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Studies on the Soil Nematode Diversity in Relation to the Soil Parameters from Sugarcane Fields of Aurangabad District Maharashtra State, India

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Abstract: ***A survey was conducted from sugarcane fields at four completely different sampling sites like Paithan, Aurangabad, Phulambri and Khultabad taluka. During May-2016 - April-2017. To study the nematodes diversity and their correlation with the soil parameters soil samples was collected from the sugarcane root zones from the four completely different sugarcane fields. The Nematodes were extracted from collected soil samples by the Baermann's funnel technique. And also prepared the soil samples for testing the different soil parameters in the laboratory like Temperature, Moisture content, Water holding capacity, pH and electrical conductivity of the soil. The Nematodes were identified up to Generic level and the numbers of nematodes per 150grams of soil were determined. From all fields, eleven genera of nematodes were collected the collected nematodes belongs to the genus, Iotonchus, Dorylaimus, Dorylaimoides, Indodorylaimus, Xiphinema, Eudorylaimus, Axonchium, Longidorus, Hemicycliophora, Monhystera and Hoplolaimus. Among these, the seven genera were found from Paithan taluka which belongs to Dorylaimus, Dorylaimoides, Iotonchus, Xiphinema, Eudorylaimus, Hoplolaimus and Indodorylaimus. In Phulambri and Khultabad taluka also have same genera, however, in Aurangabad, another generas was additionally recorded i.e. Axonchium, Longidorus, Hemicycliophora and Monhystera. In this study co relationship between plant-parasitic nematodes and soil physicochemical parameters of sugarcane soil. Is carried out and also studied the effect of soil parameters on the nematode diversity. The details are discussed in the text.***

Keywords: Aurangabad district; correlation coefficient; Nematodes diversity; Sugarcane; Soil factors

I. INTRODUCTION

The abundance and composition of the nematode diversity have been used as soil health indicators in many environments [1]. Nematodes are functionally diverse and ubiquitous and give a response to the changes in the environment. The Plant-parasitic nematodes spend some part of their life-cycle in the soil. In addition to the host plant, the type of a soil is known to be major factors which affect on nematodes distribution. For example, Meloidogyne spp. is abundantly found in sandy soils than the clay soils [2, 3]. Soil nematodes are very small near about 0.3–5.0mm long as adults. Worm-like animals which are very abundant and diverse in all soils [4]. The nematodes are dependent on the continuity of soil water films for their movement and are also required soil organism for its feeding.

The activities of the nematodes are largely controlled by soil biological and physical conditions. For the growth of the plant, the chemical and physical conditions of the soil required remain suitable [5]. The major nutrient which is carbon, potassium, phosphorus, nitrogen and sulphur (CNPKS) are not must be required in balance in the soil but they must be available for plant uptake.

In the world, many researchers demonstrated that the relationship between different soil properties and plant pathogen [6-10]. In the sugarcane farming has less risk because the farmer is getting some returns even in adverse condition also. The nematodes are abundant of the soil metazoans and it also plays a vital role within the soil mesofauna as a secondary consumer [11]. Several nematode genera show the power to be infective to the sugarcane crop, The Meloidogyne and Pratylenchus it becomes the infective worldwide microorganism to the sugarcane crop [12, 13] Several researchers reported that the communities of the nematodes within the sugarcane fields combined with the many endoparasitic and ectoparasitic species [14, 15]. Physical and chemical soil parameters each play an important role in the activity of living organisms within the soil. Five properties characterizing the Physical and Chemical status of soil, [Temperature, moisture, water holding capacity of the soil, pH and electrical conductivity of the soil], this five soil parameters play an important role in soil functioning and soil diversity. The various kinds of soil factors are responsible for the distribution of the soil nematodes have been demonstrated by several researchers [16, 17]. This paper reports on a survey aimed at assessing the impact of the soil physicochemical parameters on the nematode diversity in several sugarcane fields of Aurangabad district.

II. MATERIALS AND METHODS

A. Study area

Aurangabad district is found within the Maharashtra state, India with the annual rain 734 millimeter and the temperature variations from Aurangabad district is close to near about 6–46 degree Celsius. The farming of sugarcane in Aurangabad district is characterized by the nice, sandy soils to clay loam soil. The experiment was conducted by collecting the soil samples from the various sugarcane plantation fields placed in Paithan, Aurangabad, Phulambri and Khultabad taluka of Aurangabad district in Maharashtra state. (located at19° and 20° great circles, and 74° and 76° latitudes) during May-2016 to April 2017.

B. Soil sampling technique for nematodes

Sugarcane fields were randomly selected for soil sampling from Aurangabad district the overall forty-eight soil samples were collected from sixteen sites of 4 fields. In every field, a hand auger was used for collecting soil from four completely different fields from a depth of 0–20cm.The collected soil sample was sealed in a polythene bags and labelled it properly. The labelled soil sample kept alone from the sun and delivered to Nematology laboratory and then this soil sample sent to the MIT Institute of Technology, Aurangabad soil testing laboratory for the analysis of soil physical and chemical parameters. And the remaining soil sample which can use to extract nematodes in Department of zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (M.S).

C. Soil and nematode analysis

1) Soil analysis: The soils are analysed at the MIT Institute of Technology, Aurangabad soil testing laboratory, through a scientific way [18]. The one soil parameter was analysed on the field during soil sampling that is the temperature, and remaining four soil parameter were analysed in MIT Institute of Technology, Aurangabad soil testing laboratory like moisture content, water holding capacity, pH, and electrical conductivity

2) Nematode extraction, identification and counting: The analyses of nematodes were conducted at the Laboratory of Nematology within the department of Zoology Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. Nematodes were separated from the soil by the Baermann funnel technique [19]. The counting of nematodes was done under the dissecting microscope with count dish [20] and additionally by hand. The nematodes were counted and identified up to the generic level by using identification keys of Siddiqi (2000). The abundance of nematodes was determined per 150gm of moist soil

3) Statistical analyse: The collected data were analysed by using the correlation matrix in between nematode and soil parameters.

III.RESULTS

In this study, we understand the effect of soil parameters on the nematodes population. When we correlate the nematodes with soil parameters they show some positive as well as some negative effect on the nematodes population distribution. In this study, we correlate between the genuses of the nematodes such as Dorylaimus, Dorylaimoides, Iotonchus, Xiphinema, Eudorylaimus, Hoplolaimus and Indodorylaimus, from Paithan taluka with the soil parameters as like as Temperature, Moisture, Water holding capacity, pH, and Electrical conductivity of the soil. Details are shown in Table.1. From Paithan taluka at statistically significant ($p = 0.01$) the negative correlation was observed between the population of Eudorylaimus and temperature ($r = -0.827$). This negative correlation of the temperature shows the effect on the population of nematodes when the temperature increases the population of Eudorylaimus ultimately decreases. The moisture content of the soil can't be showing any correlation with the genuses of the nematodes from Paithan taluka. The pH showed the significant negative correlation with the population of Dorylaimoides ($r = -0.845$), Xiphinema($r = -0.549$) and Hoplolaimus($r = 0.757$), when the pH increases the population of Dorylaimoides, Xiphinema and Hoplolaimus ultimately decreases. In this correlation, the water holding capacity of the soil showed the statistically significant ($p = 0.05$) the positive correlation with the population of Dorylaimoides ($r = 0.576$). this positive correlation shows the positive effect on the population of nematodes, if the water holding capacity of the soil increases the population of Dorylaimoides also increases and finally as with pH, the electrical conductivity (E.C.) also showed the significant negative correlation with Dorylaimoides ($r = -0.632$) and Eudorylaimus ($r = -0.652$), and this negative correlation showing the negative effect on the nematode population means when the electrical conductivity (E.C.) increases the population of *Dorylaimoides* and *Eudorylaimus* ultimately decreases as shown in Table.1.

TABLE. 1. THE CORRELATION MATRIX AMONG THE PHYSICOCHEMICAL PARAMETERS AND SUGARCANE SOIL NEMATODES OF PAITHAN TALUKA DURING MAY-2016 TO APRIL- 2017. FROM AURANGABAD DISTRICT.

	Dorylaimus	Dorylaimoides	Iotonchus	Xiphinema	Eudorylaimus	Hoplolaimus	Indodorylaimus	Temperature	Moisture	W.H.C.	pH	E.C
Dorylaimus	0.000	0.507	-0.279	0.623*	0.094	0.491	0.766**	0.100	-0.526	0.127	-0.421	0.099
Dorylaimoides		0.000	0.105	0.432	0.550	0.526	0.107	-0.453	-0.538	0.576*	-0.845**	-0.632*
Iotonchus			0.000	0.060	-0.123	-0.321	-0.104	0.215	0.139	-0.242	-0.183	-0.279
Xiphinema				0.000	-0.223	0.581*	0.588*	0.358	-0.177	-0.028	-0.579*	0.137
Eudorylaimus					0.000	0.107	-0.130	-0.827**	-0.457	0.440	-0.332	-0.652*
Hoplolaimus						0.000	0.409	-0.083	0.024	0.506	-0.757**	-0.003
Indodorylaimus							0.000	0.210	0.003	-0.251	-0.180	0.456
Temperature								0.000	0.125	-0.475	0.144	0.570*
Moisture									0.000	-0.081	0.296	0.316
W.H.C.										0.000	-0.486	-0.687**
pH											0.000	0.384
E.C												0.000

In this study from Aurangabad taluka it is seen that correlation between the generas of the nematodes such as Dorylaimus, Indodorylaimus, Axonchium, Longidorus, Hemicycliophora, Hoplolaimus and Monhystera with the soil parameters as like as Temperature, Moisture, Water holding capacity, pH, and Electrical conductivity of the soil details are shown in Table.2. From Aurangabad taluka, the nematode population showed nonsignificant association with pH. But the electrical conductivity (E.C.) showed the significant negative correlation with Axonchium (r = -628) and Hemicycliophora (r = -0.581), means when electrical conductivity of the soil increases the population of the Axonchium and Hemicycliophora decreases. But no correlation showed between the nematode genuses and soil parameters such as temperature, water holding capacity and moisture content of the soil as shown in Table.2.

TABLE. 2. THE CORRELATION MATRIX AMONG THE PHYSICOCHEMICAL PARAMETERS AND SUGARCANE SOIL NEMATODES OF AURANGABAD TALUKA DURING MAY-2016 TO APRIL-2017. FROM AURANGABAD DISTRICT.

	Dorylaimus	Indodorylaimus	Axonchium	Longidorus	Hemicycliophora	Hoplolaimus	Monhystera	Temperature	Moisture	W.H.C.	pH	E.C
Dorylaimus	0.000	0.165	0.312	0.198	0.443	-0.224	-0.106	-0.122	0.249	0.277	0.158	-0.394
Indodorylaimus		0.000	0.013	0.239	-0.145	0.113	0.396	0.384	-0.205	-0.018	0.381	-0.387
Axonchium			0.000	0.295	0.668*	-0.169	0.017	-0.426	0.533	0.312	0.519	-0.628*
Longidorus				0.000	0.255	0.267	0.320	-0.176	-0.074	0.352	-0.069	-0.293
Hemicycliophora					0.000	-0.260	-0.012	-0.131	0.509	0.531	0.489	-0.581*
Hoplolaimus						0.000	0.694**	0.521	-0.452	0.285	-0.458	0.366
Monhystera							0.000	0.444	-0.532	-0.012	-0.229	0.260
Temperature								0.000	-0.486	0.306	0.015	0.105
Moisture									0.000	0.316	0.566*	-0.672*
W.H.C.										0.000	0.156	-0.530
pH											0.000	-0.823**
E.C												0.000

Dorylaimus, Dorylaimoides, Hoplolaimus, Indodorylaimus, Longidorus, Eudorylaimus and Xiphinema correlated with the soil parameters such as Temperature, Moisture, Water holding capacity, pH, and Electrical conductivity of the soil. Details are shown in Table.3. From Phulambri the statistically significant (p = 0.01) the negative correlation was observed between temperature and Dorylaimoides (r = -0.83), Hoplolaimus(r = -0.79) and Xiphinema (r = -0.71) it means if the temperature increases the genus Dorylaimoides ultimately decreases. The water holding capacity of the soil also showed the negative correlation with Dorylaimoides(r =-0.60) and Xiphinema (r = -0.67) which indicating that if the Water holding capacity of the soil increases, the population of Dorylaimoides ultimately decreases. But the population of the nematodes from Phulambri shows the nonsignificant association with the pH while the moisture content of the soil failed to show any correlation with the species of nematodes under this investigation. And finally, the electrical conductivity (E.C.) also showed the significant negative correlation with Dorylaimoides(r = -0.72) and Hoplolaimus (r = -0.67), when the electrical conductivity (E.C.) increases the population of Dorylaimoides and Hoplolaimus ultimately decreases as shown in Table.3.

TABLE.3. THE CORRELATION MATRIX AMONG THE PHYSICOCHEMICAL PARAMETERS AND SUGARCANE SOIL NEMATODES OF PHULAMBRI TALUKA THROUGHOUT MAY-2016 TO APR-2017. FROM AURANGABAD DISTRICT.

	Dorylaimus	Dorylaimoides	Hoplolaimus	Indodorylaimus	Longidorus	Eudorylaimus	Xiphinema	Temperature	Moisture	W.H.C.	pH	E.C
Dorylaimus	0.00	0.52	0.38	0.60*	0.11	0.34	-0.04	-0.26	-0.03	-0.05	0.32	-0.49
Dorylaimoides		0.00	0.83**	0.23	-0.01	0.15	0.73**	-0.83**	-0.24	-0.60*	0.22	-0.72**
Hoplolaimus			0.00	0.42	0.02	0.53	0.52	-0.79**	0.12	-0.25	0.18	-0.67*
Indodorylaimus				0.00	-0.42	0.32	-0.41	-0.16	-0.02	0.28	0.29	-0.30
Longidorus					0.00	0.40	0.13	-0.10	0.39	0.09	-0.27	0.02

Eudorylaimus						0.00	-0.10	-0.09	0.50	0.28	-0.11
Xiphinema							0.00	-0.71**	-0.14	-0.67*	0.13	-0.55
Temperature								0.00	0.01	0.35	-0.34	0.79
Moisture									0.00	0.72	0.17	-0.14
W.H.C.										0.00	0.23	0.08
pH											0.00	-0.77
E.C												0.00

In Khultabad taluka of Aurangabad district the encountered generas of nematodes are Dorylaimus, Xiphinema, Longidorus, Dorylaimoides, Monhystera, Hemicycliophora and Eudorylaimus correlated with the soil parameters such as Temperature, Moisture, Water holding capacity, pH, and Electrical conductivity of the soil. Details are shown in Table.4. The statistically significant (p = 0.05) the positive correlation was observed between the population of Xiphinema(r = 0.71), Monhystera (r = 0.93), Hemicycliophora(r =0.56) and Eudorylaimus(r = 0.57) with the temperature, this positive correlation indicated that if the temperature increases the population of Xiphinema, Monhystera, Hemicycliophora and Eudorylaimus also increases. The water holding capacity of the soil shows the negative correlation with the Dorylaimus (r= -0.66), Longidorus (r= -0.87) and Monhystera (r = -0.59), but this negative correlation shows the against effect on the nematode population, means if the water holding capacity of the soil increases the population of Dorylaimus, Longidorus and Monhystera ultimately decreases. As well as

the pH is also showed the significant negative correlation with Longidorus(r = -0.82), Monhystera (r = -0.85) and Hemicycliophora (r = - 0.65), it is also showing the against effect on the nematode population, means when pH increases the population of the Longidorus, Monhystera and Hemicycliophora ultimately decreases. And finally the electrical conductivity (E.C) of the soil was highly significant positive correlation with the populations of Longidorus(r = 0.92), Monhystera (r = 0.75) and Hemicycliophora (r = 0.67), it shows the positive effect on the nematode population means if the electrical conductivity of the soil increases the population of Longidorus, Monhystera and Hemicycliophora also increases. But the moisture content of soil has no any correlation with the genus of nematodes as shown in table.4.

TABLE.4. THE CORRELATION MATRIX AMONG THE PHYSICOCHEMICAL PARAMETERS AND SUGARCANE SOIL NEMATODES OF KHULTABAD TALUKA DURING MAY-2016 TO APRIL-2017. FROM AURANGABAD DISTRICT.

	Dorylaimus	Dorylaimoides	Hoplolaimus	Indodorylaimus	Longidorus	Eudorylaimus	Xiphinema	Temperature	Moisture	W.H.C.	pH	E.C
Dorylaimus	0.00	0.18	0.59*	0.44	0.42	0.34	0.04	0.23	-0.19	-0.66*	-0.50	0.52
Xiphinema		0.00	0.09	0.43	0.21	0.38	-0.35	0.05	0.07	-0.04	-0.26	0.12
Longidorus			0.00	0.51	0.69**	0.77**	0.21	0.71**	0.23	-0.87**	-0.82**	0.92**
Dorylaimoides				0.00	0.42	0.26	0.39	0.40	-0.13	-0.55	-0.41	0.45
Monhystera					0.00	0.58*	0.48	0.93**	0.19	-0.59*	-0.89**	0.75**
Hemicycliophora						0.00	-0.30	0.56*	0.52	-0.48	-0.65*	0.67*
Eudorylaimus							0.00	0.57*	-0.23	-0.35	-0.33	0.31
Temperature								0.00	0.31	-0.61*	-0.84**	0.77**
Moisture									0.00	0.14	-0.10	0.05
W.H.C.										0.00	0.79**	-0.93**
pH											0.00	0.90**
E.C												0.00

IV. DISCUSSION

The aim of this study was to evaluate the relationships between nematode diversity and soil parameters. It is generally accepted that the soil parameters are strongly influenced by the nematodes diversity and it is also useful as an indicator of soil health status and several soil functions [11] The different statistical analyses were applied to understanding the relationships between different genera of nematodes and soil physical-chemical parameters [21-23]. In this study, we have identified the eleven genera of the nematodes and understood their correlation with the soil parameters from four selected talukas. During this study period from Paithan taluka, we correlate the nematode genera with the five soil parameters such as temperature, moisture content, water holding capacity, pH

and electrical conductivity of the soil. Out of this five soil parameters shows some positive as well as negative correlation with the nematode diversity. On the diversity of the nematodes, the moisture content of the soil doesn't show any effect from all selected talukas but the temperature, pH and electrical conductivity showed the negative correlation with the diversity of nematodes from Paithan taluka as well as the water holding capacity of the soil showed the positive correlation with nematode diversity. From Aurangabad, taluka pH doesn't show any association with nematode diversity but the electrical conductivity showed the negative correlation. The water holding capacity, moisture content and temperature it doesn't show any correlation with the nematode diversity. As well as from Phulambri taluka the temperature, electrical conductivity and water holding capacity of the soil showed the negative correlation with the nematode diversity. The pH doesn't show an association with the nematode and the moisture content of the soil have no any correlation with the nematode diversity and finally the temperature and electrical conductivity showed the positive correlation with nematodes diversity as well as water holding and pH of the soil showed the negative correlation with the nematodes but the moisture content of the soil not showed any correlation with the nematode diversity. Daily fluctuations in temperature and moisture in the upper few cm of soil probably caused daily fluctuations in nematode population densities, but such measurements were not made in this study.

V. CONCLUSION

In this study after the correlation, we finally come to the conclusion that, the moisture content of the soil is totally failed to show any correlation with the genuses of the nematodes. Means doesn't show any effect of moisture content of the soil on the population of nematodes. But the water holding capacity of the soil is adversely affected by the nematode population, from all regions except Paithan taluka. The pH of soil also showed the adverse effect on the nematode population, if it is changed.

Finally, an overall result is indicated that the significant impact of soil parameters on the nematode population. The change in temperature, water holding capacity, pH and electrical conductivity adversely affected on the population of some genus of the nematodes.

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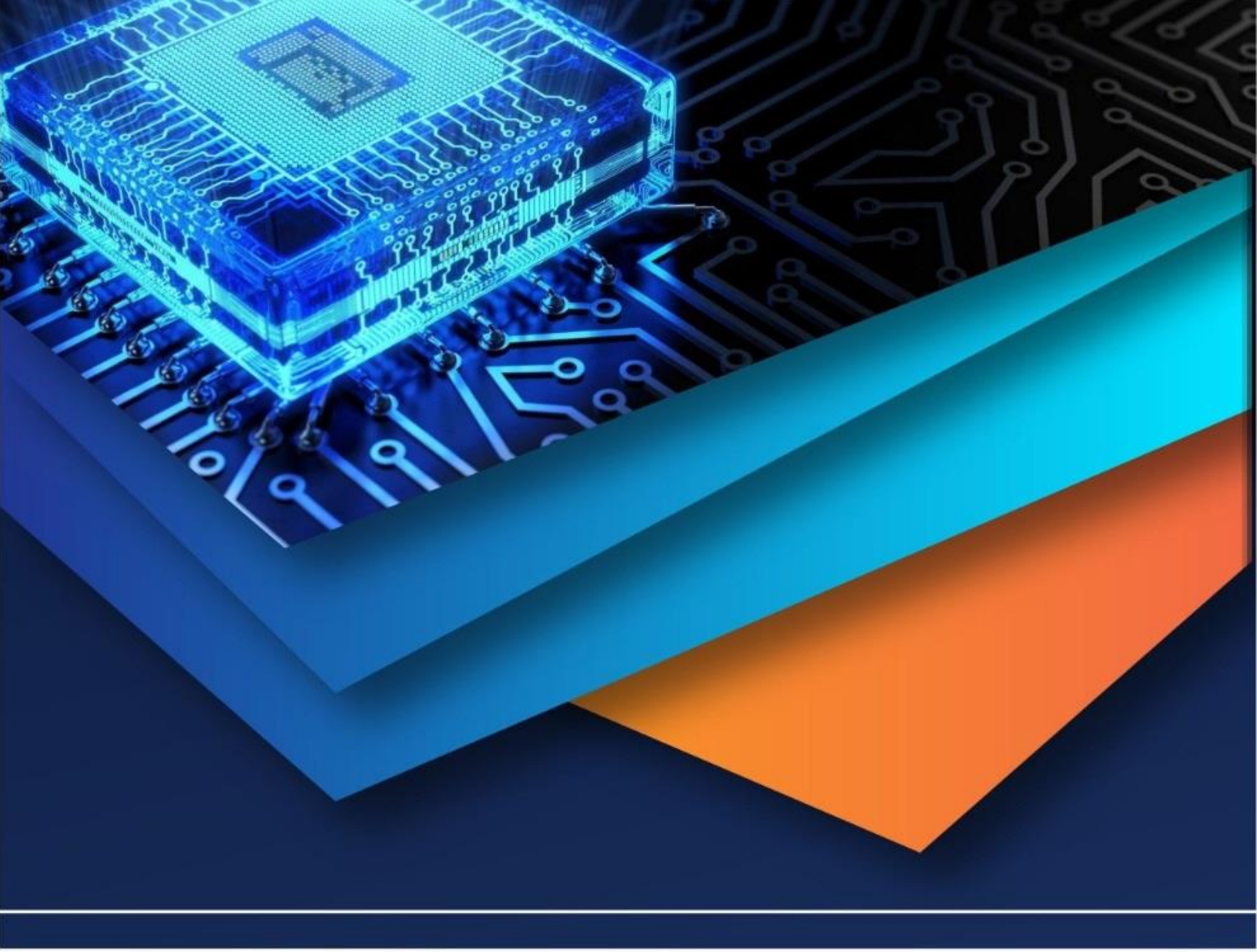

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