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04

EFFECT OF FLOOD ON PH AND ELECTRICAL CONDUCTIVITY (EC) OF SUGARCANE SOIL AND ITS ROLE IN CYANOBACTERIAL ABUNDANCE AND DIVERSITY IN SUGARCANE SOIL OF SHIROL TAHASIL OF KOLHAPUR (M.S., INDIA)

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Abstract

Composition of cyanobacteria contributes to making a major role in fertility of soil to fix atmospheric nitrogen. Sugarcane is the major cash crop of shirol. The present research work carried on study of cyanobacteria in sugarcane soil and effect of flooding on pH and electrical conductivity (EC) in sugarcane fields of flood sensitive villages of shiroltahasil. The experiment was conducted in December (2019) after the three month after the flood (2019), when soil became dry and moist. The collected soil samples were analyzed in a laboratory and found variable range in pH and EC. The data were statistically analyzed using analysis of variance to test differences in pH and EC among various conditions ($p<0.05$).There was significantly different on an average pH and EC among the various conditions due to flooding. During the investigation an abundance of Cyanobacteria were encountered in completely flooded (CFLD), partially flooded (PFLD) sensitive study areas.

Keywords: pH, Electrical conductivity (EC), Flood, Soil, Sugarcane, Shirol. *etc.*

Introduction:

Ideal indication of chemical nature of soil specifies pH and EC. According to Somawanshi et.al 1999 Soil with 6.5 to 7.5 and EC below 1 mS/cm are considered as better soil growth.In agro farming it gives ideas about the proportion of soil nutrient, microbial growth and related environmental impacts in soil. Soil with slightly alkaline promotes the cyanobacterial activity. (Kaushik, B.D. 1994, Singh, R.N. 1961). In the soil water system PH determines the hydrogen ion concentration of soil. It describes how the soil becomes acidic and alkaline in nature.If PH more than 7 the soil is considered to be alkaline or it is less than 7 then soil becomes acidic. If the PH in between 6.5 to 7.5 found satisfactory growth of plant i.e. slightly acidic and slightly alkaline nature of soil. Soil electrical conductivity (EC) calculates quantity salts present in soil means Salinity of soil. More than 1dS/m EC value accelerates microbial processes and in an anaerobic condition nitrate level becomes high by denitrification. (Adviento-Borbe 2006 and others Smith J. L. and J. W. Doran1996).Since Fritsch's accounts (Fritsch, 1907a,) available literature showed that plenty of Cyanobacteria in rice fields. Culture studies introduced by Bannejee (1935) reported that in the rice field cyanobacteria play an important role in nitrogen fixation in helping to maintain fertility of soil. Inoculation of Cyanobacterial also improves soil fertility and increased yield were also reported in several crops such as barley, oats, tomato, radish, cotton, sugarcane, chili and lettuce (Thajuddin and Subramanian, 2005).

Materials and methods:

Collection, analysis and sampling:

Shirol Taluka is prosperous because of the Krishna, Panchganga, Dhudhganga and Warna rivers, which make this area an extensive alluvial tract. Sugarcane can be grown on all types of soils ranging from sandy-loam to clay-loam. The soil samples were collected in 2018 (rainfall 354.34mm) and after the heavy rainfall and flood in 2019, (rainfall 839.57 mm) in the month of November – December when soil was dry and moist and analysed. The soil samples were collected and analyzed Sugarcane fields from 60 different locations from completely flooded, partially flooded and non-flooded villages of sugarcane fields each. Based on the study of survey, collected data and past flood situation in Shiroltahasil villages can be classified in following manner as completely flooded (CFLD), partially surrounded flooded (PFLD) and non-flooded (NFLD) villages. The analysis of sugarcane soil pH and EC by standard methodology given by Jackson (1967).Trivedi and Goel (1986). Kodarkar et.al. (1998). Analysis of variance used to test difference properties across various conditions and locations, significant variation in the means were determined using least significant difference (LSD 0.05) test. R.G.Steel, J.H Torie (1980).These statically analyse carryout by using statically software package.

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Isolation of cyanobacteria:

For ideal cyanobacterial investigation Soil samples were collected from the depth of 0–5 cm on sugarcane suffering fields. (Rangaswamy 1996). Collected Soil samples were transferred to sterile Petri plates. Then sterilized BG-11 medium with pH: 7.1 added in them and put in a culture chamber at 25° C and a 12/12 h light dark cycle at artificial illumination (2000–2500 Lux). After two weeks, colonies were formed, a part of each colony was removed by a loop and transferred to a new plate. After purification of taxa preserved in formalin and taxonomic identified by light microscopy tracing relevant literature. (Kamat 1939, 1963; Somashekar 1983 and Desikachary1959, Prescott, G.W. 1970, Wehr et al. 2002) and corrected based on algae base website **(www.algaebase.org).**

Results and Discussion:

Soil pH status before and after the flood:

	In 2018(before flood)			In 2019(after flood)		
pH	CFLD	PFLD	NFLD	CFLD	PFLD	NFLD
Range	6.88 to 8.55	7.02 to 8.3	7.2 to 8.52	7.18 to8.35	7.1 to 7.98	7.5 to 8.1
Minimum	6.88	7.02	7.2	7.18	7.1	7.05
maximum	8.55	8.3	8.52	8.35	7.98	8.1
Average	7.843548387	7.837580645	7.907096774	7.511935484	7.606774194	7.548548387

During before the flood pH of soil sample ranges as 6.88 to 8.55 with the average value 7.84 in completely flooded (CFLD), 7.02 to 8.3 with the average value 7.84 partially flooded (PFLD) 7.2 to 8 .52 with the average value 7.91 non-flooded (NFLD) locations. After the flood pH of soil sample ranges as 7.18 to 8.35 with the average value 7.51 in completely flooded (CFLD), 7.1 to 7.98 with the average value 7.61 partially flooded (PFLD) and 7.5 to 8 .1 with the average value 7.55 non-flooded (NFLD) locations .

Analysis of Variance:

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
CFLD	60	470.87	7.847833	0.133200311
PFLD	60	470.61	7.8435	0.061101102
NFLD	60	474.52	7.908667	0.090133785

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*
Between Groups	0.159323333	2	0.079662	0.840208954	0.433334
Within Groups	16.78167667	177	0.094812		
Total	16.941	179			

In 2018 statistically hypothesis testing specified that calculated value is 0.840 while table value is 3.047. Calculated value is smaller than the table value. So Null hypothesis H_0 is accepted. Null hypothesis that says there is no statistically significance between the variables. There is no significant difference on an average pH due to various flood conditions and locations.

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Analysis of Variance:

Anova: Single Factor 2019

SUMMARY

Groups	Count	Sum	Average	Variance
CFLD	60	450.21	7.5035	0.043490932
PFLD	60	456.54	7.609	0.029415932
NFLD	60	452.86	7.547667	0.052485989

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.336854444	2	0.168427	4.029589041	0.019438	3.047012
Within Groups	7.398178333	177	0.041798			
Total	7.735032778	179				

In2019 Statistically hypothesis testing specified that calculated value is 4.029, while table value is 3.047. Calculated value is larger than table value it means ($p<0.05$) So Null hypothesis H_0 is rejected. The alternative hypothesis H_a is a position that something is happening a new theory instead of null hypothesis. The result of soil pH indicated significantly different on an average pH due to various flood conditions and locations in the study area. But in both years soil becomes slightly alkaline in nature because the values for pH ranges above the 7.5 in completely flooded (CFLD), partially flooded (PFLD) and non-flooded (NFLD) locations.

Soil EC status before and after the flood

	In 2018(before flood)			In 2019(after flood)		
EC (mS/cm)	CFLD	PFLD	NFLD	CFLD	PFLD	NFLD
Range	0.18 to 1.39	0.14 to 1.58	0.15 to 0.8	0.18 to3.7	0.2 to 2.88	0.14to 1.68
Minimum	0.18	0.14	0.15	0.18	0.2	0.14
maximum	1.39	1.58	0.8	3.7	2.88	1.68
Average	0.420645161	0.477903226	0.398387097	0.74483871	0.655483871	0.482096774

During before the flood EC of soil sample ranges as 0.18 mS/cm to1.39 mS/cm with the average value 0.42 mS/cm in completely flooded (CFLD), 0.14 mS/cm to 1.58 mS/cm with the average value 0.48 mS/cm in partially flooded (PFLD) and 0.15 mS/cm to 0.8 mS/cm with the average value 0.40 mS/cm in non-flooded (NFLD) locations. After the flood EC of soil sample ranges as 0.18 mS/cm to 3.7 mS/cm with the average value 0.74 mS/cm in completely flooded (CFLD), 0.2 mS/cm to 2.88 mS/cm with the average value 0.65 mS/cm in partially flooded (PFLD) and 0.14 mS/cm to 1.68 mS/cm with the average value 0.48 mS/cm in non-flooded (NFLD) locations.

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Analysis of Variance:

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
CFLD	60	24.51	0.4085	0.044027
PFLD	60	27.91	0.465167	0.073039
NFLD	60	23.75	0.395833	0.028177

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.163573	2	0.081787	1.68931	0.18761	3.047012
Within Groups	8.569322	177	0.048414			
Total	8.732895	179				

In2018 Statistical hypothesis testing specified that the calculated value is 1.689 mS/cm while table value is 3.047 mS/cm. calculated value is smaller than table value. So Null hypothesis H_0 is accepted. Null hypothesis that says there is no statistically significance between the variables.

Analysis of Variance:

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
CFLD	60	42.3	0.705	0.319914
PFLD	60	37.56	0.626	0.274414
NFLD	60	28.07	0.467833	0.066594

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1.750114	2	0.875057	3.971988	0.020539	3.047012
Within Groups	38.99436	177	0.220307			
Total	40.74447	179				

Statistical hypothesis testing specifies that the calculated value is 3.972 mS/cm, while table value is 3.047 mS/cm. Calculated value is larger than table value it means ($p<0.05$) so null hypothesis H_0 is rejected. The alternative hypothesis H_a is a position that something is happening a new theory instead of null hypothesis. The result of soil EC indicated there is significant difference on an average EC due to various flood conditions and locations in study area. Value of electrical conductivity shows variable range.

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Table showing the abundance of Cyanobacteria encountered fromflood suffering sugarcane fields.

Division – Cyanophyta	Genera	Species found in flooded field
class-Cyanophyceae		
A) order- Chroococcales		
Family-Chroococcaceae	*Microcystis,*	+
	Chroococcus	+
	Gloeothece	+
	Gleocapsa	+
	Aphanocapsa	+
B) order- Nostocales		
1)Family- Oscillatoriaceae	*Oscillatoria*	+
	Phromidium	+
	Lyngbya	+
	Schizothrix,	+
	Symploca	+
2) Family-Microchaetaceae	*Microchache*	
3)Family-Nostocaceae	*Nostoc*	+
	Nodularia	+
	Anabaena	+
	Aulosira	+
C) Order-Stigonematales		
Family- Stigonemataceae	*Stigonema*	+

Abundance of cyanobacterial species were studied but some dominated species are overview here from locations of shirolTahasil.*Nostoc* species like *Nostocpunctiforme, Nostocrivulare, Nostoc corneun, Nostoc ellipsosporum, Nostocendophytum* are the dominant colonies followed by *Phromidium*species *Phromidiummucicola, Phromidiummolle, PhromidiumfoveolarumPhromidium ambiguum.*

Chroococcus commonly represented as *Chroococcus turgidus, Chroococcuswestii, Chroococcusminuyes, Chroococcus minor, Chroococcusindicus.*Large number of *Oscillatoria species areOscillatoriaprinceps, Oscillatoriaformosa, Oscillatoriaagardhii, Oscillatoriapseudogeminata. Anabaena* grows abundantly species like *Anabaena planctonia, Anabaena spiroides Anabaena aphanizomenoides.Anabaena sphaerica.* Species of *CylendrospermummanjusCylendrospermumlicheniforme, Cylendrospermumindicum, Cylendrospermum muscicola*dominated in sugarcane soil.Species of *Nodularia, Gleocapsa, lyngbya, Aphanocapsa, Gloeotheca, Gloeocapsa,Microcystis, Aulosira, Stigonema, Microchache,Schizothrix. Symploca* were reported from sugarcane field.

Conclusion:

From the above study it could be specified that floods affect the pH and EC of soil which is slightly alkaline and reported abundance of cyanobacteria. Most of them are nitrogen fixing forms which play a role in productivity of sugarcane crops.

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