with locality and climate. Different types of inorganic compounds containing various minerals are present in soil. Amongst them the dominant minerals are Silicon, Aluminium and iron and others like Carbon, Calcium, Potassium, Manganese, Sodium, Sulphur, Phosphorus etc. are in trace amount. Rice grown study areas are essential to know the physiochemical properties present in the soil. In this connection, Soil samples from 10 sites in of both the talukas were collected and analysed for physiochemical parameters such as pH, EC, organic carbon, N, P and K (Table -1).

Micro- Elements in Soils

Soils have been defined differently by geologists, agriculturists, chemists, engineers, environmentalists and soil scientists but the commonly accepted definition of soil is ``soil is natural body formed out of weathered material and it is defined as a three dimensional body at the earth surface, which supports plants and distinct layers of mineral and organic components`` (Kale and Gupta, 2001).
Parent materials of soil play a key role in concentrating various micro-elements (including heavy metals) in the soils by releasing them into the soils during soil formation processes. Metals like Zn,

Cu, Mn and Fe are naturally enter into the soils due to weathering of parent material. Present attempt is made to know micro-elements in different soil types from 10 rice growing sites of Bhor and Velhe regions (Table-2).

Soil Micro-Flora

Soil is an excellent culture media for the growth and development of various microorganisms. Soil is not an inert static material but a medium pulsating with life. Soil is now believed to be dynamic or living system. Soil contains several distinct groups of microorganisms and amongst them bacteria, fungi, actinomycetes, algae, protozoa and viruses are the most important. But bacteria are more numerous than any other kind of micro-organisms.

Microorganisms form a very small fraction of the soil mass and occupy a volume of less than one percent. In the upper layer of soil (top soil up to 10-30 cm depth i.e. Horizon A), the microbial population is very high which decreases with depth of soil.

Each organism or a group of organisms are responsible for a specific change / transformation in the soil. The final effect of various activities of microorganisms in the soil is to make the soil fit for the growth and development of higher plants.

Living organisms present in the soil are grouped into two categories that are follows.1.Soil flora (micro flora) e.g. Bacteria, Fungi and Algae etc. Relative proportion / percentage of various soil microorganisms are: Bacteria-aerobic (70%), anaerobic (13 %), Actinomycetes (13%), Fungi /molds (03 %) and others (Algae Protozoa viruses) 0.2-0.8 %.

Soil organisms play key role in the nutrient transformations. In the present study soil samples from four locations from Bhor and Velhe were studied for their micro-flora in relation to bio-chemical results (Powar and Diginwala, 1994). The results obtained from colony characters, biochemical findings and referring standard.

Krieg (1984) Bergey's Manual of systematic bacteriology referred for identification of Bacteria like Alcaligenes, Halomonas and Rhizobacterm Meriiscul may be present in the soil samples.

Colony Characters

Sample Description	**Salekarvasti**	**Kiwat**	**Wanjale**	**Pabe**
Media	Luria Agar	Luria Agar	Luria Agar	Luria Agar
Size	0.5 cm	o.2 cm	0.1 cm	0.5 cn
Shape	Circular	Circular	Circular	Irregular
Colour	Off White	Off White	Chalky White	Off White
Elevation	Flat	Flat	Flat	Flat
Consistency	Butyrous	Butyrous	Butyrous	Butyrous
Opacity	Opaque	Opaque	Opaque	Translucent
Margin	Entire	Entire	Entire	Wavy
Incubation Time and Temp.	24 hrs at 37 ^{o} c	24 hrs at 37 ^{o} c	24 hrs at 37 ^{o} c	24 hrs at 37 ^{o} c
Gram Staining	Gram Positive Cocci	Gram Negative Short Rods	Gram Negative Short Rods	Gram Negative Short Thin Rods
Motility	Non-Motile	Motile	Non-Motile	Motile

Biochemical Results

Test	Kiwat	Salekarvasti	Pabe	Wangale
Mannitol	No Acid Gas	Acid	Acid	No Acid & Gas
Glucose	Acid	Acid & Gas	Acid	No Acid & Gas
Maltose	No Acid & Gas	Acid	No Acid & Gas	No Acid & Gas
Xylose	Acid	No Acid & Gas	Acid	No Acid & Gas
Cellobiose	No Acid & Gas	No Acid & Gas	Acid and Gas	No Acid & Gas
Arabinose	No Acid & Gas	No Acid & Gas	No Acid & Gas	No Acid & Gas
H_2S Production	Negative	Negative	Negative	Negative
Starch Hydrolysis	No Hydrolysis	Positive	No Hydrolysis	Positive

Table 1: Soil Analysis

Taluka	Village	pH	EC	N %	P %	K %	Zn (ppm)	Cu (ppm)	Fe (ppm)	Mn (ppm)
BHOR	Karanje	7.18	0.12	0.43	0.001	0.016	0.81	7.00	4.00	11.20
	Karnawad	6.20	0.08	0.36	0.0014	0.032	1.31	7.00	17.00	31.40
	Kiwat	7.17	0.18	0.25	0.007	0.011	0.64	6.00	5.00	3.20
	Nighudghar	5.19	0.10	0.54	0.013	0.021	2.45	10.60	54.00	14.30
	Salekarvasti	6.80	0.21	0.32	0.011	0.084	1.98	6.50	1.00	32.40
VELHE	Ambavane	7.20	0.22	0.22	0.013	0.10	2.28	7.30	15.00	29.90
	Gunjavane	6.80	0.08	0.13	0.012	0.13	0.70	4.90	17.00	28.80
	Pabe	5.56	0.11	0.56	0.008	0.09	1.17	6.70	55.00	28.70
	Vinzar	7.34	0.20	0.30	0.006	0.11	4.20	9.40	17.00	31.80
	Wanjale	6.60	0.11	1.34	0.009	0.11	1.70	11.60	41.00	34.60

Discussion

Rice grown areas are essential to know the physiochemical properties present in the soil. In this connection, Soil samples from 10 sites in both the talukas were collected and analysed for physiochemical parameters such as pH, EC, organic carbon, N, P and K. It is also essential to know the Zn, Cu, Iron and Manganese present in the soil.

Bhor taluka selected for soil analysis, 5 soil samples were collected from five villages namely Karanje, Karanawad, Kiwat, Nigudhghar and Salekarvasti.

Ph values of Karanje was 7.18 it is alkaline in nature and Nigudhghar has 5.19 in acidic in nature. Higher levels of Nitrogen 0.54 %, Zinc 2.45 ppm and Copper 10.60 ppm, Iron 54.00 ppm in Nigudhghar.

Salekarvasti has maximum level of EC 0.21, Phosperous 0.011 %, Potash 0.084 and Iron 1.00 ppm and Manganese 32.40 ppm.

Five soil samples from Velhe taluka were analysed from Ambavane, Gunjavane, Pabe, Vinzer and Wanjale villages. Soil samples from Pabe has 5.56 pH is acidic and Vinzer is 7.34 in alkaline nature. Electric conductive 0.22 maximum in Ambavane, Gunjavane has 0.08 EC., Nitrogen 0.13 %, Potash 0.13 % Zn 0.70 ppm, Cu 4.90 ppm minimum level,

Pabe has 0.09 % minimum level of Potash and maximum level of Fe 55.00 ppm and minimum level of 28.70 ppm Mn. While village Wanjale has maximum level of nitrogen 1.34 %, Cu 11.60 and 34.60 Mn in ppm.

Micro-Elements in Soils

Total 10 soil samples were analysed for micro-elements from Bhor and Velhe. Graphic representation shows that minimum level of Zn 2.31, Cu 12.34 in Karnawad. Fe 17.38 in Karanje and Mn 17.58 in Nigudhghar. Higher level of Zn 4.73 and Mn 77.36 in Salekarvasti, Fe 66.38 in Nigudhgar and 40.43 Cu in Kiwat in Bhor region.

Velhe taluka 5 soil samples were analysed from micro-elements. Village Pabe has 1.28 Zn, 31.34 Mn, 7.32 Cu and 27. 24 Fe in village Vinzer in low level. Fe level 60.06 in Pabe, Mn 56.03 in Gunjavane, 6.73 Zn and 15.06 Cu in village Vinzer in higher concentration.

The bioavailability of elements in the soil to plants is controlled by factors associated with soil and climatic conditions. The high level of bio- available Mn in the soil did not pose any problem as this metal is a nutrient required for paddy growth. It was reported that the deficiency of Zn in paddy soils of the Asian region was not uncommon (Alloway, 1995, 2001). Zinc is one of the micronutrients required for paddy growth and commonly included in fertilizers. The fertilizer that contains Zn, but mostly few farmers applied this fertilizer. The low concentration of Cu is suggests minor anthropogenic inputs in paddy soils. It is available in agricultural soils is commonly obtained from Cu present in the fertilizers, fungicides and livestock manure. It is evident that Cu toxicity in the paddy soils studied was negligible. Most of the soil Fe was found to be in the unavailable form in the soil fractions. Low amount of Fe in the soils was observed, indicating the low bioavailability of Fe in the paddy soils. The higher amount of Fe and its affinity to the resistant forms might be attributed to the presence of iron oxides and hydroxides in the paddy soils (Khairiah *et al.*, 2012).

Soil Micro-Flora

Four soil samples were collected during the rainy season. Salekarvasti and Kiwat from Bhor and Wanjale and Pabe from Velhe region. Microbial colony characters were analysed in laboratory. Size of colony was from 0.1 cm to 0.5 cm.

Shape of colony is circular in three types of soils and irregular in Pabe sample. Colour of colony is off white in three soil samples and chalkey white in Wanjale samples. Opacity was observed in four samples out of which three samples opaque and one translucent in Pabe samples. Margins of microbes entire in three and wavy in Pabe samples. Other characters like gram negative with short rods and short thin rods in Pabe samples.

Motality studies shows that Saleskarvasti and Wangale non-motile and Kiwat and Pable are motile. Biochemical characters regarding organo-sacchrieds like Manitol, Glucose, Maltose, Xylose, Cellobiose, Arabinose, H2s production and starch hydrolysis tests were carried out. Bacteria produces acids and some were no acid or gas production. Starch hydrolysis indicate that Salekarvasti and Wangale shows positive activity of bacteria and no hydrolysis in Kiwat and Pabe soil bacteria. The results obtained from colony characters and biochemical findings and referring standard Bergey's Manual of determinative bacteriology. Bacteria like Alcaligenes, Halomonas, Rhizobacterm Meriiscul may be present in the soil samples.

Conclusion

The rice fields were extensively studied with respect to agronomic aspects, like pests, natural enemies and troublesome weeds. The present studies added more dimension documenting soil related aspects resulting comprehensive ecology and biodiversity from Bhor and Velhetaluka.

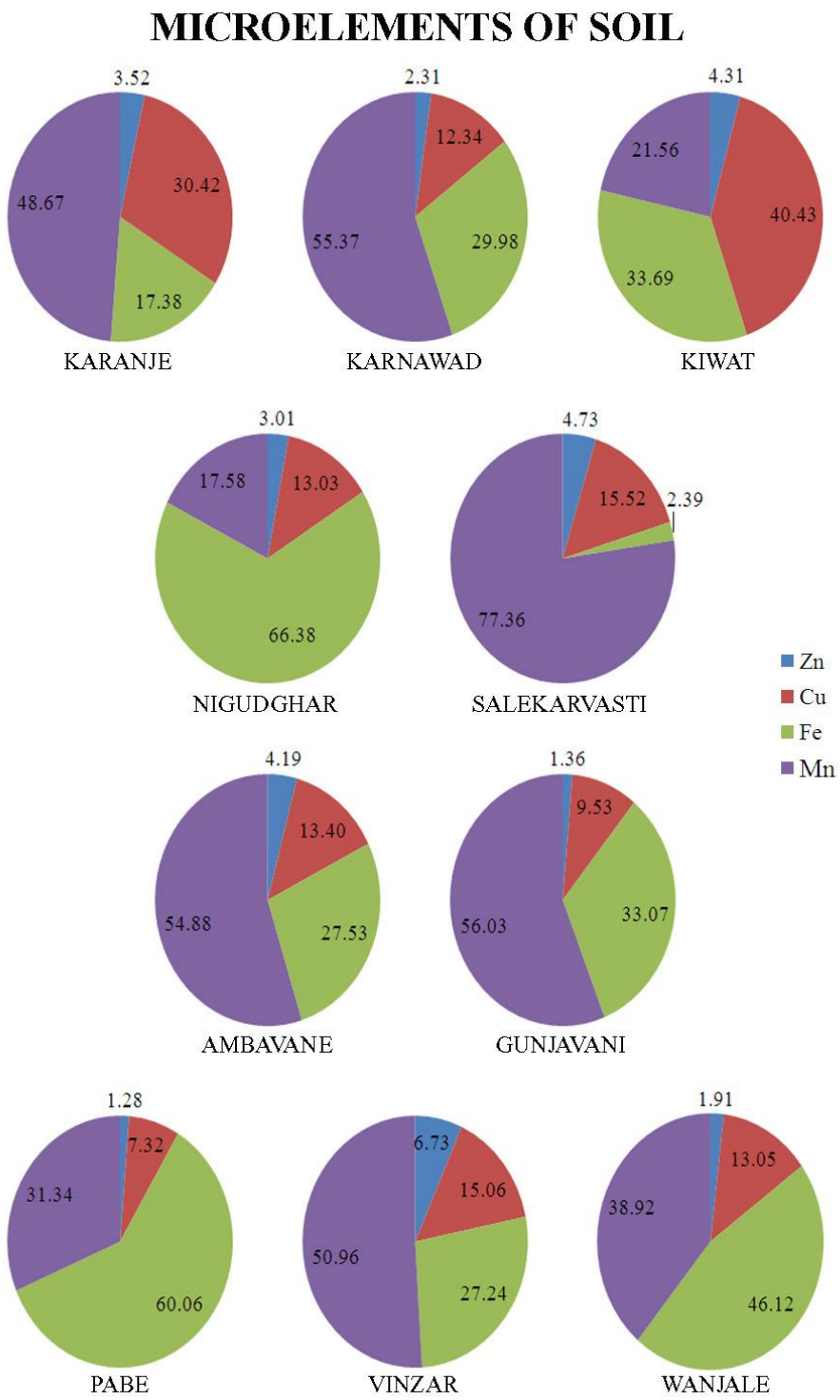

Table 2: Graphics of Microelements in Soils

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