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Influence of Pre-Sowing Seed Treatments on Germination Pattern of Senna auriculata, (L.) Roxb.; Adenanthera pavonina, Linn.; and Abrus precatorius, Linn.; (Family-Fabaceae)

Fida Afnan B. M[1], Dr. Sr M. Arul Sheeba Rani[2]
[1, 2]*Department Of Botany, Nirmala College for Women, Coimbatore*

Abstract: ***Seed dormancy is a state in which seeds are prevented from germinating even under environmental conditions normally favourable for germination such as adequate water supply, suitable temperature and the normal composition of the atmosphere.Senna auriculata, (L.)Roxb.;is a much branched shrub with brown bark and closely pubescent branch lets. Adenanthera pavonina, L.; is a medium-sized to large deciduous tree. Abrus precatorius, L.; is a slightly woody vine. Dormancy breaking is of economic importance.***

Under laboratory conditions and in agriculture certain means of rendering the seed coat permeable have been adopted. The mechanism of artificial dormancy breaking and the natural process leading to the same effect are frequently similar. In nature seed dormancy is broken automatically due to development of growth hormones to counter growth inhibitors, leaching of germination inhibitors, maturation and after-ripening of embryo.

Artificial breaking of seed dormancy includes stratification, exposure to light, scarification, alternating temperatures, hormone treatment and chemicals, pressure etc. This study aims at discovering efficient method of breaking seed dormancy in a tree, shrub and a climber. Seeds of Senna auriculata, (L.)Roxb.; Adenanthera pavonina, L.; and Abrus precatorius, L.; were taken as samples. These seeds were subjected to hot water treatment and H_2SO_4 scarification for 30, 45 and 60 minutes. H_2SO_4 scarification was found to be efficient treatment in all the samples breaking the seed dormancy.

Keywords: Seed dormancy, H_2SO_4 scarification, Germination index, Germination percentage, Mean germination time.

I. INTRODUCTION

The seeds of angiosperms are essentially simple in structure. It is enclosed in a covering called the seed coat, usually store some food along with. It is the product of fertilization.

The seeds insure that the gene pool will continue to the next generation. Plants have many ways to disperse and spread the population through their seeds.Seeds are fairly resistant to extreme external conditions, provided they are in a state of desiccation. As a result seeds can retain their ability to germinate, or viability, for considerable periods. Seed has a pivotal role in human and animal nutrition and life. Many of the seeds, after distribution of mother plants or harvest do not germinate in optimal conditions due to a period of dormancy.

For the seed, to germinate it must be placed in environmental conditions favourable to this process. Among the conditions required are an adequate supply of water, a suitable temperature and composition of the gases in the atmosphere, as well as light for certain seeds.

The requirement for these conditions varies according to the species and variety and is determined both by the conditions which prevailed during seed formation and even more by hereditary factors, (Mayer and Poljakoff -Mayber, 1982).

Hard seed coat is found in species like Senna auriculata (L.) Roxb.;, Adenanthera pavonina, Linn.; and Abrus precatorius, Linn.; etc.To overcome the problem associated with germination, seeds need to be subjected to a specific treatment for breaking dormancy, increasing of per cent and acceleration of uniform seed germination (Frett, 1987).

The seed dormancy is considered to have importance in various aspects, like perennation, dispersal, germination under favourable conditions, storage etc. Seed dormancy facilitates their storage and transport to the areas of deficiency. The present study aims to find out, suitable methods for breaking seed dormancy. It is essential for achieving a uniform cultivation and proper weed control.

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II. MATERIALS AND METHODS

A. *Study Area (Plate-2)*

Tamil Nadu is the eleventh largest state in India and covers an area of 130,058 square kilometers. It is heavily dependent on monsoon rains. Nirmala College for Women is located in Coimbatore, Tamil Nadu. Coimbatore district is a district in the Kongu Nadu region of the state of Tamil Nadu. It is located on the banks of the Noyyal River and surrounded by the Western Ghats. The climate of the state ranges from dry sub-humid to semi-arid. The soil types commonly found are loamy soil, clayey soil and calcareous black cotton soil.

Plate 1: Location Map

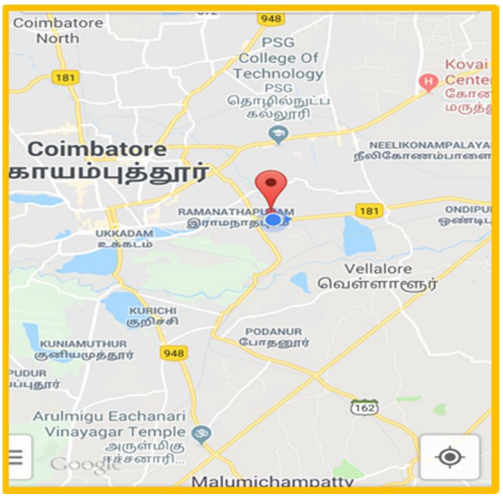


Plate 2: Study Area

B. *Sample Collection*

For the present study the seeds of, Senna auriculata (L.) Roxb.; Adenanthera pavonina, L.; and Abrus precatorius, Linn.; were collected from Calicut, Kerala and Sowripalayam pirivu, Coimbatore. The seeds were obtained from the collected pods and kept in dry place till treatments.

Sample- 1

Systematic position

1) Kingdom : Plantae
2) Sub Division : Spermatophyta
3) Division : Magnoliophyta
4) Class : Magnoliopsida
5) Sub Class : Rosidae
6) Order : Fabales
7) Family : Fabaceae
8) Genus : *Senna*
9) Species : S. *auriculata* (L.) Roxb.;

C. *Plant Description*

Senna auriculata, (L.) Roxb.; is native of India. It is commonly called Avaram tree. The plant is wild in dry regions of Madhya Pradesh, Tamil Nadu and Rajasthan. It is cultivated in other parts of India. It is a much branched shrub with brown bark and closely pubescent branch lets. The leaves are alternate, stipulate, paripinnate compound. Leaflets are very shortly stalked, oval oblong, obtuse. Its flowers are irregular, bisexual, bright yellow and large, the pedicels are glabrous. The racemes are few-flowered, short; erect, to form terminal inflorescence. The fruit is a short legume, 12-20 seeds per fruit are carried each in its separate cavity.

1) *Uses:* The pod husk contains nonacosane, chrysophanol, emodin and rubiadin. The roots are used in skin diseases and asthma and flowers are used in diabetes, urinary disorders and nocturnal emissions. Its Bark is used as astringent. The leaves and flowers possess anti-diabetic activity.

Sample- 2

Systematic position

a) Kingdom : Plantae
b) Sub Division : Spermatophyta
c) Division : Magnoliophyta
d) Class : Magnoliopsida
e) Sub Class : Rosida
f) Order : Fabale
g) Family : Fabacea
h) Genus : Adenanther
i) Species : A. Pavonina, L.;

D. Plant Description

Adenanthera pavonina, L.; is a native of Australia. It is a medium-sized to large deciduous tree. They are generally erect; bark is dark brown to greyish.

The crown is spreading. Leaves are bipinnate; 2-6 opposite pairs of pinnae, each with alternate leaflets, that are oval-oblong, with an asymmetric base and blunt apex.

The flowers are borne in narrow spike like racemes. The flowers are small, creamy yellow and fragrant. Each flower is star shaped with 5 petals, connate at the base.

The pods are long and narrow, with slight constrictions between seeds. The seeds are hard-coated, showy and lens shaped. Seeds adhere to pod. Ripened pods remain on the tree for long periods.

1) Uses: This useful tree provides quality fuel wood, wood for furniture, food, and shade for economic crops like coffee and spices. Various parts of this plant have also been used in traditional medicine for the treatment of asthma, boil, diarrhoea, gout, inflammations, rheumatism, tumour and ulcers, and as a tonic (Watt, 1962).

Sample- 3

Systematic position

a) Kingdom : Plantae
b) Sub Division : Spermatophyta
c) Division : Magnoliophyta
d) Class : Magnoliopsida
e) Sub Class : Rosidae
f) Order : Fabales
g) Family : Fabaceae
h) Genus : Abrus
i) Species : A. Precatorius, L.;

E. Plant Description

Abrus precatorius, L.; is a native of India is found in lowland tropical forest, trailing over thickets and hedges in open or shady places, and commonly called as rosary pea.

It prefers a rich, well-drained, sandy loam and a position in full sun or partial shade. Plants are saline tolerant. It is slightly woody vine, twining, much branched from the base, attaining 3 m in length. The stem is green, cylindrical, glabrous and slightly flattened when mature.

The leaves are alternate, pinnate, entire, oblong and membranous. The venation is inconspicuous. The flowers are arranged into small axillary or terminal pseudoracemes, with 5-7 flowers clustered on rachis.

1) Uses: The leaves and roots contain glycyrrhizin. The seeds contain many medicinally active ingredients like indole alkaloids, anthocyanins and toxic substance called abrin which are easily broken down by heat. The seeds are antiperiodic, diaphoretic, purgative and emetic. They are important in the treatment of conjunctivitis. Glycyrrhizin and abrin are present in roots and leaves. The seeds are much valued in native jewelry for their bright coloration.

F. Pre-Sowing Treatments

Dormancy breaking treatments were imposed with a control. The seeds were subjected for hot water scarification and H_2SO_4 scarification.

1) T0 – Control
2) T1 – Hot water treatment for 30 min
3) T2 – Hot water treatment for 45 min
4) T3 – Hot water treatment for 60 min
5) T4 –Scarification with H2SO4 for 30 min
6) T5 –Scarification with H2SO4 for 45 mi
7) T6 –Scarification with H2SO4 for 60 min

12 seeds of each of the plant is subjected for six dormancy breaking treatments each as indicated above. For hot water soaking treatments, the seeds were soaked in hot water (80°C) for different durations. In H_2SO_4 scarification treatments, the seeds were scarified with concentrated sulphuric acid for different durations. Immediately after scarification, the seeds were washed with distilled water thoroughly. The seeds were taken in clean petri plates after different treatments. After imposing the treatments, the seeds were subjected for germination. They were sown in fertile soil taken in small pots. Each pot is labeled corresponding the treatment imposed for the sawn seeds. Proper irrigation was provided to ensure adequate water availability for seeds. Germination of each of the lots were noted for next 20 days. A comparison of calculated data is done among the seeds of selected plants to derive a conclusion on effect of seed dormancy breaking treatments.

The following parameters were found,

a) *Germination Percentage (%):* Twelve seeds of each of the plant subjected for six dormancy treatments each were sawn in soil. After the test period of forty five days the normal seedlings were counted and the mean value was expressed as percent (International Seed Testing Association (ISTA), 1999).

$$GP=(\text{Final no. of seeds germinated in a seed lot} \div \text{Total no. of seeds sown}) \times 100$$

b) *Mean Germination Time (MGT)*

$MGT = Pf \cdot x/Pf$

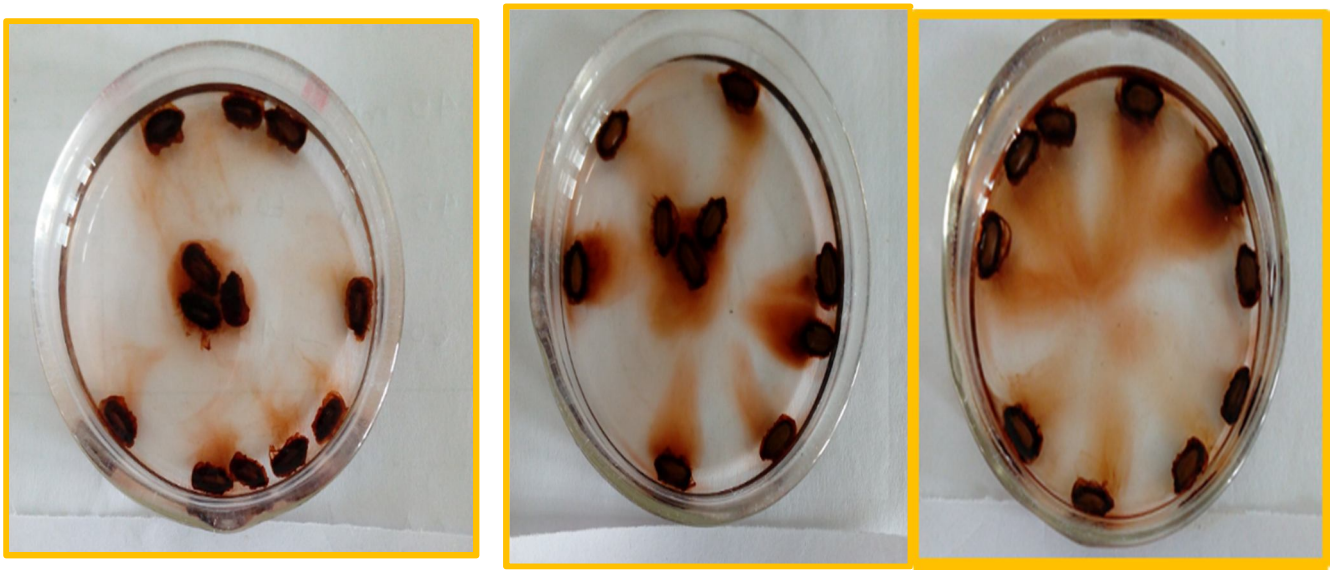
Where, f = Seeds germinated on day x

c) *Germination Index (GI):* Germination Index $GI = (20\times n_1) + (19\times n_2) + \cdot\cdot\cdot + (1\times n_{20})$

Where, n_1, n_2 . . . n_{20} = No. of germinated seeds on the first, second and subsequent days until the 20^{th} day; 20, 19 . . . and 1 are weights given to the number of germinated seeds on the first, second and subsequent days, respectively.

Plate: 3 - H_2SO_4 Scarification of *Senna auriculata* (L.) Roxb.; (Sample- 1)

30 minutes 45 minutes 60 minutes



H_2SO_4 Scarification –

Plate: 4 – H_2SO_4 Scarification of *Adenanthera pavonina*, L.; (Sample-2)

30 minutes 45 minutes 60 minutes

Plate: 5-H_2SO_4Scarification of *Abrus precatorius*, L.; (Sample-3)

30 minutes 45 minutes 60 minutes

III. RESULTS AND DISCUSSION

Table: 1- Determination of Germination Percentage (GP), Germination Index (GI) and Mean Germination Time (MGT) of Senna auriculata (L.) Roxb.;

Day	Control	Hot Water Treatment			H_2SO_4 Scarification		
		30 Minutes	45 Minutes	60 Minutes	30 Minutes	45 Minutes	60 Minutes
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	1	1	0
5	0	0	0	0	1	1	0
6	0	0	0	0	2	2	1
7	0	1	0	1	1	0	0
8	0	0	1	2	2	0	0
9	0	2	0	1	0	0	0
10	0	0	0	0	0	0	0
11	1	0	0	0	0	0	0
12	2	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0
15	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0
GP	33.33%	25%	8.33%	33.33%	50%	25%	8.33%
GI	35	38	13	52	103	63	15
MGT	12.25	8.3	8	8	6.28	5.25	6

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Table- 1 Shows that the germination percentage (GP) is higher in seeds of *Senna auriculata* (L.) Roxb.; subjected to H_2SO_4 scarification for 30 minutes , that is 50%. 25 percentage of germination was found in seeds subjected to hot water treatment for 30 minutes and H_2SO_4 scarification for 45 minutes. Low germination percentage was found in seeds subjected to hot water treatment for 45 minutes and H_2SO_4 scarification for 60 minutes. The germination index (GI) is greater in seeds subjected to H_2SO_4 scarification for 30 minutes and lowest in that treated with hot water for 45 minutes. The mean germination time (MGT) is higher for untreated seeds followed by that treated with hot water for 30 minutes. It is low for seeds subjected to H_2SO_4 scarification for 45 minutes.

Table: 2 - Determination of Germination Percentage (GP), Germination Index (GI) and Mean Germination Time (MGT) of Adenanthera pavonina, Linn.;

Day	Control	Hot water treatment			H_2SO_4 scarification		
		30 Minutes	45 Minutes	60 Minutes	30 Minutes	45 Minutes	60 Minutes
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	2	1
7	0	0	0	0	1	1	0
8	0	0	0	0	1	2	0
9	0	0	0	0	2	0	0
10	0	0	0	0	0	1	0
11	0	1	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	1	1	0	0	0	0
14	0	1	0	0	0	0	0
15	0	0	1	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	1	1	0	0	0
19	1	0	0	0	0	0	0
20	0	0	0	0	0	0	0
GP	8.33%	25 %	25 %	8.33 %	33 %	50 %	8.33 %
GI	19	25	17	3	51	81	15
MGT	19	12.66	15.33	18	33	7.5	6

The seeds of Adenanthera pavonina, Linn.; subjected to H_2SO_4 scarification for 45 minutes shows higher germination percentage (GP) and lowest in that subjected to hot water treatment for 45 minutes and H_2SO_4 scarification for 60 minutes. The germination index (GI) is greater in seeds subjected to H_2SO_4 scarification for 45 minutes and lowest in that treated with hot water for 60 minutes. The mean germination time (MGT) is higher for untreated seeds followed by the seeds subjected for H_2SO_4 scarification for 30 minutes and lower for that subjected to H_2SO_4 scarification for 60 minutes.

Table: 3 - Determination of Germination Percentage (GP), Germination Index (GI) and Mean Germination Time (MGT) of Abrus precatorius, Linn.;

Day	Control	Hot water treatment			H_2SO_4 scarification		
		30 Minutes	45 Minutes	60 Minutes	30 Minutes	45 Minutes	60 Minutes
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	1	1
7	0	0	0	0	1	3	1
8	0	0	2	0	2	0	0
9	0	0	3	2	3	0	0
10	0	0	2	0	3	0	0
11	0	1	1	1	2	0	0
12	0	3	0	1	0	0	0
13	0	2	0	0	1	0	0
14	0	1	0	0	0	0	0
15	0	0	0	0	0	0	0
16	1	0	0	0	0	0	0
17	1	1	0	0	0	0	0
18	0	1	0	0	0	0	0
19	1	0	0	0	0	0	0
20	0	0	0	0	0	0	0
GP	25%	75 %	66 %	33.33%	100 %	33.33 %	16.67 %
GI	11	60	94	43	137	57	29
MGT	17.33	13.55	9.25	10.25	9.58	6.75	6.5

The germination percentage (GP) is higher in seeds of *Abrusprecatorius*, Linn.; subjected to H_2SO_4 scarification for 30 minutes and lowest in that subjected to H_2SO_4 scarification for 60 minutes. The germination index (GI) is also greater in seeds subjected to H_2SO_4 scarification for 30 minutes and low in control. The mean germination time (MGT) is higher for the control followed by seeds treated with hot water for 30 minutes and lower for that seed lot subjected to H_2SO_4 scarification for 60 minutes.

The length of time elapsed between the first seed to germinate and the last, the variation in germination speed and the timing that the majority of seeds germinate all have impacts on diverse cultural operations like fertilizing, harvesting and field maturity of crops (Roberts, 1981, Washitani and Saeki, 1986, Kader and Jutzi, 2001). 'High' (the time at which the majority of seeds germinate) and 'low' (the time at which the minority of seeds germinate) (Kader et al., 1998) germination events are also important indicators of seed vigour and stress resistance (Kader and Jutzi, 2002).

The higher the GP value, the greater the germination of a seed population (Scott et al., 1984). In the context of the parameters tested in the investigation comparing seed germination calculations and the associated interpretation, it appears that the GI is the most accurate among various parameters (Khader, 2005).For seeds of Senna auriculata(L.)Roxb.; the germination percentage (GP) is higher in those subjected to H_2SO_4 scarification for 30 minutes, that is 50%. In seeds of Adenanthera pavonina, Linn.; It is higher in those subjected to H_2SO_4 scarification for 45 minutes. In seeds of Abrus precatorius, Linn.; the seeds subjected to H_2SO_4 scarification for 30 minutes are having higher GP with the value 0f 100%. These seed lots are having greater germination.

For seeds of (L.) Roxb.; the mean germination time (MGT) is low for those subjected to H_2SO_4 scarification for 60 minutes. In seeds of Adenanthera pavonina, Linn.; it is lower for that subjected to H_2SO_4 scarification for 60 minutes and in Abrus precatorius H_2SO_4 scarification for 60 minutes. These seed lots are having seeds germinated faster when compared to others.

When the Germination Index of seeds of Senna auriculata (L.) Roxb.; ,Adenanthera pavonina, Linn.; and Abrus precatorius, Linn.; are observed, H_2SO_4 scarification for 45 minutes is found to be effective in enhancing the percentage and rate of germination. The time period of scarification varies with the sample taken. It is 30 minutes for Senna auriculata (L.) Roxb.; and Abrus precatorius, Linn.;. 45 minutes of H_2SO_4 scarification is beneficial for Adenanthera pavonina, Linn.; seeds.The Germination Percentage and Germination Index is found to be greater in seed lots of all the three plants subjected to H_2SO_4 scarification. The Mean Germination Time is low in the seeds of all three plants subjected to H_2SO_4 scarification, which is desirable. Among the samples, Senna auriculata (L.) Roxb.; and Abrus precatorius, Linn.; shows higher values of MGT for control. Hence the control germinates at a low speed.

IV. CONCLUSION

The seed germination depends on both internal and external factors. Greater Germination Percentage and thereby greater germination is found in the seed lots of all the three samples subjected to H_2SO_4 scarification. The seed lots of Senna auriculata (L.) Roxb.; and Abrus precatorius, Linn.; subjected to H_2SO_4 scarification for 30 minutes shows greater germination. Whereas it is so for seed lots of Adenanthera pavonina, Linn.;subjected to H_2SO_4 scarification for 45 minutes. A higher percentage and rate of germination is found in those seeds with higher values of germination index. The seeds of Senna auriculata (L.)Roxb.; and Abrus precatorius, Linn.; subjected to H_2SO_4 scarification for 30 minutes and in Adenanthera pavonina, Linn.; for 45 minutes is found as the lots with higher percentage and rate of germination. Also faster germination is found in those seed lots of three samples treated with H_2SO_4 with varying time periods. These are the seed lots with low MGT values.

Observing the parameters Germination Percentage, Germination Index and Mean Germination Time of seeds of Senna auriculata (L.) Roxb.; Adenanthera pavonina, Linn.; and Abrus precatorius, Linn.; H_2SO_4 scarification is found to be effective in enhancing the overall germination pattern. The time period of scarification varies with the sample taken. Over hot water treatment and control, H_2SO_4 scarification provides better results in climber, shrub and tree. The given treatments gave better results than the untreated seeds (control). Hence it is preferable to subject the dormant seeds to the pre-sowing treatments for fast and better germination. The higher seed germination due to H_2SO_4 scarification might be due to the weakening of seed coat by distributing and dissolving the lignins and pectins present on epidermal layer of the seed coat, which render them impermeable to water and oxygen. It is inconvenient for seed researchers, botanists, and farmers if seedsdo not germinate at certain times and suitable conditions. Subjecting the dormant seeds for pre-sowing treatments are useful in germinating seeds when needed. A wide range of seeds overcomes seed dormancy after pre-sowing treatments like hot water treatment andH_2SO_4 scarification. H_2SO_4 scarification is most preferred for the seeds of Senna auriculata (L.) Roxb.; Adenanthera pavonina, Linn.; and Abrus precatorius, Linn.; over the control.

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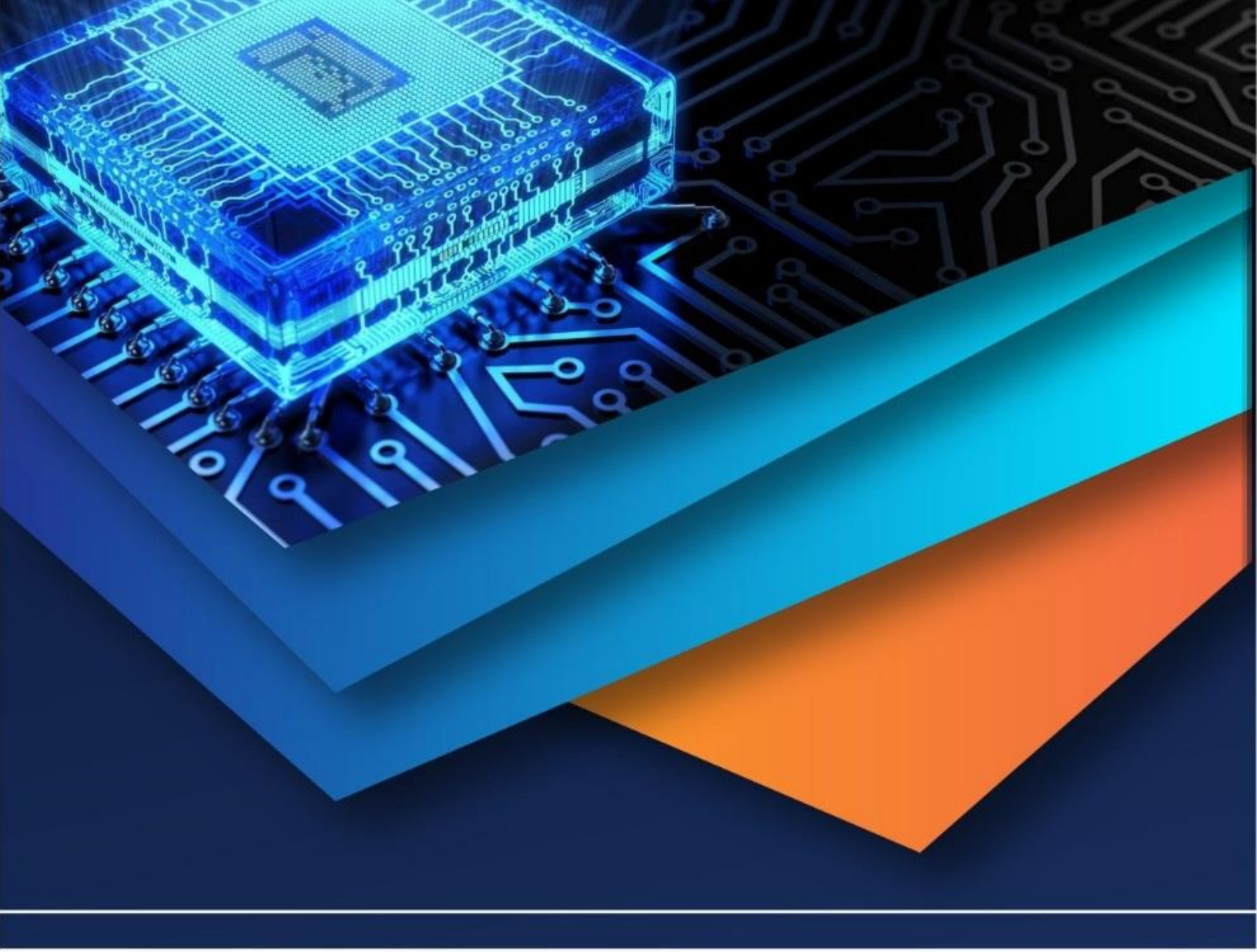

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