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Effect of Different Levels of Fertilizers on the Growth and Yield of Cotton under Different Tillage Operations of Raja Plough (MB Plow)

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Abstract— In this research an experiment was conducted at Rajput Farm, Tando Allahyar Sindh, Pakistan; to study the effect of different tillage intensity and fertilizer dosage on yield of cotton crop. The experiment was laid out in a randomized complete block design (RCBD) with three replications. The tillage and fertilizers treatments include T1 = 1 crosswise passing of a Raja Plough (MB Plow), T2 = 2 crosswise passing of a Raja Plough (MB Plow), T3 = 3 crosswise passing of a Raja Plough (MB Plow), (F1=control, F2 = 50:25, F3 = 100:50, F4 = 125:75, and F5 = 150:100) respectively. Data analysis and statistical analysis were done through ANOVA procedure. The statistical data showed that the tillage treatment T3 for all levels of fertilizers doses demonstrated better performance as compared to the other tillage treatments. The T1 treatments showed less effective results regarding all the parameters. The highest plant height (160.244 cm), number of sympodial branches per plant (19.16), number of productive bolls per plant (68.22), seed cotton yield per plant (124.51 g), GOT % (33.45 %), staple length (26.48 mm), and seed cotton yield (2357.10 kg ha-1) were recorded in T3F5 tillage and fertilizer treatment followed by (T3F4) respectively. The data indicate that the tillage treatment T3 and fertilizer dosage F5 is recommended for getting maximum yield of cotton under agro-ecological conditions of Rajput farm, Tando Allahyar, Sindh.

Keywords— Cotton, Agriculture, Tillage, MB Plow, Tando Allahyar, Fertilizer, Soil, Furrow, GOT %, Staple Length, Sindh.

I. INTRODUCTION

Pakistan is a country which is rich in natural resources of every shape and form. Cotton (Gossypium hirsutum L.) is the most important, indeterminate non-food cash crop and a significant source of foreign exchange earnings for Pakistan. The crop generally sown over 7 to 8 million acres per year in Pakistan. Pakistan is the fourth largest producer of cotton in the world and third largest exporter of raw cotton. Cotton accounts for 7.3% of the value added in agriculture and about 1.6% in GDP for Pakistan. However, with the passage of time, cotton production has faced multiple problems due to energy shortfall, inflation and high-cost of production. The per acre cotton yield in Pakistan is very low as compared to the other countries i.e. China, USA, India, Brazil, Turkey, Egypt and Iran. [1].

Among the four provinces Punjab is the leading cotton growing province (2143 thousand hectares with 7950 thousand bales), followed by Sindh (509 thousand hectares with 2000 thousand bales), while the rest of two provinces (NWFP and Balochistan) posses the negligible area under cotton crop. As far as yield ha^{-1} is concerned Sindh province has proved to be more productive than other province [2]. Ecological factors strongly influence cotton yield, particularly GOT % and staple length, which depend on appropriate irrigation and fertilizers dosage and its distribution during the growing season. Production and yield of cotton depend on climatic condition, variety, tillage practices etc [3].

Tillage operations are necessary to remove weeds and prevent crust formation. The advantages of different tillage systems are moisture conservation, reduction of soil erosion, less labour and energy requirement, more timely planting of crops and increased intensity of land use [4]. Proper fertilizer dosage and good tillage practices would be quite promising not only in providing greater stability in production, but also in maintaining higher soil fertility status [5]. Thus we need to prepare our land as per standard quality by using available resources and use fertilizer with proper dosage in order to obtain economically profitable crop yields without affecting soil fertility.

Considering the above facts, the present investigation was taken under involving tillage intensity, and fertilizers dozes to investigate the effect of tillage intensity, and fertilizers dozes on the yield contributing characters and yield of cotton.

II. MATERIALS AND METHODS

A. Location

The experiment was carried out at Rajput Farm, Tando Allahyar Sindh, Pakistan during the kharif season of the year 2013-2014. The study was performed to investigate the effect of tillage intensity, and fertilizers dozes on the yield contributing characters and yield of cotton.

B. Background of the Study Area

The total farm area was comprised of about 224 acres and which is split into 14 big blocks i.e. 1 big block is equal to 16 acres (Figure: 1). The soil of the experimental site was sandy loam in texture having particle density 2.49 g/cm^3, moderately well drained and kept fallow since many years. During initial survey of the farm, it had been observed that the topographic condition of the farm is varying due to uneven slopes. The soil condition is fertile and good for agricultural purpose. As the land kept fallow for a long time therefore, with the mutual understanding of agricultural expert and grower it has been decided that some part of his farm will used for traditional cotton cultivation and some will be used for a short term study for future interest.

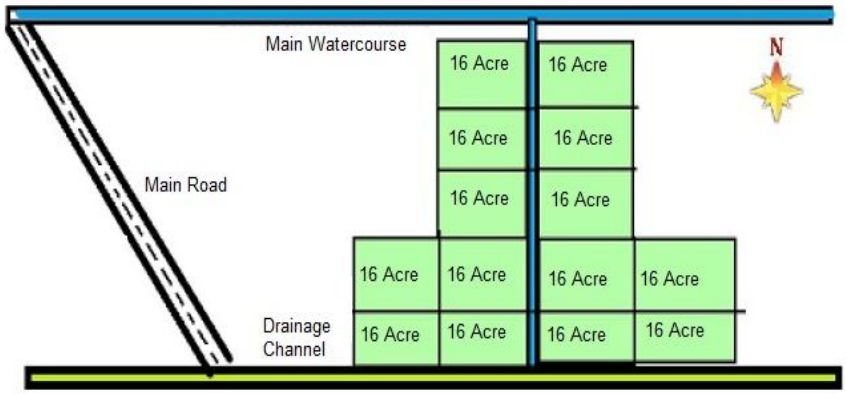

Fig: 1(a) Command Plan of Rajput Farm

III.FIELD EXPERIMENTAL PROCEDURE

In order to achieve the objectives of the study the out of 224 acres of land one big block i.e. 16 acres was selected for experiment. The main block was divided into three sub-blocks i.e. 5 acre each and the power tillage treatments for each 5 acres were provided which include T_1 = 1 crosswise passing of a Raja Plough (MB Plow), T_2 = 2 crosswise passing of a Raja Plough (MB Plow), and T_3 = 3 crosswise passing of a Raja Plough (MB Plow) accordingly. After the completion of tillage operations, the three sub blocks were divided into several small plots to analyze the effect of different dozes of fertilizers on the cotton crop. In order to prepare the land (seed bed) the disk harrow operation to eradicate the weeds, supplement with two crosswise operations of normal cultivator and rotavator operations to pulverize the land accordingly. With the objective of uniform distribution of irrigation water land was leveled by laser leveler. Finally, a good seed bed (furrows and ridges) was prepared accordingly. Figure 2(a) – 2(f) describes the overall land preparation operations which were studied during this research study.

Fig: 2(a) Power Tillage Treatment by Raja Plough (MB Plow) Operation

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Fig: 2(b) Raja Plough Operation Side View

Fig: 2(c) Soil Pulverization by Cultivator Operation

Fig: 2(d) Soil Pulverization by Rotavator Operation

Fig: 2(e) Laser Land Leveling Operation

Fig: 2(f) Ready Furrows and Ridges for Cotton Sowing

The experiment was laid out in a randomized complete block design (RCBD) with three replications. Homogenous seeds of cotton variety i.e. Shahbaz were sown for five different NP levels. Sowing was done manually by arranging the row to row distance of 2.5 ft, plant to plant distance was kept 1 ft and seed depth 2 – 2.5 inch. The treatments composed of five different fertilization doses for NP i.e. (F_1=control, F_2 = 50:25, F_3 = 100:50, F_4 = 125:75, and F_5 = 150:100). The total amount of phosphorous was applied in the form of DAP at the time of seed bed preparation (sowing). While nitrogen in the form of Urea was applied in split dozes at different crop development stages i.e. 1/3 of the nitrogen fertilizer doze was applied at first irrigation and remaining dozes of the nitrogen fertilizer was applied before flowering and boll formation accordingly.

The required irrigation water was applied on the basis of ET calculated from climatically parameters. A soaking dose of 100 mm was applied and the subsequent irrigations were based on 60% soil moisture depletion. The first irrigation after soaking dose was provided after 4 weeks and the remaining 5 subsequent irrigations were given after 3 weeks of interval accordingly. In each subsequent irrigation the applied water was kept at 75mm per acre accordingly. Figure 2(g) – 2(i) describes the different irrigation stages of the subject research study.

Fig: 2(g) First Irrigation during Sowing

Fig: 2(h) Subsequent Irrigation after Germination and Shoot Development

Fig: 2(i) Front View of Branch Watercourse Used for Irrigation Purpose

Different intercultural operations such as irrigation, weeding, pest control etc. were done in all plots throughout the growing period accordingly. For recording observations on different parameters, 100 plants from each plot were selected randomly and tagged. The quantitative and economic parameters studied during the subject study was Plant height (cm), number of sympodial branches per plant, number of productive bolls per plant, seed cotton yield per plant (g), ginning outturn (%), staple length (mm), and seed cotton yield kg / ha. Finally, data analysis and statistical analysis were done through ANOVA procedure to analysis of variance and to test the superiority of treatment mean LSD test accordingly. Figure 2(j) – 2(k) describes the different stages of cotton development studied during this research study.

Fig: 2(j) 60% of Cotton is ready for Picking

Fig: 2(k) Cotton Picking Operation in Late Morning

IV. RESULTS AND DISCUSSION

The subject research was carried out to evaluate the effect of tillage intensity of Raja Plough (MB Plow), and different doses of NP fertilizers on the yield contributing characters and yield of cotton. The outcome of the study revealed that cotton plant height (cm), number of sympodial branches per plant, number of productive bolls per plant, seed cotton yield per plant (g), ginning outturn (%), staple length (mm), and seed cotton yield kg / ha differed very significantly between application of different rates of NP fertilizer supplemented with different tillage operation intensity as shown in Table: 01 - Table 07 accordingly. The critical gathered observations and data for the above discussed parameters during the research period are appended below:

A. Quantitative Parameters Studied for Cotton

1) *Plant height (cm):* The results revealed that plant height affected significantly by the NP levels and tillage treatments, while their interaction was non-significant statistically (Table 1). The lowest plant height was observed in T_1F_1 (116.16 cm) and the highest plant height was attained in T_3F_5 (160.24 cm). Similar results were also reported by the Sial et al. [6] for the cotton plant

height.

Table: 01. Effect of tillage intensity and different levels of NP application and their interactions on Plant Height.

NP levels Kg / ha	No of Power Tiller Passing (Raja Plough)			Mean
	T1=	T_2=	T_3=	
	One Passing	Two Passing	Three Passing	
Plant Height (cm)				
F_1= 0-0 (Control)	116.16	121.01	134.31	123.82 d
F_2= 50:25 NP	120.57	125.45	144.05	130.01 c
F_3= 100-50 NP	125.62	131.49	151.22	136.11 b
F_4= 125-75 NP	132.29	136.12	157.29	141.90 a
F_5= 150-100 NP	133.86	138.23	160.244	144.12 a
Mean	125.70 c	130.46 b	149.42 a	--
	Tillage Intensity (T)	Fertilizer Dosage (F)	Interaction (T x F)	
S.E	1.89	2.45	4.24	
Cdi = at P<0.05	3.83	4.94	--	
Cdi = at P<0.01	5.11	6.60	--	

Means followed by common letters do not differ significantly at 5% level.

B. Number of sympodial branches per plant

It was observed that number of sympodial branches per plant varied significantly between the NP levels and tillage treatments, whereas no significant difference was observed in the interaction of NP levels and tillage treatments (Table 02). Cotton treated with T_3F_5 produced maximum number of sympodial (19.16 per plant) and T_1F_1 produced minimum number of sympodial (5.57 per plant). These results of variation are confirmed by the Qaimkhani. [7], who also found significant differences among the cotton Shahbaz variety for the sympodial branches per plant.

Table: 02. Effect of tillage intensity and different levels of NP application and their interactions on Number of sympodial branches per plant.

NP levels Kg / ha	No of Power Tiller Passing (Raja Plough)			Mean
	T1=	T_2=	T_3=	
	One Passing	Two Passing	Three Passing	
Number of Sympodial Branches per plant				
F_1= 0-0 (Control)	5.57	7.12	8.09	6.93 d
F_2= 50:25 NP	8.65	9.91	12.37	10.31 c
F_3= 100-50 NP	11.40	12.37	14.34	12.70 b
F_4= 125-75 NP	13.53	14.98	17.65	15.38 a
F_5= 150-100 NP	14.47	16.34	19.16	16.65 a
Mean	10.73 c	12.14 b	14.32 a	--
	Tillage Intensity (T)	Fertilizer Dosage (F)	Interaction (T x F)	
S.E	0.49	0.64	1.10	
Cdi = at P<0.05	1.00	1.28	--	
Cdi = at P<0.01	1.33	1.72	--	

Means followed by common letters do not differ significantly at 5% level.

V. NUMBER OF PRODUCTIVE BOLLS PER PLANT

The results revealed that number of productive bolls per plant affected significantly by the NP levels, tillage treatments and their interaction (Table 03). The lowest number of bolls per plant was observed for T_1F_1 (19.54). The highest number of bolls per plant was observed for T_3F_5 (68.22) followed by T_3F_4 (66.44). These results were according to the observation of the Sial et al. [6], who also observed the variation in cotton cultivars for the number of bolls per plant.

Table: 03. Effect of tillage intensity and different levels of NP application and their interactions on Number of productive bolls per plant.

NP levels Kg / ha	No of Power Tiller Passing (Raja Plough)			Mean
	T1=	T_2=	T_3=	
	One Passing	Two Passing	Three Passing	
Number of Productive Bolls Per Plant				
F_1= 0-0 (Control)	19.54	27.58	31.54	26.23 d
F_2= 50:25 NP	23.66	34.62	47.87	36.37 c
F_3= 100-50 NP	32.44	39.28	51.95	41.23 b
F_4= 125-75 NP	37.34	49.79	66.44	51.20 a
F_5= 150-100 NP	40.497	56.45	68.22	55.06 a
Mean	31.28 c	41.54 b	53.21 a	--
	Tillage Intensity (T)	Fertilizer Dosage (F)	Interaction (T x F)	
S.E	1.50	1.93	3.34	
Cdi = at P<0.05	3.02	3.90	6.75	
Cdi = at P<0.01	4.04	5.21	9.03	

Means followed by common letters do not differ significantly at 5% level.

VI. ECONOMIC PARAMETERS STUDIED FOR COTTON

Analysis of variance of different economic character viz, seed cotton yield per plant (g), ginning outturn (%), staple length (mm), and seed cotton yield kg / ha differed very significantly between application of different rates of NP fertilizer supplemented with different tillage operation intensity as shown in Table: 04 – Table: 07.

A. Seed cotton yield per plant (g)

It was found that seed cotton yield of individual plant was changed significantly among the NP levels and tillage treatments while their interaction was non-significant statistically (Table: 04). Maximum and minimum seed cotton yield was recorded in case of T_3F_5 (124.51 g per plant), and T_1F_1 (31.18 g per plant) respectively. Similar results were also reported by the Qaimkhani, [7] for the seed cotton yield per plant.

Table: 04. Effect of tillage intensity and different levels of NP application and their interactions on Seed cotton yield per plant (g)

NP levels Kg / ha	No of Power Tiller Passing (Raja Plough)			Mean
	T1=	T_2=	T_3=	
	One Passing	Two Passing	Three Passing	
Seed Cotton Yield per Plant (g)				
F_1= 0-0 (Control)	31.18	42.42	48.82	123.82 d
F_2= 50:25 NP	50.18	67.26	90.00	130.01 c
F_3= 100-50 NP	61.25	89.38	99.38	136.11 b
F_4= 125-75 NP	70.56	99.05	120.61	141.90 a
F_5= 150-100 NP	73.07	106.05	124.51	144.12 a
Mean	57.25 c	68.62 b	96.63 a	--
	Tillage Intensity (T)	Fertilizer Dosage (F)	Interaction (T x F)	
S.E	1.76	2.28	3.94	

Cdi = at P<0.05	3.56	4.60	--
Cdi = at P<0.01	4.78	6.14	--

Means followed by common letters do not differ significantly at 5% level.

VII. GINNING OUTTURN (%)

The Analysis of variance indicated that the differences in ginning outturn percentage among the NP levels and tillage intensities were highly significant; however, their interaction was non-significant (Table 5). The results indicated that individually, higher G.O.T was observed in case of T_3F_5 and T_3F_4 (33.45% or 33.37%), and the lower G.O.T was observed in case of T_1F_1 (29.82 %). These results were entirely according to the observation of the Iqbal et al. [8].

Table: 05. Effect of tillage intensity and different levels of NP application and their interactions on Ginning Outturn Percentage (GOT %).

NP levels Kg / ha	No of Power Tiller Passing (Raja Plough)			Mean
	T1=	T_2=	T_3=	
	One Passing	Two Passing	Three Passing	
Ginning Outturn Percentage (GOT %)				
F_1= 0-0 (Control)	29.82	30.50	31.37	30.56 c
F_2= 50:25 NP	31.13	31.36	32.74	31.75 b
F_3= 100-50 NP	31.28	31.96	32.79	32.01 ab
F_4= 125-75 NP	31.81	32.68	33.37	32.62 a
F_5= 150-100 NP	32.01	32.78	33.45	32.75 a
Mean	31.21 c	31.86 b	32.73 a	--
	Tillage Intensity (T)	Fertilizer Dosage (F)	Interaction (T x F)	
S.E	0.33	0.42	0.73	
Cdi = at P<0.05	0.36	0.85	--	
Cdi = at P<0.01	0.88	1.13	--	

Means followed by common letters do not differ significantly at 5% level.

VIII. STAPLE LENGTH (MM)

The results revealed that staple length affected significantly by the NP levels and tillage intensities, while the interaction of fertilizer levels and tillage intensities was non-significant statistically (Table 6). The results indicated that maximum staple length was observed in case of T_3F_5 and T_3F_4 (26.48 mm or 26.19 mm), and the minimum staple length was observed in case of T_1F_1 (22.98 mm) respectively.

Table: 06. Effect of tillage intensity and different levels of NP application and their interactions on Staple Length (mm)

NP levels Kg / ha	No of Power Tiller Passing (Raja Plough)			Mean
	T1=	T_2=	T_3=	
	One Passing	Two Passing	Three Passing	
Staple Length (mm)				
F_1= 0-0 (Control)	22.98	23.42	24.65	23.68 c
F_2= 50:25 NP	24.25	24.57	25.56	24.79 b
F_3= 100-50 NP	24.44	25.14	26.00	25.19 ab
F_4= 125-75 NP	24.97	25.41	26.19	25.53 ab
F_5= 150-100 NP	25.03	25.72	26.48	25.74 a
Mean	24.33 c	24.98 b	25.77 a	--
	Tillage Intensity (T)	Fertilizer Dosage (F)	Interaction (T x F)	
S.E	0.32	0.41	0.74	

Cdi = at P<0.05	0.43	0.87	--
Cdi = at P<0.01	0.85	1.11	--

Means followed by common letters do not differ significantly at 5% level.

IX. SEED COTTON YIELD KG / HA

It was observed that the differences in the seed cotton yield between the NP levels and tillage intensities were highly significant, whereas the interaction among NP levels and varieties were non-significant (Table: 07). The maximum seed cotton yield per hectare was observed for treatment T_3F_5 (2357.10 kg/ha), while the lowest seed cotton yield per hectare was observed for treatment T_1F_1 (906.95 kg/ha). Similar results were also reported by the Latif et al. [9].

Table: 07. Effect of tillage intensity and different levels of NP application and their interactions on Seed Cotton Yield Kg / ha.

NP levels Kg / ha	No of Power Tiller Passing (Raja Plough)			Mean
	T1=	T_2=	T_3=	
	One Passing	Two Passing	Three Passing	
Seed Cotton Yield Kg / Ha				
F_1= 0-0 (Control)	906.95	989.41	1193.10	1030.14 d
F_2= 50:25 NP	1212.51	1377.45	1930.30	1506.41 c
F_3= 100-50 NP	1455.03	1726.67	2037.00	1739.21 b
F_4= 125-75 NP	1697.51	1920.68	2274.65	1954.55 a
F_5= 150-100 NP	1833.31	2066.11	2357.10	2085.50 a
Mean	1421.05 c	1610.2 b	1958.43 a	--
	Tillage Intensity (T)	Fertilizer Dosage (F)	Interaction (T x F)	
S.E	50.73	65.50	113.44	
Cdi = at P<0.05	102.48	132.30	--	
Cdi = at P<0.01	136.98	176.84	--	

Means followed by common letters do not differ significantly at 5% level.

X. CONCLUSIONS

As a consequence of subject study it can be concluded that different levels of NP fertilizers under different tillage systems had a significant effect on growth and the higher yield of Cotton (Shahbaz). The experiment was laid out in a randomized complete block design (RCBD) with three replications. The tillage and fertilizers treatments include T_1 = 1 crosswise passing of a Raja Plough (MB Plow), T_2 = 2 crosswise passing of a Raja Plough (MB Plow), T_3 = 3 crosswise passing of a Raja Plough (MB Plow), (F_1=control, F_2 = 50:25, F_3 = 100:50, F_4 = 125:75, and F_5 = 150:100) respectively. Data analysis and statistical analysis were done through ANOVA procedure. The statistical data showed that the tillage treatment T_3 for all levels of fertilizers doses demonstrated better performance as compared to the other tillage treatments. The T_1 treatments showed less effective results regarding all the parameters.

The highest plant height (160.244 cm), number of sympodial branches per plant (19.16), number of productive bolls per plant (68.22), seed cotton yield per plant (124.51 g), GOT % (33.45 %), staple length (26.48 mm), and seed cotton yield (2357.10 kg ha-1) were recorded in T_3F_5 tillage and fertilizer treatment followed by (T_3F_4) respectively. The data indicate that the tillage treatment T_3 and fertilizer dosage F_5 is recommended for getting maximum yield of cotton under agro-ecological conditions of Rajput farm, Tando Allahyar, Sindh. Furthermore, as the area under study was sandy loam; therefore these suggestions and working methodology are only applicable for sandy loam soils while the results may vary for other types of soil.

XI. SUGGESTIONS

In the light of present research study carried out it is suggested to all the cotton crop growers that cotton yield can be increased by managing critical stages properly i.e. Land selection and preparation, soil sampling / testing and seed selection and variety, appropriate sowing, fertilizers, irrigation, weed removal, pesticides application, and picking operations etc. For the cultivation of cotton crop fertile clay soils, with good levelling and drainage is required. Saline, Sodic, Saline – Sodic, water logged, and poor

drainage soils are not suitable for cotton cultivation. For uniform irrigation the land must leveled.

As the roots of cotton crop penetrate straight in to the soil i.e. 3 – 4 ft in one complete season therefore, it is necessary to perform a chisel plow and Raja plough operation in to the soil. It will not only open the hard pan of the soil but also enhance the water movement and retention into the soil. The cultivator operations may be increase or decrease depending upon the soil conditions. The seed bed must be prepared according to the conditions of ecological zone, soil texture and structure.

Cotton picking is an important operation, if its picking or storage is not up to the mark so there will be a decrease in its quality. Picking operation must done when the crop is fully ready and dry. After picking it should to be placed on dry and clean place. Always choose those bolls which are fully developed. Don't pick cotton during heavy dust climatic conditions. Place different varieties of cotton in different warehouses in order to protect the fibre and seed quality. After final picking of cotton release the cattle in the field so that they may eat the remains of cotton crop i.e. bolls and leaves.

XII. ACKNOWLEDGEMENTS

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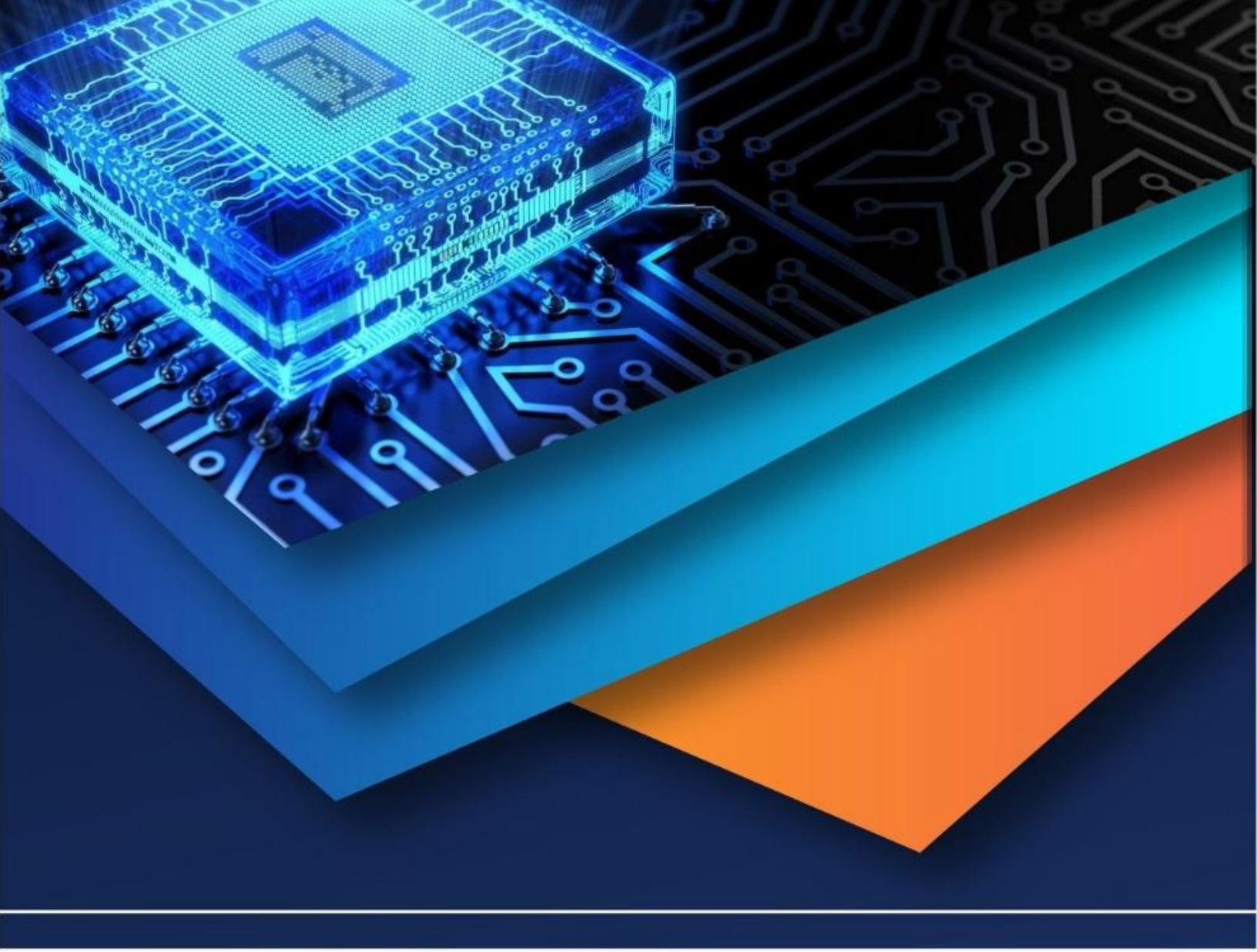

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