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3.4.3 Number of research papers published per teacher in the Journals as notified on UGC CARE list during the last five years

NUMBER OF RESEARCH PAPERS PUBLISHED (2019-2020)

3.4.3 Number of research papers published per teacher in 2019-2020

S.No	Title of paper	Name of the author/s	Department of the teacher	Name of journal
1	Smartphone usage patterns of college students	K. Lavanya	Home science	International Journal of Home science
2	Upper Total Unidomination Number of a path	Dr. V. Ananthalakshmi	Mathematics	International Journal of Engineering Science and Mathematics
3	Minimal total Unidominating functions With Maximum Weight of A Path	Dr.V.Ananthalakshmi	Mathematics	International Journal of Engineering Science and Mathematics
4	Advantages and disadvantages of green technology: a study	K. Venkateswara Rao	Physics	Journal of Interdisciplinary Cycle Research
5	Advantages and disadvantages of green technology: a study	R.Sashikala	Physics	Journal of Interdisciplinary Cycle Research
6	Key to Effective Classroom Management	Dr. G.Sowjanya	Commerce	Research Journal of English Language and Literature
7	Studies on In vitro antagonism of native biocontrol agents on coconut stem bleeding and bud rot disease pathogens	K. Aruna	Microbiology	International Journal of Current Microbiology and Applied Sciences
8	Teaching Language Through Literature	P.Sanjotha	English	Research Journal of English
9	Mutual Funds in India: Challenges and Opportunities	Rama Durga Sirisha Reddy	Commerce	Parishodh Journal
10	Characteristics diagnosis of white blood cells using CNN	N.Naga Subrahmanyeswari	Computer Science	Journal of Critical Reviews
11	In vitro and Field Efficacy of Native Biocontrol Agents on Stem Bleeding Pathogen of Coconut Thielaviopsis paradoxa	K. Aruna	Microbiology	International Journal of Current Microbiology and Applied Sciences Sciences

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Smartphone usage patterns of college students

K Lavanya and Dr. R Varalakshmi

Abstract
College students are a section of the population with a high usage of smartphones. The self efficacy of this age group in adapting to the latest updates and advancements in technology motivate them to use these phones with advanced features. Availability of smartphones at lower prices, low tariffs on calling and uninterrupted internet connectivity has further increased the usage of smartphones by college students. Vast research is going on across the globe to study the smartphone behaviours of college students and also the effect it is going to cause to the users. Present study is undertaken to study the time spent on smartphone and also to study the various patterns of smartphone usage like the various activities carried out on smartphone and the preferred apps by the college students.
The study group comprised of college students in the age group pf 16 years to 25 years and majority pursuing their under graduation. Major chunk of the participants are from low and middle income groups and the students possessed phones of reputed brands irrespective of their family income. The results revealed that the college students are spending up to 6 hours and a few of them more than 6 hours also. They shared up to 100 text/whatsapp messages on working and holidays without any difference and a few of them even shared up to 500 messages. It was also found that they spend more time on entertainment followed by academics and social activities. Least preferred activity was shopping. Regarding the apps installed, majority of them installed more entertainment apps and the least number of apps installed were dating apps followed by health apps.

Keywords: Adolescent, rural, urban, habits, attitudes, education

Introduction
College students are the section of the population with high usage of smartphones. The self efficacy of this age group in adapting to the latest updates and advancements in technology motivate them to use these phones with advanced features. The statistics indicate that 90 percent of the college students own a mobile phone and majority of them are smartphones. Availability of smartphones at lower prices, low tariffs on calling and uninterrupted internet connectivity has further increased the usage of smartphones by college students. In the present education system, smartphones are even used as a teaching/learning tool. Smartphones are serving many needs of college students viz., learning, entertainment, social connectivity, shopping, organizer and so on.
A study conducted by Pew research Center also stated that young people under the age group of 35 were more likely having smartphones in many countries across the world. Another study conducted by Dr. Khan in collaboration with ICSSR on students from 20 central universities of India revealed that while only 26 percent of the respondents used their phone primarily for calling, the other 74 percent used it for entertainment, social networking and browsing. It was also found that while 14% of those surveyed use smartphones for 3 hours or less in a day, 63% use smartphones for 4 to 7 hours daily and shockingly 23% are logging more than 8 hours daily. (India Today, 2018) Bagimilik Dergisi (2017) [2] in a study conducted in Turkey on students found that the average time spent on smartphones per day is +3.15 hours and the major activities on smartphones were listening to music, texting, social networking, watching films and chatting while only a few used it for note making, scientific information, shopping and emailing. Adelhardt, Z., Markus, S., & Eberle, T. (2018) [1] found that smartphone usage was positively correlated with their positive attitude towards technology use. The present study is an attempt to study the smartphone usage patterns of college students.

Materials and Methods

The study is undertaken in Kakinada city, East Godavari, Andhra Pradesh, India. Kakinada is a hub of educational institutions with various Government and private colleges. The sample included 400 students of engineering, medical, government and private degree colleges and vocational college. The college students in the age group of 16-25 years were included in the study. Those students, who were using smartphone for not less than a year were selected through Purposive sampling technique. Married students were not included in the study. In the selected colleges of Kakinada, the study was carried out during January 2019 to April 2019. Those who participated in the study were given consent forms to give their willingness to participate in the study which also stated that no remuneration is provided for participating in the study and the participation was purely voluntary.

The tools used for the study are a General Questionnaire to study the socio demographic variables of the respondents and a Smartphone Usage Questionnaire developed by the investigator for the study. All the tools used for data collection are self reported questionnaires. The questionnaire was sent for content analysis to the experts in the area of study and the necessary modifications were undertaken.

Results and Discussion

The collected data on the smartphone usage patterns of the selected college students is analyzed and tabulated and the results are presented below.

Table 1: Socio-demographic variables of the respondents

Socio-demographic Variables		Frequency (N=400)	Percentage
Age	16-17	16	4
	18-19	194	49
	20-21	149	37
	22-23	25	6
	24-25	16	4
Gender	Male	153	38
	Female	247	62
Type of family	Nuclear	338	82
	Joint	45	11
	Extended	29	7
Mothers Education	Illiterate	189	47
	Schooling	153	38
	College	21	5
	Graduation	29	7
	PG	8	2
Fathers Education	Illiterate	151	38
	Schooling	105	26
	College	54	13
	Graduation	78	19
	PG	12	3
Family Income	Less than 1 Lakh	280	70
	1-3 Lakhs	87	22
	3-6 lakhs	21	5
	7-10 Lakhs	8	2
	Above 10 Lakhs	4	1

The above table presents the frequencies and percentages of the demographic variables of the respondents. The variables studied were age, gender, type of family, mother's and father's education and family income. Out of the total respondents, nearly 50 percent belong to the age group of 18-19 years and 20-21 years (39%) which indicates that majority of them are undergraduates. Reason for majority being in under graduation is that most of the college students are purchasing smartphones after they enter their under graduation. While selecting the sample for the study, it was found that the junior colleges are not permitting the students to carry phones to the college.

Regarding gender, Males were 38 percent and females were 62 percent. Among the respondents, majority (82%) are from nuclear families and very few of them are from joint (11%) and extended families (7%). Mother's education level was very low i.e., 85 percent of them are illiterates or have completed their schooling. Only 12 percent of them are graduates and Postgraduates. Similarly, in case of fathers as well only 22 percent of them possess graduation and post graduation degree while majority (64%) are either illiterates or completed just their schooling. The family income of the respondents indicates that major chunk of the respondent's income lies below rupees 1 lakh per annum and out of the total respondents, 92 percent fall under the income below 3 lakhs and only 1 percent of them have the annual family income of above 10 lakhs.

Table 2: Showing the Smartphone Usage Patterns of College Students

Smartphone Usage Patterns	Frequency N=400	%	Frequency N=400	%	Frequency N=400	%	Frequency N=400 %	
	Less than 5000		5000-10000		10000-20000		Above 20000	
Average cost of the phone	24	6	240	60	120	30	16	4
Years of smartphone usage	1-3 yrs		3-5 yrs		More than 5 yrs		-	
	300	75	80	20	20	5	-	
Time spent on smartphone per day	Less than 1 hour		1-3 hours		3- 6 hours		Above 6 hours	
	32	8	196	49	128	32	44	11
No of text/Whatsapp messages sent on a working day	Nil		Up to 100		101-500		More than 500	
	12	3	351	85	42	10	7	2
No of text/Whatsapp messages sent on a working day	12	3	283	69	94	23	22	5

It can be inferred from the table that majority (60%) of the sample had smartphones in the price range of Rs.5000 to Rs.10000 while 30 percent of them had smartphones worth Rs.10000 to Rs. 20000 and only 4 percent of them possessed the smartphones of above Rs.20000/- price range. It is surprising to note that, the family income of majority of the participants is below one lakh per annum but they were using smartphones of reputed brands and medium to high price range. These results can be supported by the findings of Bhuvaneswari (2016) [3] in a study conducted in Palakkad district of Kerala who found that no significant relationship exists between family income and the brand of the phone used by youth.

With regard to years of smartphone usage of the respondents, 75 percent of them are using their smartphones for less than 3 years and only 5 percent of them were using for more than 5 years.

Pertaining to the time spent on smartphone per day, it is observed that major chunk of them spend nearly 1-6 hours (81%) on their smartphones and 11 percent of them spend more than 6 hours per day on smartphone. These results are consistent with the findings of Uichin Lee (2014) [7] who divided the sample in his study into risk and non risk group based on their responses and found that the risk group spent 253 min per day (nearly 4hours) while the non risk group spent 207 min per day. Bagimilik Dergisi (2017) [2] also reported that in his study conducted in Turkey the average time spent on smartphones per day is ±3.15 hours by the students.

Chatting is one of the major activities carried out on smartphones by students (Xavier Carbonell, *et al*., 2012) [8]. In the present study, the messaging patterns of the respondents were studied. From the data, it can be inferred that the college students send nearly 100 to 500 text/ Whatsapp messages per day. There were no prominent differences between a working day and holiday as majority of them send nearly 100 messages either it's a holiday or a working day. Less than 5 percent of them send more than 500 messages per day.

For clear understanding of the sample distribution, the tabulated data is presented graphically through pie-charts below:

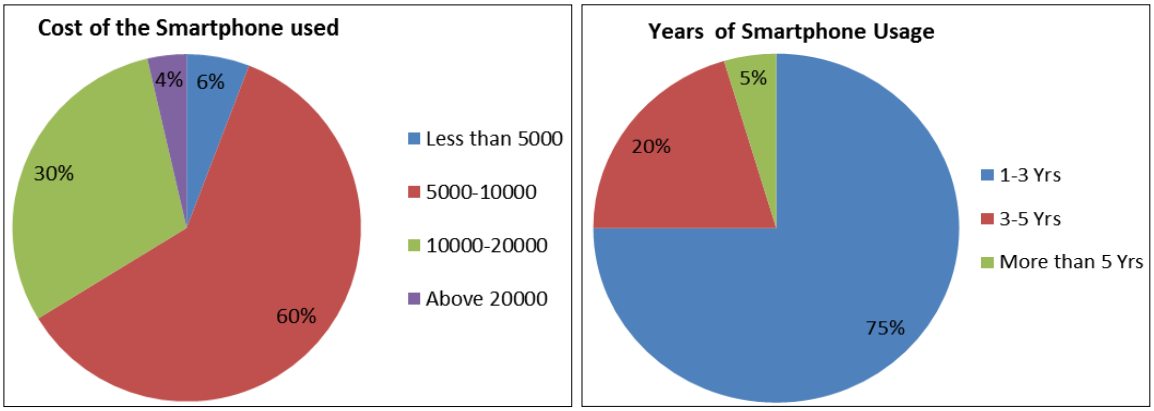

Fig 1 & 2: Distribution of sample based on cost of the smartphone and years of usage

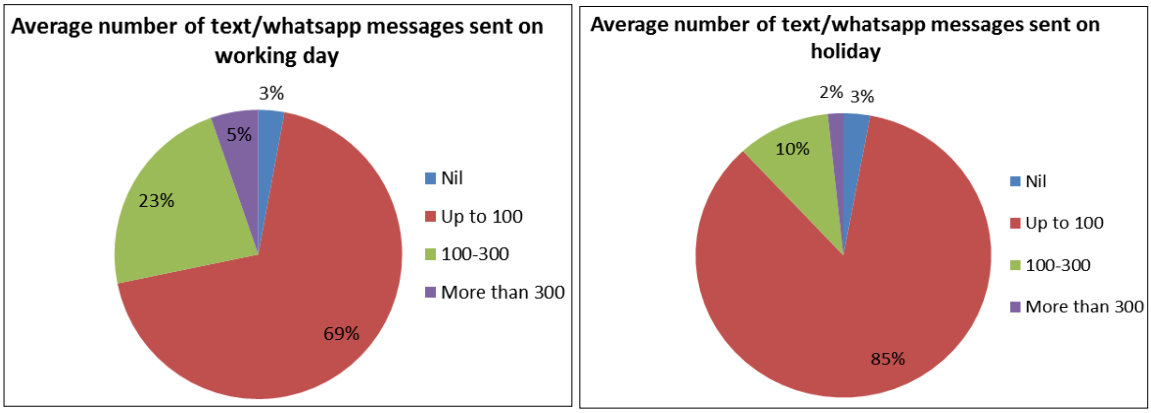

Fig 3 & 4: Distribution of sample based on the number of messages sent on a working day and a holiday

Social networking, entertainment, shopping, academics etc., are the other activities actively carried out on smartphones by the students. In the present study, an attempt was done to study the time spent by the college students on various activities via smartphone. The results are presented in table 3.

Table 3: Showing the time spent by college students on different activities via smartphones

Time spent on different activities via smartphones	Less than 1 hr		1-3 hrs		More than 3 hrs	
	Frequency	%	Frequency	%	Frequency	%
Academic	60	15	319	80	21	5
Entertainment	32	8	320	80	48	12
Shopping	180	45	206	52	14	3
Social activities	92	23	258	65	50	12

From the table, it is evident that highest proportion of the college students in the present study are spending 1-3 hours on all the different activities and highest percent (81%) spend 1-3 hours on entertainment (online gaming, watching movies etc.,). These results are in tune with the findings of Catherine Chambliss *et al*., (2017) [4] who reported binge watching among students which included watching videos, Netflix along with other programs on TV. Shopping was found to be the least preferred activity as nearly half of them spend less than an hour on shopping online. The reason might be that all the respondents are college students and are financially dependent on their families. The results of the present study are consistent with the findings of Liu, C. H., *et al*., (2016) [5] who reported in his study that the smartphone addiction group spent more time on gaming and also gaming along with other multiple apps. Ruth.C.King & Su Dong (2017) [6] also found that the average time spent by a student per day on different activities like music, social media, browsing, school work, shopping etc ranged from 3.7 hours to 0.8 hours with highest time spent on music and the least on online shopping and emailing. Sana Sarfaraz *et al*., (2015) studied the smartphone usage patterns of different colleges and universities of Karachi to study the effect of mobile phones on health. The results indicated that 24% used mobiles for more than 16 hours and the other 43.5 used it for more than 8 hours. The major activities on mobile phones were texting (63%) followed by Facebook and whatsapp (36.5%). The results are presented graphically in the fig 5.

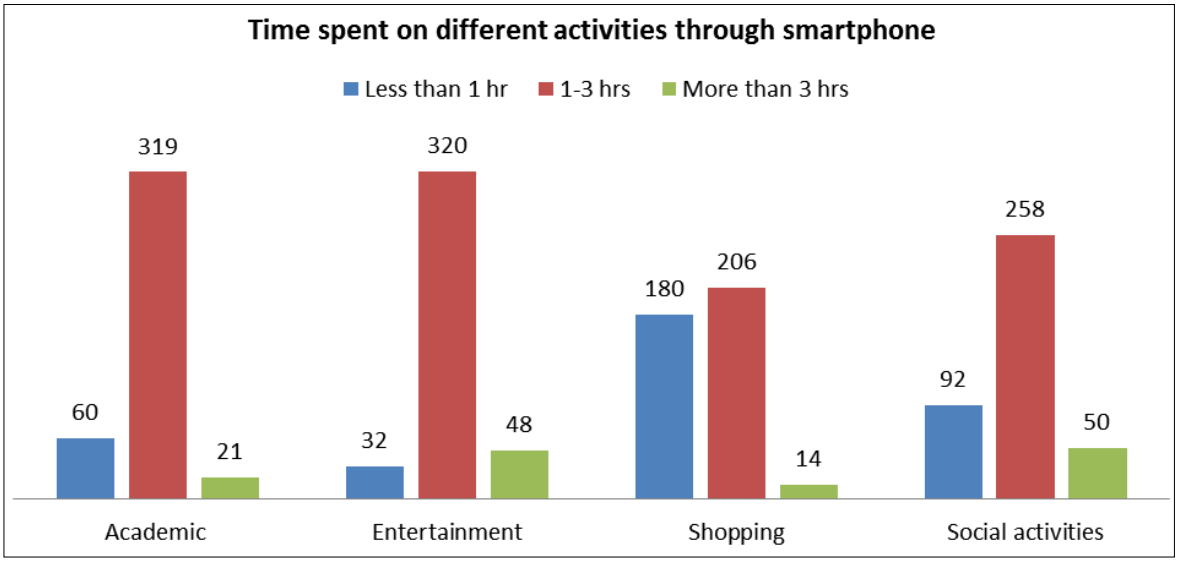

Fig 5: Distribution of sample based on the time spent on different activities through smartphone

As smartphones facilitate installation of various applications for carrying out various activities easily, the number of apps installed in the smartphones of the respondents was studied. The results are presented in Table 4.

Table 4: Showing the apps installed in smartphones of the respondents (N=400)

Variable	None	1-2	3-4	More than 4
Educational apps	104(26)	196(49)	96(24)	4(1)
Information apps	52(13)	272(68)	76(19)	0(0)
Productivity apps	64(16)	228(57)	92(23)	12(3)
Entertainment apps	32(8)	216(54)	108(27)	44(11)
Social apps	60(15)	220(55)	120(30)	0(0)
Ecommerce apps	72(18)	180(45)	76(19)	4(1)
Health apps	176(44)	184(46)	40(10)	0(0)
Dating apps	352(88)	40(10)	8(2)	0(0)

The results from table 4 indicate that entertainment apps (Netflix, Amazon Pime, Tik Tok etc.,) are the highest in number (More than 4) installed by the college students in the present study. The least apps installed were dating apps followed by health apps i.e highest percentage of respondents (88%) says that they have not installed any dating apps and health apps (44%). It is also interesting to note that nearly 75 percent of the college students in the present study have

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UPPER TOTAL UNIDOMINATION NUMBER OF A PATH

V.ANANTHA LAKSHMI*
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ABSTRACT

The concept of total unidominating function was introduced and total unidominating functions of a path are studied in [8]. Minimal total unidominating functions and upper total unidomination number were introduced in [9]. In this paper the minimal unidominating functions of a path are studied and the upper total unidomination number of a path is found.

KEYWORDS:

Total unidominating function,
Minimal total unidominating function,
Upper total unidomination number.

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1. INTRODUCTION

Graph Theory is developing rapidly with its applications to other branches of Mathematics, Social Sciences, Physical Sciences and Technology. In which the theory of

domination introduced by Berge [2] and Ore [6] is a rapidly growing area of research. Several graph theorists, Allan and Laskar [1], Cockayne and Hedetniemi [3], SampathKumar [7] and others have contributed significantly to the theory of domination.

Recently dominating functions in domination theory have received much attention. Hedetniemiet.al. [5] introduced the concept of dominating functions. The concept of total dominating functions was introduced by Cockayne et.al. [4]. The concept of total unidominating function was introduced by the authors in [8]. Minimal total unidominating functions and upper total unidomination number were introduced in [9].

In this paper the minima total unidominating functions of a path are studied and the upper total unidomination number of a path is found and the results obtained are illustrated.

2. UPPER TOTAL UNIDOMINATION NUMBER OF A PATH

In this section the upper total unidomination number of a path is discussed.First the concepts of minimal total unidominating functions and upper total unidomination number are defined as follows.

Definition 2.1: Let $G(V,E)$ be a connected graph. A function $f: V \to \{0,1\}$ is said to be a **total unidominating function,** if

$$\sum_{u \in N(v)} f(u) \geq 1 \ \forall\, v \in V \text{ and } f(v) = 1,$$

$$\sum_{u \in N(v)} f(u) = 1 \ \forall\, v \in V \text{ and } f(v) = 0,$$

where $N(v)$ is the open neighbourhood of the vertex v.

Definition 2.2: Let $G(V,E)$ be a connected graph. A total unidominating function $f: V \to \{0,1\}$ is called a **minimal total unidominating function** if for all $g < f$, g is not a total unidominating function.

Definition 2.3: The **upper total unidomination number** of a connected graph $G(V,E)$ is defined as $\max\{f(V)/f \text{ is a minimal total unidominating function}\}$. It is denoted by $\Gamma_{tu}(G)$.

Theorem 2.1: The upper total unidomination number of a path P_n is

$$\Gamma_{tu}(P_n) = \begin{cases} 2 & \text{if } n = 2, \\ \left\lfloor \frac{5n}{7} \right\rfloor & \text{if } n > 2. \end{cases}$$

Proof: Let P_n be a path with vertex set $V = \{v_1, v_2, \dots, v_n\}$.

To find upper total unidomination number of P_n, the following seven cases arise.

Case1: Let $n \equiv 0(mod\ 7)$.

Define a function $f: V \to \{0, 1\}$ by

$$f(v_i) = \begin{cases} 1 & for\ i \equiv 2,3,4,5,6(mod\ 7), \\ 0 & for\ \ i \equiv 0,1(mod\ 7). \end{cases}$$

Now we prove that f is a minimal total unidominating function.

Subcase 1: Let $i \equiv 0(mod\ 7)$ and $i \neq n$. Then $f(v_i) = 0$.

Now $\sum_{u \in N(v_i)} f(u) = f(v_{i-1}) + f(v_{i+1}) = 1 + 0 = 1.$

For $i = n$ we have $\sum_{u \in N(v_n)} f(u) = f(v_{n-1}) = 1.$

Subcase 2: Let $i \equiv 1(mod\ 7)$ $and\ i \neq 1$. Then $f(v_i) = 0$.

Now $\sum_{u \in N(v_i)} f(u) = f(v_{i-1}) + f(v_{i+1}) = 0 + 1 = 1.$

$For\ \ i = 1\ \ we\ have$ $\sum_{u \in N(v_1)} f(u) = f(v_2) = 1.$

Subcase 3: Let $i \equiv 2(mod\ 7)$. Then $f(v_i) = 1$.

Now $\sum_{u \in N(v_i)} f(u) = f(v_{i-1}) + f(v_{i+1}) = 0 + 1 = 1.$

Subcase 4: Let $i \equiv 3,4,5(mod\ 7)$. Then $f(v_i) = 1$.

Now $\sum_{u \in N(v_i)} f(u) = f(v_{i-1}) + f(v_{i+1}) = 1 + 1 = 2 > 1.$

Subcase 5: Let $i \equiv 6(mod\ 7)$. Then $f(v_i) = 1$.

Now $\sum_{u \in N(v_i)} f(u) = f(v_{i-1}) + f(v_{i+1}) = 1 + 0 = 1.$

Hence from all the above subcases it follows that f is a total unidominating function.

Now we check for the minimality of f.

Define a function $g: V \to \{0,1\}$ by

$g(v_i) = f(v_i)$ for all $v_i \in V, i \neq k,\ k \equiv 2(mod\ 7)\ and\ g(v_k) = 0.$

Then by the definition of f and g it is obvious that $g < f$.

Since $k \equiv 2(mod\ 7),\ k-1 \equiv 1(mod\ 7)$. Then $g(v_{k-1}) = f(v_{k-1}) = 0.$

But $\sum_{u \in N(v_{k-1})} g(u) = g(v_{k-2}) + g(v_k) = 0 + 0 = 0 \neq 1.$

Therefore g is not a total unidominating function.

Similarly when$k \equiv 3,4,5,6(mod\ 7)$, then also we can show that g is not a total unidominating function.

Hence for all possibilities of defining a function $g < f$, we can see that g is not a total unidominating function.

Therefore f is a minimal total unidominating function.

Now $\sum_{u \in V} f(u) = \sum_{i=1}^{n} f(v_i) = \underbrace{0+1+1+1+1+1+0}+\ldots\ldots$

$$+\ \underbrace{0+1+1+1+1+1+0} = \frac{5n}{7}.$$

Therefore $\Gamma_{tu}(P_n) \geq \frac{5n}{7} - - - (1)$

Let f be a minimal total unidominating function of P_n. Then amongst seven consecutive vertices in P_n atmost five consecutive vertices can have functional value 1 and atleast two vertices must have functional value 0.

Therefore sum of the functional values of seven consecutive vertices is less than or equal to 5.

That is $\sum_{i=1}^{7} f(v_i) \leq 5, \sum_{i=8}^{14} f(v_i) \leq 5, \ldots, \sum_{i=n-6}^{n} f(v_i) \leq 5.$

Therefore $\sum_{u \in V} f(u) = \sum_{i=1}^{7} f(v_i) + \sum_{i=8}^{14} f(v_i) + \cdots + \sum_{i=n-6}^{n} f(v_i) \leq \underbrace{5+5+\cdots+5}_{\frac{n}{7}\ times} \leq \frac{5n}{7}.$

Since f is arbitrary, it follows that $\Gamma_{tu}(P_n) \leq \frac{5n}{7} - - - (2)$

Thus from the inequalities (1) and (2), we have $\Gamma_{tu}(P_n) = \frac{5n}{7}$.

Case 2: Let $n \equiv 1(mod\ 7)$.

Define a function $f: V \to \{0,1\}$ by

$$f(v_i) = \begin{cases} 1 & for\ i \equiv 2,3,4,5,6(mod\ 7), i \neq n-3, i \neq n-2\ , \\ 0 & for\ i \equiv 0,1(mod\ 7), i \neq n-1, i \neq n. \end{cases}$$

and $f(v_{n-3}) = 0, f(v_{n-2}) = 0, f(v_{n-1}) = 1, f(v_n) = 1.$

Then this function is defined similarly as the function f defined in Case 1 and so for the vertices $v_1, v_2, \ldots, v_{n-4}$ the function f is a total unidominating function. We can check easily the condition of total unidominating function for the remaining vertices $v_{n-3}, v_{n-2}, v_{n-1}, v_n$ and hence$f$ becomes a total unidominating function.
Now we check for the minimality of f.

Define a function $g: V \to \{0,1\}$ by

$$g(u) = f(u) \quad \forall\, u \in V,\ u \neq v_n$$

and $g(v_n) = 0$.

Then by the definition of f and g, it is obvious that $g < f$.

Now $g(v_{n-1}) = f(v_{n-1}) = 1$. But

$$\sum_{u \in N(v_{n-1})} g(u) = g(v_{n-2}) + g(v_n) = 0 + 0 = 0 \neq 1.$$

Therefore g is not a total unidominating function.

For all possibilities of defining a function $g < f$, we can see that g is not a total unidominating function.

Therefore f is a minimal total unidominating function.

Now $\sum_{u \in V} f(u) = \underbrace{0+1+1+1+1+1+0} + \cdots + \underbrace{0+1+1+1+0} + \underbrace{0+1+1}$

$$= 5\left(\frac{n-8}{7}\right) + 3 + 2 = \frac{5n-5}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Therefore $\Gamma_{tu}(P_n) \geq \left\lfloor \frac{5n}{7} \right\rfloor - - - (1)$

Let f be a minimal total unidominating function.

Suppose $n = 8$. Then the possible assignment of functional values to these eight vertices is 1,1,0,0,1,1,1,0 or 0,1,1,1,0,0,1,1, so that $f(V) = 5$ and

$\Gamma_{tu}(P_8) = 5 = \left\lfloor \frac{5n}{7} \right\rfloor = \left\lfloor \frac{40}{7} \right\rfloor$.

Let $n \geq 15$.

As in Case 1 of this Theorem we have $\sum_{i=2}^{n} f(v_i) \leq \frac{5(n-1)}{7}$.

Now we assign the functional value to v_1 as follows.

Suppose $f(v_1) = 0$.

Then $f(V) = f(v_1) + \sum_{i=2}^{n} f(v_i) \leq 0 + \frac{5(n-1)}{7} = \frac{5n-5}{7} = \left\lfloor \frac{5n}{7} \right\rfloor$.

Suppose $f(v_1) = 1$.

In such case among the $\frac{n-1}{7}$ sets of seven consecutive vertices, there will be one set of seven consecutive vertices whose functional values sum is 4.Otherwise the assignment makes f no more a minimal total unidominating function. Without loss of generality assume that the last set of seven consecutive vertices has functional values sum 4.

Then $f(V) = f(v_1) + \sum_{i=2}^{n-7} f(v_i) + \sum_{i=n-6}^{n} f(v_i) \leq 1 + \frac{5(n-8)}{7} + 4 = \frac{5n-5}{7} = \left\lfloor \frac{5n}{7} \right\rfloor$.

Since f is arbitrary it follows that $\Gamma_{tu}(P_n) \leq \left\lfloor \frac{5n}{7} \right\rfloor - - - (2)$

Thus from the inequalities (1) and (2), we have $\Gamma_{tu}(P_n) = \left\lfloor \frac{5n}{7} \right\rfloor$.

Case 3: Let $n \equiv 2(mod\ 7)$.

Sub case 1: Let $n = 2$.

Then there is only one total unidominating function f defined by

$$f(v_1) = 1, f(v_2) = 1.$$

Thus total unidomination number of P_2 is 2.

Sub case 2: Let $n \geq 9$.

Define a function $f: V \to \{0,1\}$ by

$$f(v_i) = \begin{cases} 1 & for\ i \equiv 2,3,4,5,6 (mod\ 7), i \neq n-3, \\ 0 & for\ i \equiv 0,1 (mod\ 7), \quad i \neq n-1, \end{cases}$$

and $f(v_{n-3}) = 0,\ f(v_{n-1}) = 1.$

On similar lines to Case 1 we can verify that f is a total unidominating function.

Now we check for the minimality of f.

Define a function $g: V \to \{0,1\}$ by

$g(u) = f(u)\ \forall\ u \in V, u \neq v_{n-1}$ and $g(v_{n-1}) = 0.$

Then by the definitions of f and g it is obvious that $g < f$ and for $g(v_{n-2}) = 0$,we have

$$\sum_{u \in N(v_{n-2})} g(u) = g(v_{n-3}) + g(v_{n-1}) = 0 + 0 = 0 \neq 1.$$

Therefore g is not a total unidominating function.

Thus for all possibilities of defining a function $g < f$, we can see that g is not a total unidominating function.

Therefore f is a minimal total unidominating function.

$$\text{Now} \sum_{u \in V} f(u) = \underbrace{0+1+1+1+1+1+0} + \cdots + \underbrace{0+1+1+1+1+1+0} + \underbrace{0+1+1}$$

$$= 5\left(\frac{n-9}{7}\right) + 6 = \frac{5n-3}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

$$\text{Therefore}\ \ \Gamma_{tu}(P_n) \geq \left\lfloor \frac{5n}{7} \right\rfloor - - - (1)$$

Let f be a minimal total unidominating function.

Suppose $n = 9$. Then the possible assignment of functional values to these nine vertices is 1,1,0,0,1,1,1,1,0 or 0,1,1,1,1,0,0,1,1, so that $f(V) = 6\ and$

$$\Gamma_{tu}(P_9) = 6 = \left\lfloor \frac{5n}{7} \right\rfloor = \left\lfloor \frac{45}{7} \right\rfloor.$$

Let $n \geq 16$.

As in Case 1 of this Theorem we have $\sum_{i=3}^{n} f(v_i) \leq \frac{5(n-2)}{7}$.

Since f is a minimal total unidominating function, the assignment of functional values to v_1, v_2isas follows.

Suppose $f(v_1) = 0, f(v_2) = 1$.

Then $f(V) = f(v_1) + f(v_2) + \sum_{i=3}^{n} f(v_i) \leq 0 + 1 + \frac{5(n-2)}{7} = \frac{5n-3}{7} = \left\lfloor \frac{5n}{7} \right\rfloor$.

Suppose $f(v_1) = 1, f(v_2) = 1$.

Then as in Case 2 we have

$$\sum_{i=3}^{n} f(v_i) = \sum_{i=3}^{n-7} f(v_i) + \sum_{i=n-6}^{n} f(v_i) \leq \frac{5(n-9)}{7} + 4$$

Therefore $f(V) = f(v_1) + f(v_2) + \sum_{i=3}^{n-7} f(v_i) + \sum_{i=n-6}^{n} f(v_i)$

$$\leq 1 + 1 + \frac{5(n-9)}{7} + 4 = \frac{5n-3}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Since f is arbitrary, it follows that $\Gamma_{tu}(P_n) \leq \left\lfloor \frac{5n}{7} \right\rfloor - - - (2)$

Thus from the inequalities (1) and (2), we have$\Gamma_{tu}(P_n) = \left\lfloor \frac{5n}{7} \right\rfloor$.

Case 4: Let $n \equiv 3(mod\ 7)$.

Define a function $f: V \to \{0,1\}$ by

$$f(v_i) = \begin{cases} 1 & for\ i \equiv 2,3,4,5,6(mod\ 7), \\ 0 & for\ i \equiv 0,1(mod\ 7). \end{cases}$$

On similar linesto Case 1 we can verifythat f is a minimal total unidominating function.

Now $\sum_{u \in V} f(u) = \underbrace{0+1+1+1+1+1+0} + \cdots + \underbrace{0+1+1+1+1+1+0} + \underbrace{0+1+1}$

$$= 5\left(\frac{n-3}{7}\right) + 2 = \frac{5n-1}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Therefore $\Gamma_{tu}(P_n) \geq \left\lfloor \frac{5n}{7} \right\rfloor - - - (1)$

Let f be a minimal total unidominating function.

Suppose $n = 3$. Then the possible assignment of functional values to these three vertices is 1,1,0 or 0,1,1 so that $f(V) = 2$ *and* $\Gamma_{tu}(P_3) = 2 = \left\lfloor \frac{5n}{7} \right\rfloor = \left\lfloor \frac{15}{7} \right\rfloor$.

Let $n \geq 10$.

Now$n \equiv 3(mod\ 7) \Rightarrow$ n $- 3 \equiv 0(mod\ 7)$.

So by Case 1 we have $\sum_{i=1}^{n-3} f(v_i) \leq \frac{5(n-3)}{7}$.

Then for the vertices v_{n-2}, v_{n-1}, v_n we have $\sum_{i=n-2}^{n} f(v_i) = 2$.

$$\text{There fore } f(V) = \sum_{u \in V} f(u) = \sum_{i=1}^{n-3} f(v_i) + \sum_{i=n-2}^{n} f(v_i) \leq \frac{5(n-3)}{7} + 2 \leq \frac{5n-1}{7}$$

$$\leq \left\lfloor \frac{5n}{7} \right\rfloor.$$

Since f is arbitrary, it follows that $\Gamma_{tu}(P_n) \leq \left\lfloor \frac{5n}{7} \right\rfloor - - - (2)$

Therefore from the inequalities (1) and (2), we have $\Gamma_{tu}(P_n) = \left\lfloor \frac{5n}{7} \right\rfloor$.

Case5: Let $n \equiv 4(mod\ 7)$.

Define a function $f: V \to \{0,1\}$ by

$$f(v_i) = \begin{cases} 1 & for\ i \equiv 2,3,4,5,6(mod\ 7), i \neq n, \\ 0 & for\ i \equiv 0,1(mod\ 7) \cdot \end{cases}$$

and $f(v_n) = 0$.

On similar lines to Case 1 we can show that f is aminimal total unidominating function.

Now $\sum_{u \in V} f(u) = \underbrace{0+1+1+1+1+1+0} + \cdots + \underbrace{0+1+1+1+1+1+0} +$

$$\underbrace{0+1+1+0} = \frac{5(n-4)}{7} + 2 = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Therefore $\Gamma_{tu}(P_n) \geq \left\lfloor \frac{5n}{7} \right\rfloor - - - (1)$

Let f be a minimal total unidominating function.

Suppose $n = 4$. Then the possible assignment of functional values to these four vertices is 0,1,1,0, so that $f(V) = 2 \ and \ \Gamma_{tu}(P_4) = 2 = \left\lfloor \frac{5n}{7} \right\rfloor = \left\lfloor \frac{20}{7} \right\rfloor$.

Let $n \geq 11$.

As in Case 1 of this Theorem we have $\sum_{i=2}^{n-3} f(v_i) \leq \frac{5(n-4)}{7}$.

Similar to Case 3 for the vertices v_{n-2}, v_{n-1}, v_n we have $\sum_{i=n-2}^{n} f(v_i) = 2$.

Now the functional value to v_1 is assigned as follows.

Suppose $f(v_1) = 0$.

$$\text{Then } f(V) = f(v_1) + \sum_{i=2}^{n-3} f(v_i) + \sum_{i=n-2}^{n} f(v_i) \leq 0 + \frac{5(n-4)}{7} + 2 = \frac{5n-6}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Suppose $f(v_1) = 1$.

Then as in Case 2 we have

$$f(V) = f(v_1) + \sum_{i=2}^{n-10} f(v_i) + \sum_{i=n-9}^{n-3} f(v_i) + \sum_{i=n-2}^{n} f(v_i)$$

$$\leq 1 + \frac{5(n-11)}{7} + 4 + 2 = \frac{5n-6}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Since f is arbitrary, it follows that $\Gamma_{tu}(P_n) \leq \left\lfloor \frac{5n}{7} \right\rfloor - - - (2)$

From the inequalities (1) and (2), we have $\Gamma_{tu}(P_n) = \left\lfloor \frac{5n}{7} \right\rfloor$.

Case 6: Let $n \equiv 5(mod\ 7)$.

Define a function $f: V \to \{0, 1\}$ by

$$f(v_i) = \begin{cases} 1 & for\ i \equiv 2,3,4,5,6(mod\ 7), i \neq n, \\ 0 & for\ \ i \equiv 0,1(mod\ 7) \cdot \end{cases}$$

and $f(v_n) = 0$.

Then on similar lines to Case 1 we can show that f is a minimal total unidominating function.

Now $\sum_{u\in V} f(u) = \underbrace{0+1+1+1+1+1+0}+\cdots+\underbrace{0+1+1+1+1+1+0}+$

$$\underbrace{0+1+1+1+0} = 5\left(\frac{n-5}{7}\right)+3 = \frac{5n-4}{7} = \left\lfloor\frac{5n}{7}\right\rfloor.$$

Therefore $\Gamma_{tu}(P_n) \geq \left\lfloor\frac{5n}{7}\right\rfloor - - - (1)$

Let f be a minimal total unidominating function.

Suppose $n = 5$.

Then thefunctional values to these five vertices can be assigned as 0,1,1,1,0, so that

$$f(V) = 3 \text{ and } \Gamma_{tu}(P_5) = 3 = \left\lfloor\frac{5n}{7}\right\rfloor = \left\lfloor\frac{25}{7}\right\rfloor.$$

Let $n \geq 12$.

As in Case 1 of this theorem we have $\sum_{i=3}^{n-3} f(v_i) \leq \frac{5(n-5)}{7}$.

As in Case 3 for the vertices v_{n-2}, v_{n-1}, v_n we have $\sum_{i=n-2}^{n} f(v_i) = 2$.

Since f is a minimal total unidominating function, the assignment of functional values to $v_1, v_2$is as follows.

Suppose $f(v_1) = 0, f(v_2) = 1$.

Then $f(V) = f(v_1) + f(v_2) + \sum_{i=3}^{n-3} f(v_i) + \sum_{i=n-2}^{n} f(v_i)$

$$\leq 0 + 1 + \frac{5(n-5)}{7} + 2 = \frac{5n-4}{7} = \left\lfloor\frac{5n}{7}\right\rfloor.$$

Suppose $f(v_1) = 1, f(v_2) = 1$.

Then as in Case 2 we have

$$\sum_{i=3}^{n-3} f(v_i) = \sum_{i=3}^{n-10} f(v_i) + \sum_{i=n-9}^{n-3} f(v_i) \leq \frac{5(n-12)}{7} + 4.$$

Therefore $f(V) = f(v_1) + f(v_2) + \sum_{i=3}^{n-10} f(v_i) + \sum_{i=n-9}^{n-3} f(v_i) + \sum_{i=n-2}^{n} f(v_i)$

$$\leq 1 + 1 + \frac{5(n-12)}{7} + 4 + 2 = \frac{5(n-12)}{7} + 8 = \frac{5n-4}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Since f is arbitrary, it follows that $\Gamma_{tu}(P_n) \leq \left\lfloor \frac{5n}{7} \right\rfloor - - - (2)$

Thus from the inequalities (1) and (2), we have $\Gamma_{tu}(P_n) = \left\lfloor \frac{5n}{7} \right\rfloor$.

Case 7: Let $n \equiv 6(mod\ 7)$.

Define a function $f: V \to \{0,1\}$ by

$$f(v_i) = \begin{cases} 1 & for\ i \equiv 2,3,4,5,6(mod\ 7), i \neq n, \\ 0 & for\ i \equiv 0,1(mod\ 7). \end{cases}$$

and $f(v_n) = 0$.

On similar lines to Case 1 we can verify that f is a minimal total unidominating function.

Now $\sum_{u \in V} f(u) = \underbrace{0+1+1+1+1+1+0} + \cdots + \underbrace{0+1+1+1+1+1+0} +$

$$\underbrace{0+1+1+1+1+1+0} = 5\left(\frac{n-6}{7}\right) + 4 = \frac{5n-2}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Therefore $\Gamma_{tu}(P_n) \geq \left\lfloor \frac{5n}{7} \right\rfloor - - - (1)$

Let f be a minimal total unidominating function.

Suppose $n = 6$. Then the possibilities of assigning functional values to these six vertices are 0,1,1,1,1,0 or 1,1,0,0,1,1, so that $f(V) = 4$ and

$\Gamma_{tu}(P_6) = 4 = \left\lfloor \frac{5n}{7} \right\rfloor = \left\lfloor \frac{30}{7} \right\rfloor$.

Let $n \geq 13$.

If f is any minimal total unidominating function, then the functional values of first three vertices and the last three vertices must satisfy the following conditions.

$$\sum_{i=1}^{3} f(v_i) = 2 \ and \ \sum_{i=n-2}^{n} f(v_i) = 2.$$

Now $n \equiv 6(mod\ 7) \Rightarrow n-6 \equiv 0(mod\ 7)$. Then as per the discussion in Case 1,

we have $\sum_{i=4}^{n-3} f(v_i) \leq \frac{5(n-6)}{7}$.

Therefore $f(V) = \sum_{u \in V} f(u) = \sum_{i=1}^{3} f(v_i) + \sum_{i=4}^{n-3} f(v_i) + \sum_{i=n-2}^{n} f(v_i)$

$$\leq 2 + \frac{5(n-6)}{7} + 2 = \frac{5n-2}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

Since f is arbitrary, it follows that $\Gamma_{tu}(P_n) \leq \left\lfloor \frac{5n}{7} \right\rfloor - - - (2)$

Therefore from the inequalities (1) and (2), we have $\Gamma_{tu}(P_n) = \left\lfloor \frac{5n}{7} \right\rfloor$.

Thus for all possibilities of $n, n \neq 2$ we have $\Gamma_{tu}(P_n) = \left\lfloor \frac{5n}{7} \right\rfloor$ and

$$\text{for } n = 2, \Gamma_{tu}(P_n) = 2. \blacksquare$$

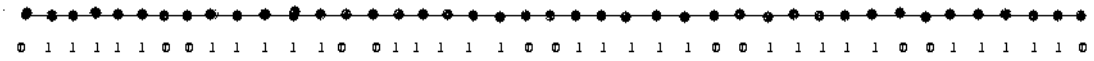
3. ILLUSTRATIONS

Example 3.1: Let $n = 42$.

We know that $42 \equiv 0(mod\ 7)$.

The functional values of a minimal total unidominating function f defined as in

Case 1 of Theorem 2.1 for P_{42} are given at the corresponding vertices.



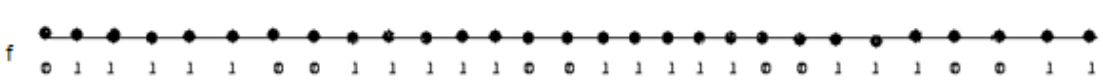
Upper total unidomination number $= \left\lfloor \frac{5 \times 42}{7} \right\rfloor = 30. \blacksquare$

Example 3.2: Let $n = 29$.

We know that $29 \equiv 1(mod\ 7)$.

The functional values of a minimal total unidominating function f defined as in

Case 2 of Theorem 2.1 for P_{29} are given at the corresponding vertices.



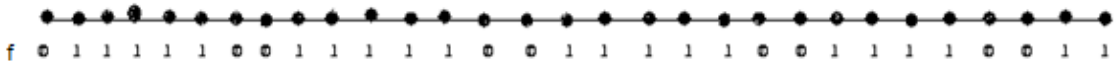
Upper total unidomination number ofP_{29} is $\left\lfloor \frac{5\ x\ 29}{7} \right\rfloor = 20.$

Example 3.3: .Let $n = 30.$

We know that $30 \equiv 2(mod\ 7).$

The functional values of a minimal total unidominating function f defined as in

Case 3 of Theorem 2.1 for P_{30} are given at the corresponding vertices.



Upper total unidomination number of P_{30} is $\left\lfloor \frac{5\ x\ 30}{7} \right\rfloor = 21.$

Example 3.4: Let $n = 24.$

We know that $24 \equiv 3(mod\ 7).$

The functional values of a minimal total unidominating function f defined as in

Case 4 of Theorem 2.1 for P_{24} are given at the corresponding vertices.

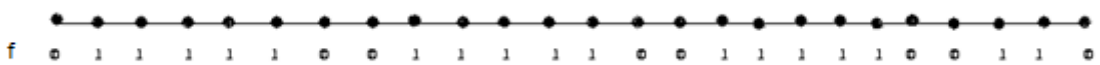
Upper total unidomination number of P_{24} is $\left\lfloor \frac{5x24}{7} \right\rfloor = \left\lfloor \frac{120}{7} \right\rfloor = 17.$

Example 3.5: Let $n = 25.$

We know that $25 \equiv 4(mod\ 7).$

The functional values of a minimal total unidominating function f defined as in

Case 5 of Theorem 2.1 for P_{25} are given at the corresponding vertices.



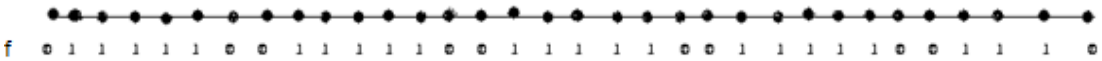
Upper total unidomination number is $\left\lfloor \frac{5\ x\ 25}{7} \right\rfloor = 17.$

Example 3.6: Let $n = 33.$

We know that $33 \equiv 5(mod\ 7).$

The functional values of a minimal total unidominating function f defined as in

Case 6 of Theorem 2.1 for P_{33} are given at the corresponding vertices.



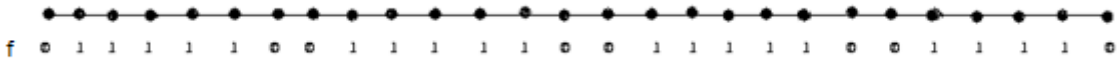
Upper total unidomination number is $\left\lfloor \frac{5\ x\ 33}{7} \right\rfloor = \left\lfloor \frac{165}{7} \right\rfloor = 23$.

Example 3.7: Let $n = 27$.

We know that $27 \equiv 6(mod\ 7)$.

The functional values of a minimal total unidominating function f defined as in

Case 7 of Theorem 2.1 for P_{27} are given at the corresponding vertices.



Upper total unidomination number is $\left\lfloor \frac{5\ x\ 27}{7} \right\rfloor = 19$.

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MINIMAL TOTAL UNIDOMINATING FUNCTIONS WITH MAXIMUM WEIGHT OF A PATH

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ABSTRACT

The upper unidomination number of a path and the number of minimal unidominating functions of a path with maximum weight were found in [12]. The upper total unidomination number of a path was found in [13]. In this paper the number of minimal total unidominating functions of a path with maximum weight isfound.

1.INTRODUCTION

Graph Theory plays a vital role in several areas of computer science such as switching theory, logical design, artificial intelligence, formal languages, computer graphics, compiler writing, information organization retrieval etc.

In Graph Theory, one of the rapidly growing area of research is the theory of domination which was introduced by Berge [2] and Ore [7]. Total dominating sets were introduced by Cockayane, Dawes and Hedetniemi [3]. Some results on total domination can be seen in [1].

Domination and its properties have been extensively studied by T.W.Haynes et.al.in [8], [9]. Domination in graphs have applications to several fields such as School bus routing, Computer communication networks, Facility location problems, Locating radar stations problem etc.

Recently dominating functions in domination theory have received much attention. Hedetniemiet.al. [6] introduced the concept of dominating functions and the concept of total dominating functions, was introduced by Cockayne et.al. [4]. Properties of minimal

dominating functions are studied in [5]. The concept of total unidominating function was introduced by the authors in [10]. Minimal total unidominating functions and upper total unidomination number were introduced in [11]. The upper total unidominationnumber of a path was found in [13].

In this paper the minimal total unidominating functions and upper total unidomination number of a path are discussed and the number of minimal total unidominating functions with maximum weight is found and the results obtained are illustrated.

2.UPPER TOTAL UNIDOMINATION NUMBER OF A PATH

In this section the minimal total unidominating functions of a patharediscussed and also the number of minimal total unidominating functions withmaximum weight is found.

First the concepts of total unidominating function, minimal total unidominating functions and upper total unidomination number are defined as follows.

Definition 2.1: Let $G(V,E)$ be a connected graph. A function $f: V \to \{0,1\}$ is said to be a **total unidominating function,** if

$$\sum_{u \in N(v)} f(u) \geq 1 \ \forall\, v \in V \text{ and } f(v) = 1,$$

$$\sum_{u \in N(v)} f(u) = 1 \ \forall\, v \in V \text{ and } f(v) = 0,$$

where $N(v)$ is the open neighbourhood of the vertex v.

Definition 2.2: Let $G(V,E)$ be a connected graph.A total unidominating function $f: V \to \{0,1\}$ is called a **minimal total unidominating function** if for all $g < f$, g is not a total unidominating function.

Definition 2.3: The **upper total unidomination number** of a connected graph $G\ (V,E)$ is defined asmax$\{f(V)/f$ is a minimal total unidominating function$\}$. It is denoted by$\Gamma_{tu}(G)$.

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We need the following theorem published by the authors and the proof can be found in [13]

Theorem 2.1: The upper total unidomination number of a path P_n is

$$\Gamma_{tu}(P_n) = \begin{cases} 2 & if\ n = 2, \\ \left\lfloor \frac{5n}{7} \right\rfloor & if\ n > 2. \end{cases}$$

The number of minimal total unidominating functions with maximum weight is found in the following theorem.

Theorem 2.2: The number of minimal total unidominating functions of P_n with maximum weight is

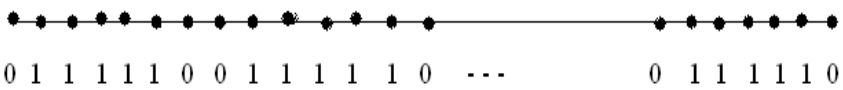
$$\begin{cases} 1 & when\ \ n \equiv 0(mod\ 7), \\ \left\lfloor \frac{n}{7} \right\rfloor \left\lceil \frac{n}{7} \right\rceil & when\ \ n \equiv 1(mod\ 7), \\ \left\lfloor \frac{2n}{7} \right\rfloor & when\ \ n \equiv 2(mod\ 7), n \neq 2, \\ 1 & when\ \ n = 2, \\ 2 & when\ \ n \equiv 3(mod\ 7), \\ \frac{1}{2}\left\lceil \frac{n}{7} \right\rceil \left\lceil \frac{3n}{7} \right\rceil + \frac{1}{6}\left\lceil \frac{n}{7} \right\rceil \left\lfloor \frac{n}{7} \right\rfloor \left(\left\lfloor \frac{n}{7} \right\rfloor - 1 \right) & when\ \ n \equiv 4(mod\ 7), \\ \left\lceil \frac{n}{7} \right\rceil + \frac{1}{2}\left\lceil \frac{n}{7} \right\rceil \left\lfloor \frac{n}{7} \right\rfloor + \left\lfloor \frac{n}{7} \right\rfloor & when\ n \equiv 5(mod\ 7), \\ \left\lceil \frac{n}{7} \right\rceil + 1 & when\ n \equiv 6(mod\ 7). \end{cases}$$

Proof: Let P_n be a path with vertex set $V = \{v_1, v_2, \dots, v_n\}$.

Now we find the number of minimal total unidominating functions with maximum weight in the following seven cases.

Case 1: Let $n \equiv 0(mod\ 7)$.

The minimal total unidominatingfunction f defined in Case 1 of Theorem 2.1 is given by



The functional values of f are $01111100111110 - - - 0111110$.

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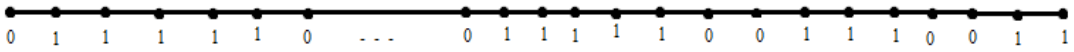
Take $a-0111110$. Then the functional values of f are in the pattern of $aaa\ldots a$. These letters $aaa\ldots a$ can be arranged in one and only one way. Therefore there is only one minimal total unidominating function with maximum weight $\left\lfloor\frac{5n}{7}\right\rfloor$.

Case 2: Let $n \equiv 1(mod\ 7)$.

The minimal total unidominating function f defined in Case 2 of Theorem 2.1 is given by



The functional values of f are $0111110\ldots011111001110011$.

Take $a-0111110$, $c-01110$. Then the functional values of f are in the pattern of $aaa\ldots ac011$. As there are $\frac{n-8}{7}$ $a's$ and one c, these letters $a's$ and c can be arranged in $\frac{\left(\frac{n-1}{7}\right)!}{\left(\frac{n-8}{7}\right)!}=\frac{n-1}{7}$ ways. Therefore there are $\frac{n-1}{7}$ minimal total unidominating functions.

We further investigate some more minimal total unidominating functions of P_n with maximum weight in the following way.

Define a function $f_1: V \to \{0,1\}$ by

$$f_1(v_i)=\begin{cases}1 & for\ i \equiv 0,1,2,5,6(mod\ 7)\ i \neq n,\\ 0 & for\ i \equiv 3,4(mod\ 7),\end{cases}$$

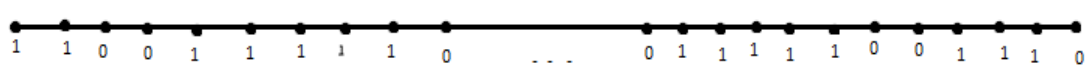
and $f_1(v_n)=0$.

As in Theorem 2.1 we can show that f_1 is a minimal total unidominating function. Also

$$\sum_{u\in V} f_1(u)=\underbrace{1+1+0}+\underbrace{0+1+1+1+1+1+0}+\cdots+\underbrace{0+1+1+1+1+1+0}$$

$$+\underbrace{0+1+1+1+0}=2+\frac{5(n-8)}{7}+3=\frac{5n-5}{7}=\left\lfloor\frac{5n}{7}\right\rfloor.$$

This function is given by



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The functional values of f_1 are $1100111110---011111001110.$

Take $a-0111110,\ b\ -\ 011110,\ c\ -\ 01110.$

Then the functional values of f_1 are in the pattern of $110aaa\ldots ac$. In similar lines as above we can see that there are$\frac{n-1}{7}$minimal total unidominating functions.

Define another function $f_2: V \to \{0,1\}$ by

$$f_2(v_i) = f(v_i) \quad for\ all\ v_i \in V, i \neq n-7, n-9,$$

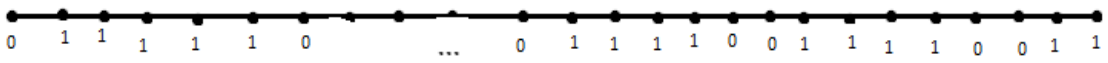
and$f_2(v_{n-7}) = 1,\ f_2(v_{n-9}) = 0,\ n \geq 15.$

We can see that this is a minimal total unidominating function.

Now $\sum_{u \in V} f_2(u) = \underbrace{0+1+1+1+1+1+0} + \cdots + \underbrace{0+1+1+1+1+0} +$

$$\underbrace{0+1+1+1+1+0} + \underbrace{0+1+1} = \frac{5(n-15)}{7} + 10 = \left\lfloor \frac{5n}{7} \right\rfloor.$$

This function is given by



The functional values of f_2 are $01111110\ldots 011111001111001111001 1.$

Take $a-0111110$ and $b-011110$.Then $f_2$is in the pattern of $aaa\ldots abb011$.These letters $a's$ and $b's$ can be arranged in $\frac{\left(\frac{n-1}{7}\right)!}{\left(\frac{n-15}{7}\right)!.2!} = \frac{\left(\frac{n-1}{7}\right)\left(\frac{n-8}{7}\right)}{2}$ ways.

Therefore there are$\frac{\left(\frac{n-1}{7}\right)\left(\frac{n-8}{7}\right)}{2}$minimal total unidominating functions.

Define another function $f_3: V \to \{0,1\}$ by

$$f_3(v_i) = f_1(v_i) \quad for\ all\ v_i \in V, i \neq n-4, n-6$$

And $f_3(v_{n-4}) = 1,\ f_3(v_{n-6}) = 0,\ n \geq 15.$

This is also a minimal total unidominating function.

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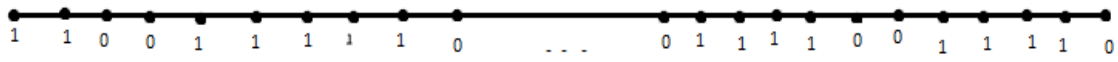
$$\text{Now } \sum_{u\in V} f_3(u) = \underbrace{1+1+0}+\underbrace{0+1+1+1+1+1+0}+\cdots$$

$$+\underbrace{0+1+1+1+1+0}+\underbrace{0+1+1+1+1+0}$$

$$= 2+\frac{5(n-15)}{7}+4+4 = \left\lfloor\frac{5n}{7}\right\rfloor.$$

This function is given by



The functional values of f_3 are $1100111110 \ldots 01111100111110011110.$

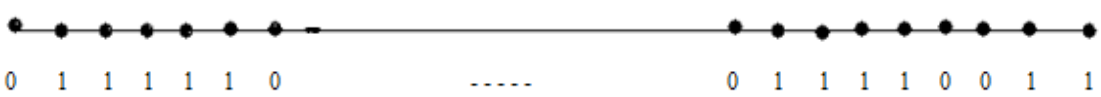
Take $a-0111110$ and $b-011110.$ Then f_3 is in the pattern of $110aaa \ldots abb.$ These letters $a's\ and\ b's$ can be arranged in $\frac{\left(\frac{n-1}{7}\right)!}{\left(\frac{n-15}{7}\right)!.2!} = \frac{\left(\frac{n-1}{7}\right)\left(\frac{n-8}{7}\right)}{2}$ ways.

Therefore there are $\frac{\left(\frac{n-1}{7}\right)\left(\frac{n-8}{7}\right)}{2}$ minimal total unidominating functions.

Thus there are $\frac{n-1}{7}+\frac{n-1}{7}+\frac{\left(\frac{n-1}{7}\right)\left(\frac{n-8}{7}\right)}{2}+\frac{\left(\frac{n-1}{7}\right)\left(\frac{n-8}{7}\right)}{2} = \left\lfloor\frac{n}{7}\right\rfloor.\left\lfloor\frac{n}{7}\right\rfloor$minimal total unidominating functions with maximum weight$\left\lfloor\frac{5n}{7}\right\rfloor$.

Case 3: Let $n \equiv 2(mod\ 7)$.

The minimal total unidominating function f defined in Case 3 of Theorem 2.1 is given by



The functional values of f are $0111110 \ldots 0111110011110011.$

Take $a-0111110,\ b-011110.$ Then f is in the pattern of $aaa \ldots ab011$. These letters $aaa \ldots ab$ can be arranged in $\frac{n-9}{7}+1 = \frac{n-2}{7}$ ways.

Therefore there are $\frac{n-2}{7}$ minimal total unidominating functions.

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Now as per the discussion in Case 2 we obtain some other minimal total unidominating functions.

Define a function $f_1: V \to \{0,1\}$ by

$$f_1(v_i) = \begin{cases} 1 & for\ i \equiv 0,1,2,5,6 (mod\ 7)\ i \neq n, \\ 0 & otherwise. \end{cases}$$

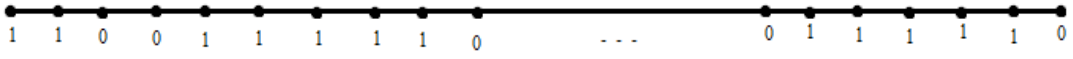
On similar lines as in Theorem 2.1 we can show that f_1 is a minimal total unidominating function.

Now $\sum_{u \in V} f_1(u) = \underbrace{1+1+0}+\underbrace{0+1+1+1+1+1+0}+\cdots+$

$$\underbrace{0+1+1+1+1+1+0}+\underbrace{0+1+1+1+1+0}=2+\frac{5(n-9)}{7}+4=\frac{5n-3}{7}$$

$$=\left\lfloor\frac{5n}{7}\right\rfloor.$$

This function f_1 is given by



That is the functional values of f_1 are $1100111110 \ldots 0111110011110$.

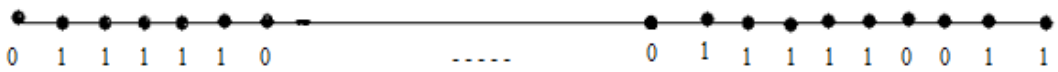
That is f_1 is in the pattern of $110aa \ldots ab$.

Therefore there are $\frac{n-2}{7}$ minimal total unidominating functions.

Therefore there are $\frac{n-2}{7}+\frac{n-2}{7}=\frac{2n-4}{7}=\left\lfloor\frac{2n}{7}\right\rfloor$ minimal total unidominating functions with maximum weight $\left\lfloor\frac{5n}{7}\right\rfloor$.

Case 4: Let $n \equiv 3 (mod\ 7)$.

A minimal total unidominating function f defined in Case 4 of Theorem 2.1 is given by



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The functional values of f are $0111110 \ldots 01111100111110011$.

Take $a - 0111110$. Then f is in the pattern of $aaa \ldots aa011$. These letters can be arranged in only one way so that there is only one minimal total unidominating function.

Define another function $f_1 : V \to \{0,1\}$ by

$$f_1(v_i) = \begin{cases} 1 & for\ i \equiv 0,1,2,5,6 (mod\ 7), \\ 0 & otherwise. \end{cases}$$

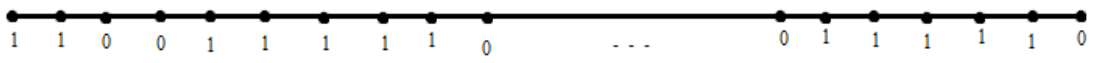
As above we can show that f_1 is a minimal total unidominating function.

$$\text{Now} \sum_{u \in V} f_1(u) = \underbrace{1+1+0} + \underbrace{0+1+1+1+1+1+0} + \cdots +$$

$$\underbrace{0+1+1+1+1+1+0} + \underbrace{0+1+1+1+1+1+0} = 2 + \frac{5(n-3)}{7} = \frac{5n-1}{7}$$

$$= \left\lfloor \frac{5n}{7} \right\rfloor.$$

This function is given by



The functional values of f_1 are $1100111110 \ldots 01111100111110$.

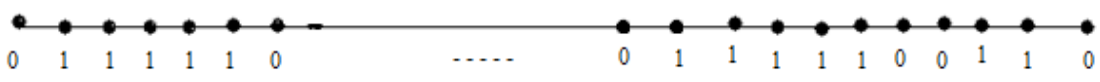
Take $a - 0111110$. Then the functional values of f_1 are in the pattern of $110aa \ldots aa$. These letters $aaa \ldots aa$ can be arranged in only one way.

Therefore there existsonly one function.

Thus there are only two minimal total unidominating functions with maximum weight $\left\lfloor \frac{5n}{7} \right\rfloor$.

Case 5: Let $n \equiv 4 (mod\ 7)$.

A minimal total unidominating function f defined in Case 5 of Theorem 2.1 is given by



The functional values of f are $0111110 - - - 011111001111100110$.

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Take $a-0111110,\ d-0110.$ Then f is in the pattern of $aaa\dots ad.$ These letters $aaa\dots ad$ can be arranged in $\frac{n-4}{7}+1=\frac{n+3}{7}$ ways.

Therefore there are $\frac{n+3}{7}$ minimal total unidominating functions.

As in Case 4 now we define another function $f_1: V \to \{0,1\}$ by

$$f_1(v_i) = f(v_i), i \neq n-3, n-5,$$

and $f_1(v_{n-3}) = 1, f_1(v_{n-5}) = 0, n \geq 11.$

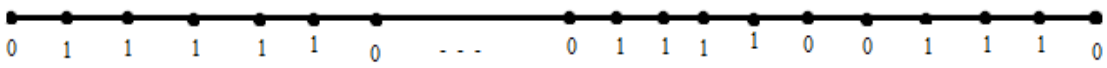
We can see that f_1 is a minimal total unidominating function.

Also

$$\sum_{u\in V} f_1(u) = \underbrace{0+1+1+1+1+1+0}+\cdots+\underbrace{0+1+1+1+1+0}+$$

$$\underbrace{0+1+1+1+0} = \frac{5(n-11)}{7}+4+3 = \frac{5n-6}{7} = \left\lfloor\frac{5n}{7}\right\rfloor.$$

This function is given by



The functional values of f_1 are $0111110\dots 011111001111001110.$

Take $a-0111110,\ b-011110,\ c-01110, d-0110.$ Then f_1 is in the pattern of $aa\dots abc$. These $\frac{n+3}{7}$letters $a's, b's\ and\ c's$ can be arranged in

$\frac{\left(\frac{n+3}{7}\right)!}{\left(\frac{n-11}{7}\right)!.1!.1!} = \left(\frac{n+3}{7}\right)\left(\frac{n-4}{7}\right)$ways.

Therefore there are $\left(\frac{n+3}{7}\right)\left(\frac{n-4}{7}\right)$ minimal total unidominating functions.

Define another function $f_2: V \to \{0,1\}$ by

$$f_2(v_i) = \begin{cases} 1 & for\ i \equiv 0,1,2,5,6 (mod\ 7), i \neq n-3, i \neq n-2, \\ 0 & for\ i \equiv 3,4\ (mod\ 7), i \neq n-1, i \neq n, \end{cases}$$

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and$f_2(v_{n-3}) = 0, f_2(v_{n-2}) = 0, f_2(v_{n-1}) = 1, f_2(v_n) = 1, n \geq 11.$

We can see that this is a minimal total unidominating function.

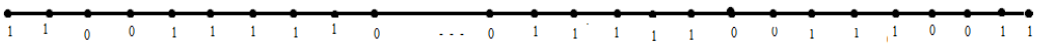
Also

$$\sum_{u \in V} f_2(u) = \underbrace{1+1+0}+\underbrace{0+1+1+1+1+1+0}+\cdots+$$

$$\underbrace{0+1+1+1+1+1+0}+\underbrace{0+1+1+1+1+0}+\underbrace{0+1+1} = 2+\frac{5(n-11)}{7}+3+2$$

$$= \frac{5n-6}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

The function f_2 is given by



The functional values of f_2 are $1100111110 \ldots 011111001110011.$

Take $a - 0111110,\ c - 01110.$ Then f_2 is in the pattern of $110aa \ldots ac011.$

These $\frac{n-11}{7}$ $a's\ and\ one\ c$ can be arranged in $\frac{n-4}{7}$ ways.

Therefore there are $\frac{n-4}{7}$ minimal total unidominating functions.

Define another function $f_3: V \to \{0,1\}$ by $f_3(v_i) = f_2(v_i),\ i \neq n-7, n-9$

and $f_3(v_{n-7}) = 1, f_3(v_{n-9}) = 0, n \geq 18.$

We can see that this is also a minimal total unidominating function.

Now

$$\sum_{u \in V} f_3(u) = \underbrace{1+1+0}+\underbrace{0+1+1+1+1+1+0}+\cdots+$$

$$\underbrace{0+1+1+1+1+0}+\underbrace{0+1+1+1+1+0}+\underbrace{0+1+1}$$

$$= 2+\left(\frac{5(n-18)}{7}\right)+4+4+2 = \frac{5n-6}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

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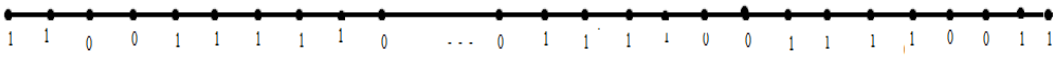
This function is given by



The functional values of f_3 are $1100111110 \ldots 011110011110011.$

Take $a - 0111110,\ b - 011110.$ Then f_3 is in the pattern of $110aa \ldots abb011.$ These $\frac{n-18}{7}$ a's and two b's can be arranged in $\frac{\left(\frac{n-4}{7}\right)!}{\left(\frac{n-18}{7}\right)!.2!} = \frac{\left(\frac{n-4}{7}\right).\left(\frac{n-11}{7}\right)}{2}$ ways.

Therefore there are $\frac{\left(\frac{n-4}{7}\right).\left(\frac{n-11}{7}\right)}{2}$ minimal total unidominating functions.

Define another function $f_4: V \to \{0,1\}$ by

$$f_4(v_i) = f_1(v_i), i \neq n-12, n-10, n-6, n-4,$$

and $f_4(v_{n-12}) = 0, f_4(v_{n-10}) = 1, f_4(v_{n-6}) = 0, f_4(v_{n-4}) = 1, n \geq 18.$

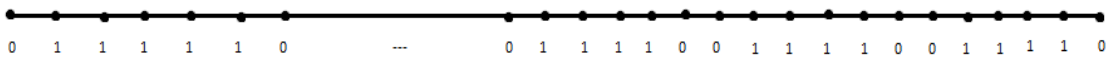
We can see that this is also a minimal total unidominating function.

Now $\sum_{u \in V} f_4(u) = \underline{0+1+1+1+1+1+0} + \cdots + \underline{0+1+1+1+1+0}$

$$+ \underline{0+1+1+1+1+0} + \underline{0+1+1+1+1+0}$$

$$= \frac{5(n-18)}{7} + 4 + 4 + 4 = \frac{5n-6}{7} = \left\lfloor \frac{5n}{7} \right\rfloor.$$

This function is given by



The functional values of f_4 are $01111110 \ldots 011111001111001111001111110.$

Take $a - 0111110,\ b - 011110.$ Then f_4 is in the pattern of $aa \ldots abbb.$ These $\frac{n-18}{7}\ a's$ and three b's can be arranged in $\frac{\left(\frac{n+3}{7}\right)!}{\left(\frac{n-18}{7}\right)!3!} = \frac{\left(\frac{n+3}{7}\right)\left(\frac{n-4}{7}\right)\left(\frac{n-11}{7}\right)}{3!}\ ways.$

Therefore there are $\frac{\left(\frac{n+3}{7}\right)\left(\frac{n-4}{7}\right)\left(\frac{n-11}{7}\right)}{3!}$ minimal total unidominating functions.

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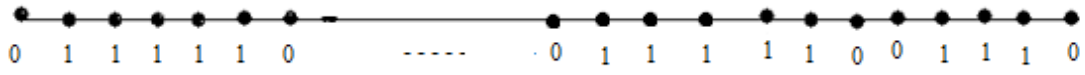
Thus there are $\frac{n+3}{7} + \left(\frac{n+3}{7}\right)\left(\frac{n-4}{7}\right) + \frac{n-4}{7} + \frac{1}{2}\left(\frac{n-4}{7}\right)\left(\frac{n-11}{7}\right) + \frac{\left(\frac{n+3}{7}\right)\left(\frac{n-4}{7}\right)\left(\frac{n-11}{7}\right)}{3!}$

$= \frac{1}{2}\left\lfloor\frac{n}{7}\right\rfloor\left\lfloor\frac{3n}{7}\right\rfloor + \frac{1}{6}\left\lfloor\frac{n}{7}\right\rfloor\left\lfloor\frac{n}{7}\right\rfloor\left(\left\lfloor\frac{n}{7}\right\rfloor - 1\right)$ minimal total unidominating functions with maximum weight $\left\lfloor\frac{5n}{7}\right\rfloor$.

Case 6: Let $n \equiv 5(mod\ 7)$.

A minimal total unidominating function f defined as in Case 6 of Theorem 2.1 is given by



The functional values of f are $0111110 \ldots 011111001110$.

Take a – 0111110, c – 01110. Then f is in the pattern of $aaa \ldots ac$. These $\frac{n-5}{7}\,a's$ and one b can be arranged in $\frac{n+2}{7}$ ways.

Therefore there are $\frac{n+2}{7}$ minimal total unidominating functions.

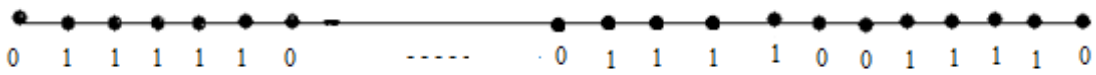
Define another function f_1 by

$$f_1(v_i) = f(v_i)\ for\ all\ v_i \in V, i \neq n-4, n-6$$

and $f_1(v_{n-4}) = 1, f_1(v_{n-6}) = 0, n \geq 12$.

We can see that this is a minimal total unidominating function and $f_1(V) = \left\lfloor\frac{5n}{7}\right\rfloor$.

This function is given by



The functional values of f_1 are $0111110 \ldots 011110011110$.

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Take a – 0111110, b – 011110. Then f_1 is in the pattern of $aaa \ldots abb$. Now there are $\frac{\left(\frac{n+2}{7}\right)!}{\left(\frac{n-12}{7}\right)!.2!} = \frac{\left(\frac{n+2}{7}\right)\left(\frac{n-5}{7}\right)}{2}$ minimal total unidominating functions.

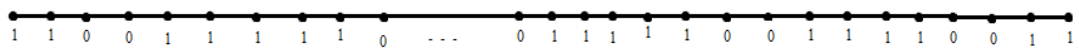
Another function $f_2: V \to \{0,1\}$ is defined by

$$f_2(v_i) = \begin{cases} 1 & i \equiv 0,1,2,5,6 (mod\ 7)\ i \neq n-3, \\ 0 & i \equiv 3,4 (mod\ 7)\ i \neq n-1, \end{cases}$$

and $f_2(v_{n-3}) = 0, f_2(v_{n-1}) = 1$.

We can see that f_2 is a minimal total unidominating function and $f_2(V) = \left\lfloor \frac{5n}{7} \right\rfloor$.

This function is given by



The functional values of f_2 are 1100111110 ... 0111110011110011.

Take a – 0111110, b – 011110. Then f_2 is in the pattern of $110aaa \ldots ab011$.

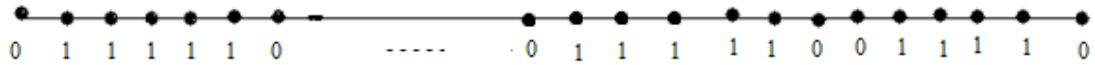
These $\frac{n-12}{7} + 1 = \frac{n-5}{7}$ letters can be arranged in $\frac{n-5}{7}$ ways.

Therefore there are $\frac{n-5}{7}$ minimal total unidominating functions.

Hence there are $\frac{n+2}{7} + \frac{1}{2}\left(\frac{n+2}{7}\right)\left(\frac{n-5}{7}\right) + \frac{n-5}{7} = \left\lfloor \frac{n}{7} \right\rfloor + \frac{1}{2}\left\lfloor \frac{n}{7} \right\rfloor \left\lfloor \frac{n}{7} \right\rfloor + \left\lfloor \frac{n}{7} \right\rfloor$ minimal total unidominating functions with maximum weight $\left\lfloor \frac{5n}{7} \right\rfloor$.

Case 7: Let $n \equiv 6 (mod\ 7)$.

A minimal total unidominating function f defined as in Case 7 of Theorem 2.1 is given by



The functional values of f are0111110 ... 0111110011110.

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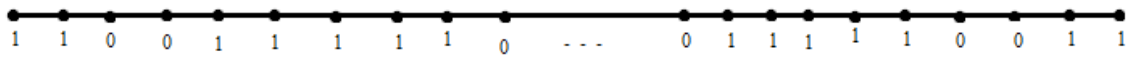
Take $a - 0111110, b = 011110$.Then the function f is in the pattern of $aaa \dots ab$. As there are $\frac{n-6}{7} a's$ and one b, there exist $\frac{n-6}{7} + 1 = \frac{n+1}{7}$ minimal total unidominating functions.

Therefore the number of minimal total unidominating functions in the pattern of f are $\frac{n+1}{7}$.

Define another function $f_1 : V \to \{0,1\}$ by

$$f_1(v_i) = \begin{cases} 1 & for\ i \equiv 0,1,2,5,6 (mod\ 7), \\ 0 & otherwise. \end{cases}$$

We can easily verify that f_1 is a minimal total unidominating function.



The functional values of f_1 are $1100111110 \dots 0111110011$.

Take $a - 0111110$. Then f_1 is in the pattern of $110aaa \dots a011$.

This is the only one function in this pattern.

Therefore there are $\frac{n+1}{7} + 1 = \left\lceil \frac{n}{7} \right\rceil + 1$ minimal total unidominating functions with maximum weight $\left\lfloor \frac{5n}{7} \right\rfloor$. ■

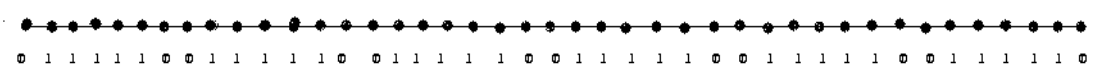
3. ILLUSTRATIONS

Example 3.1: Let $n = 42$.

We know that $42 \equiv 0 (mod\ 7)$.

The functional values of a minimal total unidominating function f defined as in

Case 1 of Theorem 2.1 for P_{42} are given at the corresponding vertices.



Upper total unidomination number $= \left\lfloor \frac{5\ x\ 42}{7} \right\rfloor = 30$. ■

There is only one minimal total unidominating function for P_{42} with maximum weight.

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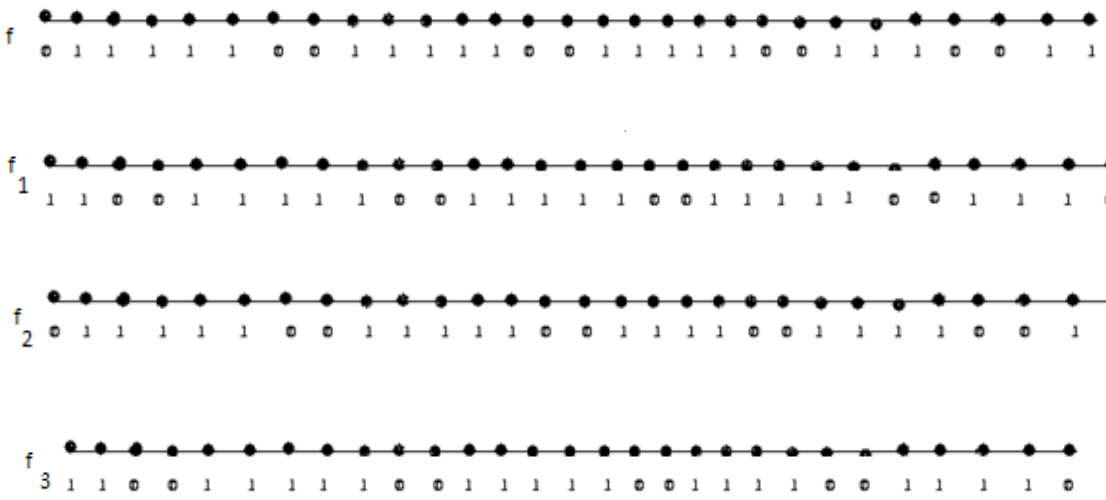
Example 3.2: Let $n = 29$.

We know that $29 \equiv 1(mod\ 7)$.

The functional values of minimal total unidominating functions f defined as in

Case 2 of Theorem 2.1 and f_1, f_2, f_3 defined as in Case 2 of Theorem 2.2 for P_{29} are given at the corresponding vertices.



Upper total unidomination number of P_{29} is $\left\lfloor \frac{5\ x\ 29}{7} \right\rfloor = 20$.

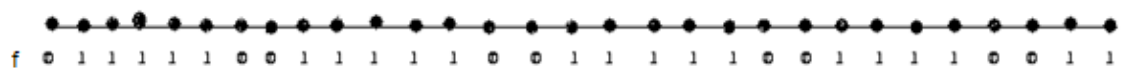
There are $\left\lfloor \frac{n}{7} \right\rfloor \left\lceil \frac{n}{7} \right\rceil = \left\lfloor \frac{29}{7} \right\rfloor \left\lceil \frac{29}{7} \right\rceil = 4x5 = 20$ minimal total unidominating functions with maximum weight. ■

Example 3.3: .Let $n = 30$.

We know that $30 \equiv 2(mod\ 7)$.

The functional values of minimal total unidominating functions f defined as in

Case 3 of Theorem 2.1 and f_1 defined as in Case 3 of Theorem 2.2 for P_{30} are given at the corresponding vertices.



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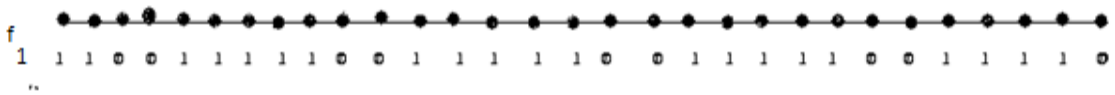


Upper total unidomination number of P_{30} is $\left\lfloor \frac{5\ x\ 30}{7} \right\rfloor = 21.$

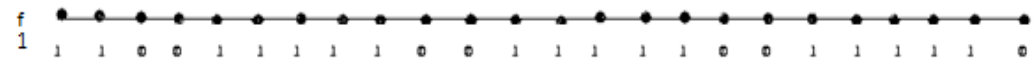
There are $\left\lfloor \frac{2n}{7} \right\rfloor = \left\lfloor \frac{2\ x\ 30}{7} \right\rfloor = 8$ minimal total unidominating functions with maximum weight. ■

Example 3.4: Let $n = 24$.

We know that $24 \equiv 3(mod\ 7)$.

The functional values of a minimal total unidominating functions f defined as in

Case 4 of Theorem 2.1 and f_1 defined as in Case 4 of Theorem 2.2for P_{24} are given at the corresponding vertices.



Upper total unidomination number of P_{24} is $\left\lfloor \frac{5x24}{7} \right\rfloor = \left\lfloor \frac{120}{7} \right\rfloor = 17.$

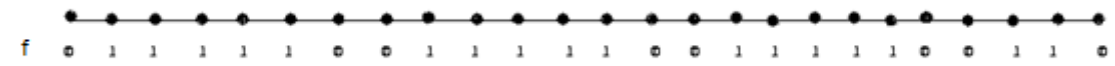
There are two minimal total unidominating functions with maximum weight. ■

Example 3.5: Let $n = 25$.

We know that $25 \equiv 4(mod\ 7)$.

The functional values of minimal total unidominating function f defined as in

Case 5 of Theorem 2.1 and f_1, f_2, f_3, f_4 defined as in Case 5 of Theorem 2.2 for P_{25} are given at the corresponding vertices.



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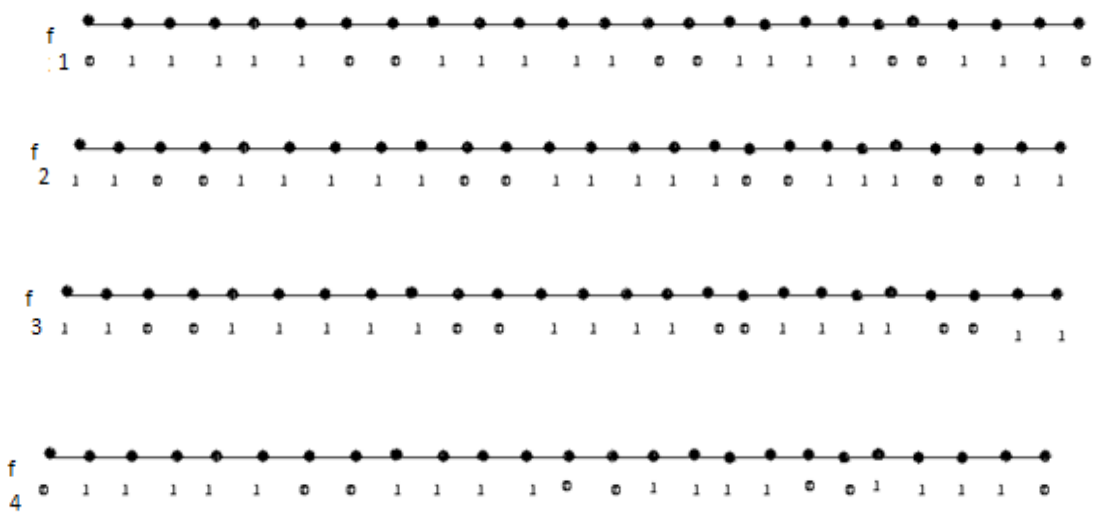


Upper total unidomination number is $\left\lfloor \frac{5 \text{ x } 25}{7} \right\rfloor = 17$.

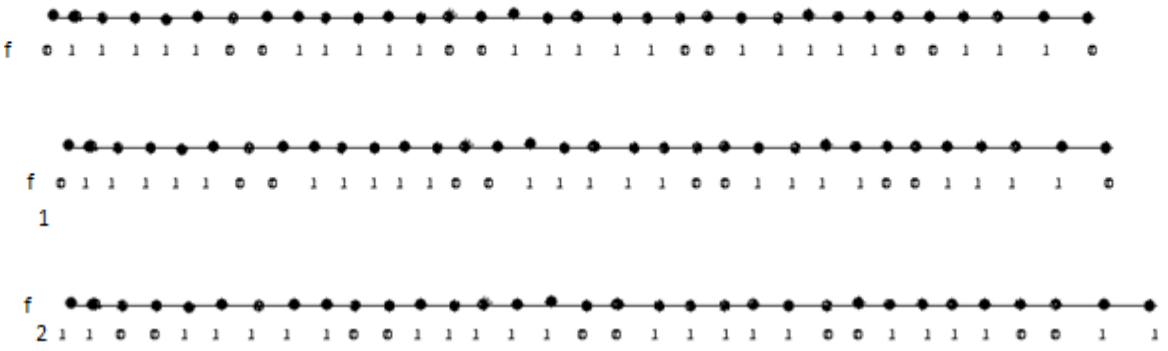
There are $\frac{1}{2}\left\lfloor \frac{n}{7} \right\rfloor \left\lceil \frac{3n}{7} \right\rceil + \frac{1}{6}\left\lceil \frac{n}{7} \right\rceil \left\lfloor \frac{n}{7} \right\rfloor \left(\left\lfloor \frac{n}{7} \right\rfloor - 1 \right) = 26$ minimal total unidominating functions with maximum weight. ■

Example 3.6: Let $n = 33$.

We know that $33 \equiv 5(mod\ 7)$.

The functional values of minimal total unidominating functions$f$ defined as in

Case 6 of Theorem 2.1 and f_1, f_2 defined as in Case 6 of Theorem 2.2 forP_{33} are given at the corresponding vertices.



Upper total unidomination number is $\left\lfloor \frac{5\ x\ 33}{7} \right\rfloor = \left\lfloor \frac{165}{7} \right\rfloor$ = 23.

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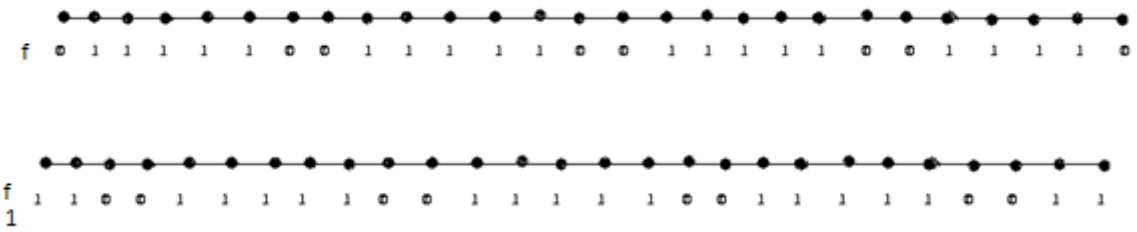
There are $\left\lceil \frac{33}{7} \right\rceil + \frac{1}{2}\left\lceil \frac{33}{7} \right\rceil \left\lfloor \frac{33}{7} \right\rfloor + \left\lfloor \frac{33}{7} \right\rfloor$ = 5+10+4 = 19 minimal total unidominating functions with maximum weight. ■

Example 3.7: Let $n = 27$.

We know that $27 \equiv 6(mod\ 7)$.

The functional values of minimal total unidominating functions$f$ defined as in

Case 7 of Theorem 2.1 and f_1 defined as in Case 7 of Theorem 2.2 for P_{27} are given at the corresponding vertices.



Upper total unidomination number is $\left\lfloor \frac{5\ x\ 27}{7} \right\rfloor = 19$.

There are $\left\lceil \frac{27}{7} \right\rceil + 1 = 5$ minimal totalunidominating functions with maximum weight. ■

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ADVANTAGES AND DISADVANTAGES OF GREEN TECHNOLOGY: A STUDY

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Abstract:

The concept of green process and technologies is the processes and technologies which are environmentally friendly and clean technology. The goals of green technologies are as follow which are to meet the needs of society in the way without depleting or damaging natural resources on earth which is the major target of green technologies. The concept is to make products which can be fully reclaimed or reused. Furthermore, by changing patterns of production and consumption, steps are being taken into account to diminish waste and pollution as one of the most indispensable aims of green technologies. Many companies have committed for establishing manufacturing practices and business regarding green technologies. Besides, this kind of technology implies to a system which utilizes innovative techniques to create environmental friendly products. Predominantly, it contains the various everyday cleaning products, waste, inventions, energy sources, clothing and host of others. Going green or using technologies which are environmental friendly is amongst the many methods which countries are looking in order to spur economic growth and develop the lives of its citizens. Green processes and technologies use renewable and natural resources which never depletes. Besides, green technology utilizes innovative and new techniques in terms of energy generation.

KeyWords: Green Technology,Pollution, Wastemanagement, recycling methods.

I. INTRODUCTION

1.1 Advantages of Green Processes and Technology

Slow the impacts of global warming by reducing CO_2 emissions The advantage of using green energy sources is that it must be clean therefore there is no discharge or damage into the environment or atmosphere. Besides, it is also replenishable in contrast to oil. In addition, green energy facilities are difficult on the pocketbook to build, it demands a lesser amount of upkeep thus it lacks to spend some huge cash to work it. Moreover, this

may also create economic advantages to some particular areas and even develop tourism industry. Even while these seem excellent, there are a few who believe there exists profits to use such technology. Establishing these facilities additionally needs plenty of land so we might have to cut on farmland which explains what many are worried about if more wind generators have to be set up. A second negative aspect is the fact many of the green energy sources cannot really be installed in specific places of the earth. As an example, wave energy can only be made use of if the waves from the sea attain at the least 16 feet. The utilization of geothermal energy only works in geologically unstable areas of the planet. But if we look at these kinds of arguments, areas that can't utilize one method of green energy source could be replaced for another.

Preventing environmental damage

How to tackle environmental damage from the throwaway society is one of the defining questions of the twenty-first century. We must encourage and support sustainable production and consumption, notably through the establishment of a circular economy. These essays by an international group of leading scholars from a range of disciplines analyse policies and legal instruments and challenge mainstream assumptions, from the choice of a policy mix to the actual effect of imposing standards on the market, and from corporate objectives and priorities to the use of precaution in assessing particularly harmful substances. Each chapter contributes to a better understanding of the current policy and regulatory framework in Europe and identifies the challenges and opportunities ahead. The book breaks new ground by examining how product policies can contribute to important objectives and visions. It is a must-read for researchers as well as for policymakers and practitioners.

II Methodology

The information was collected from various books, Journals, books and internet. This studied was performed systematically and analyzed properly. This study reports the favorable and adverse effect on society as facing various issues and challenges faced by the society and its current demands. Various issues analyzes and observed systematically in perspective of sustainable living issues.

III. Results and Discussion

3.1 Shifting Emphasis to Pollution Prevention

While the pollution control approach has achieved considerable success in producing short-term improvements for local pollution problems, it has been less effective in addressing cumulative problems that are increasingly recognized on regional (e.g., acid rain) or global (e.g., ozone depletion) levels.

The aim of a health-oriented environmental pollution control programme is to promote a better quality of life by reducing pollution to the lowest level possible. Environmental pollution control programmes and policies, whose implications and priorities vary from country to country, cover all aspects of pollution (air, water, land and so on) and involve coordination among areas such as industrial development, city planning, water resources development and transportation policies.

As environmental pollution control technologies have become more sophisticated and more expensive, there has been a growing interest in ways to incorporate prevention in the design of industrial processes - with the objective of eliminating harmful environmental effects while promoting the competitiveness of industries. Among the benefits of pollution prevention approaches, clean technologies and toxic use reduction is the potential for eliminating worker exposure to health risks.

The pollution prevention approach focuses directly on the use of processes, practices, materials and energy that avoid or minimize the creation of pollutants and wastes at source, and not on "add-on" abatement measures. While corporate commitment plays a critical role in the decision to pursue pollution prevention (see Bringer and Zoesel in Environmental policy), Bennett draws attention to the societal benefits in reducing risks to ecosystem and human health—and the health of workers in particular. He identifies principles that can be usefully applied in assessing opportunities for pursuing this approach.

3.2 Cost of Public Health and Environmental Effects; Cost-Benefit Analysis

The estimation of the costs of public health and environmental effects is the most difficult part of a clean air implementation plan, as it is very difficult to estimate the value of lifetime reduction of disabling illnesses, hospital admission rates and hours of work lost. However, this estimation and a comparison with the cost of control measures is absolutely necessary in order to balance the costs of control measures versus the costs of no such measure undertaken, in terms of public health and environmental effects.

3.3 Motto of Green Technology

To full fill the needs of demanding, damaging or depleting the natural sources on the earth is the main target of Green Technology. This Idea fulfill the present needs without making any compromises [1]. We have to know the destination to reach the goals. For reduction of waste and pollution steps are to be taken by changing the patters and production. For further protection of environment it is required to develop the technology. Speedy implementation benefit the implementation and will protect earth. To search the goals of green Technology which are introducing sustainable living, developing reduce waste and developing renewable energy.

3.4 Disadvantages of Green Processes and Technology

Green processes and technology to minimize the pollution formed by our home, living habits, and business. The main adverse impact of process and technology is may to reduce the potential negative impact that energy consumption and pollution can have on the environment [2]. While environmentally friendly living is a positive ideal, there are several possible disadvantages of Green processes and technology such as: high implementing costs, lack of information, no known alternative chemical or raw material inputs, no known alternative process technology, uncertainty about performance impacts, and lack of human resources and skills.

IV. Conclusions:

It is studied tha as various parameters like advantages of green process and Technology, Preventing environment damage, Shifting Emphasis to Pollution Prevention, Cost of Public Health and Environmental Effects; Cost-Benefit Analysis, motto of green technology and disadvantages of green processes and technology. The green technology has some disadvantages

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KEY TO EFFECTIVE CLASSROOM MANAGEMENT

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Abstract
In present days, classroom management has received an increasing amount of attention from education leaders, reformers, and researchers, who have begun to investigate, analyze, and document the effective strategies used by successful teachers. The growing emphasis on classroom management is based on effective classroom management is an absolute must and it impacts teacher's ability to enjoy their job, and create impacts on students' success as learners. If your classroom is out of control, it won't matter how passionate you are about your subject or how much you are truly dedicated to children, learning will be negatively impacted. In addition, there are now more professional-development opportunities related to classroom management being offered to teachers, and there have been discussions about the role of practical teaching techniques in teacher education to understand the students more effectively.

Keywords: Classroom management, Teaching techniques and skills, effective management.

INTRODUCTION

What is Classroom Management?

The term classroom management refers to the procedures, strategies, and instructional techniques teachers use to manage student behaviour and learning activities. Effective classroom management creates an environment that is conducive to teaching, learning and positive attitude.

When you watch a teacher with great classroom management techniques, it can feel like magic. When a student trusts their teacher, they make more of an effort to follow the rules. Generally speaking, effective teachers tend to display strong classroom-management skills, while the hallmark of the inexperienced or less effective teacher is a disorderly classroom filled with students who are not working or paying attention.

COMMON MISTAKES IN A CLASSROOM

In an effort to maintain order in the classroom, sometimes teachers can actually make the problems worse. Therefore, it is important to consider some of the basic mistakes commonly made when implementing classroom behaviour management strategies.

- A common mistake made by teachers is to define the problem behaviour by how it looks without considering its function.
- Teachers need to understand that they need to be able to change the ways they do things from year to year, as the children change.
- Not every approach works for every child.
- Teachers need to learn to be flexible.
- To become increasingly frustrated and negative when an approach is not work.
- The teacher may raise his or her voice or increase adverse consequences in an effort to make the approach work etc.

The above are very few examples which teachers do in their classroom management.

While the specific techniques used to manage classrooms and facilitate learning the following are the representative examples.

1. Demonstrating Behaviour

Make a habit of demonstrating behaviour you want to see, as many studies show that modelling effectively teaches students how to act in different situations. Talking about a test or other relatable topic be sure to:

- Use polite language

- Maintain eye contact
- Keep phones in your pockets
- Let one another speak uninterrupted
- Raise concerns about one another's statements in a respectful manner

2. Build Excitement for Content

As the bell rings and students settle, go through an agenda of the day's highlights. These could include group tasks, creating bits of curiosity. Open with couple attention getting comments and continue until everyone is with you. The goal of this classroom management technique is to immediately gain interest of the students in your agenda and thereby it can draw attention of a student. Remember, don't start teaching until all eyes are on you and everyone is in their seat.

3. Documenting the Rules

Encourage all students to help you build classroom rules, as telling them what they are not allowed to do. Near the start of the year or semester, start a discussion by asking students what they believe should and should not. At what points are phones okay and not okay? What are acceptable noise levels during lessons? This may seem like you may be shocked at the strictness of some proposed rules. Doing this emphasizes the fact that you respect their ideas and intend to adhere to them.

4. Encourage initiative

Promote growth mindset, and inject variety into your lessons, by allowing students to work ahead and deliver short presentations to share take-away points. When they deliver their subsequent presentations you may find that other students want a bit more work as well.

5. Assign open-ended projects

Encourage students to tackle open-ended projects. This may starts by giving the class a list of broad project ideas, asking each student to choose one. Be sure to explain them

- Work and learn at their own paces
- Engage actively with appropriate content
- Demonstrate knowledge as effectively as possible

With these benefits, students may actually look forward to taking on new projects.

6. Keep an Eye on Your Students

Class goes so much better when you can see your students.. When teaching, try to be facing students as much as possible. As you work with a student at his or her desk, place yourself so you can see most of the class. As you move around the classroom, don't follow the same pattern. By varying your routine, it becomes harder for students to be disruptive if they don't know where you will be next.

7. Build relationship

This is hands down the most effective classroom management technique. When a student trusts their teacher, they make more of an effort to follow the rules. Each class should feel more like a family. You need know your student names correctly.

8. Celebrate hard work

Show students that you value the work they put into learning. Identify milestones in the work everyone is accomplishing each day. Once a week, choose one particularly hardworking team or student to share their story. Students who know their work will be celebrated instead of just their grades will pay more attention and stay focused.

9. Consider peer teaching

Use peer teaching as a classroom management strategy if you feel your top performers can help engage and educate disruptive and struggling students. Peer teaching activities, such as pairing students together as reading buddies, can be especially beneficial for students who suffer from low confidence and poor interpersonal skills. Providing audio books which can play material relevant to your lessons and allowing students to work in groups while taking notes and completing work, away from quiet zones.

10. Avoid punishing the class

Address isolated behaviour issues instead of punishing an entire class, as the latter can hurt your relationships with students who are on-task. This basic approach will allow you to keep a friendly disposition, while immediately acknowledging poor behaviour.

Conclusion

While a limited or more traditional interpretation of effective classroom management may focus on rules and strategies that teachers may use to make sure students are sitting in their seats, following directions, listening attentively, etc. When teachers make an effort to get to know each student on a more personal basis, they get more out of their teaching experience as well. Each class should feel more like a family.

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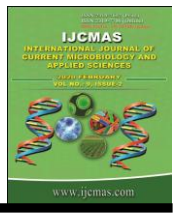

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Studies on *in vitro* Antagonism of Native Biocontrol Agents on Coconut Stem Bleeding and Bud Rot Disease Pathogens

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A B S T R A C T

In vitro antagonism of native biocontrol agents on coconut pathogens revealed that all the three isolated native *Trichoderma* spp were found inhibitory to the mycelia growth of *Thielaviopsis paradoxa* and *Phytophthora palmivora.* Maximum percent inhibition of mycelia growth of *Thielaviopsis paradoxa* and *Phytophthora palmivora* was obtained by *Trichoderma viride* followed by *Trichoderma hamatum* and *Trichoderma harzianum. Pseudomonas fluorescens* fared well against the coconut pathogens with the percent inhibition of mycelial growth of pathogen to an extent of 68.32 to 69.38%. Volatile metabolites of *Trichoderma* spp suppressed the mycelia growth of *Thielaviopsis paradoxa* and *Phytophthora palmivora.* In case of non volatile metabolites, significant inhibition of mycelia growth of test pathogens was noticed with *Trichoderma* spp at 100% concentration. Studies on the production of volatile and non volatile metabolites of *Pseudomonas fluorescens* against coconut pathogens revealed that the test pathogens *Thielaviopsis paradoxa* and *Phytophthora palmivora* were inhibited significantly. These *in vitro* studies offers scope for effective management of disease at field level.

Introduction

Diseases play an important role in palm loss and reduced yields of coconut in India. Even though coconut palm is hardy in nature and adaptable to varied climatic conditions, it is affected by many diseases (Nambiar, 1994, Henry Louis, 2002). Root (wilt)

(*Phytoplasma*), basal stem rot (BSR) (*Ganoderma spp*.), bud rot (*Phytophthora palmivora*), stem bleeding (*Thielaviopsis paradoxa*), leaf blight (*Lasiodiplodia theobromae*) and grey leaf spot (*Pestalotiopsis palmarum*) are the major diseases of coconut in India. Though a few management practices were available for combating the disease, none of them were effective in eliminating the problem completely. Several group of fungicides have yielded a satisfactory results, but their toxic nature and residual level in the coconut water has not been taken into account largely. Further, indiscriminate use of chemical pesticides or fungicides to cure or prevent plant diseases has caused soil pollution and detrimental effects in humans. Additionally, it eliminates the beneficial soil and biocontrol microorganisms. Biocontrol agents are another alternative for managing the destructive diseases of perennial crops such as basal stem rot disease of coconut (Srinivasulu *et al.,* 2005). Some species of *Trichoderma* spp. such as *T. asperellum*, *T. atroviride*, *T. virens*, and *T. harzianum* are widely used as biological control agents of many of plant pathogens in coconut and oil palm (Druzhinina *et al.,* 2011). Soil application of *Trichoderma viride* and *Pseudomonas fluorescens* talc formulations at the rate of 200g each palm in combination with 50kg farm yard manure was found effective against basal stem rot in coconut (Kartikeyan *et al.,* 2005). Darmono and Purwantara (2006) reported that an isolate of *T. harzianum* having biofungicidal activity against basal *Ganoderma spp*. an important pathogen in oil palms. Manjunath *et al.,* (2019) reported that isolates of *Trichoderma* spp mainly *Trichoderma reesei* and *Pseudomonas spp* especially *Pseudomonas fluroscence* were effective antagonists against basal stem rot disease of coconut. Biological control of plant diseases though gaining importance in the present day agriculture, its adoption in horticultural crops in general and plantation crops in particular is yet to be exploited for many other diseases in coconut. Hence, the present study was taken to exploit native biocontrol agents against stem bleeding and bud rot disease pathogens of coconut and also to study *in vitro* efficacy of native biocontrol agents against these pathogens of coconut.

Materials and Methods

Isolation and identification of antagonistic fungi from rhizospheric region of coconut

Soil samples were collected from rhizospheric region of coconut in Iragavaram and Undaraivarammandals of West Godavari district, Andhra Pradesh. Serial dilution and plate count method was used for isolation of antagonistic fungi. The collected soil samples were subjected to serial dilutions using sterile distilled water and 0.5 ml of each sample at 10^{-3} and 10^{-4} dilutions were spread on petri-dishes containing *Trichoderma* specific medium (TSM) (Elad and Chet, 1983). Two plates were maintained for each dilution. The plates were then incubated at 28^{o}C and were examined after four days. Hyphal tip method was adopted for pure culture of organisms. The isolated antagonistic fungi were identified up to the level of genus or species based of growth, color, philides characters on PDA medium and identified as *T. viride*, *T. harzianum, T. hamatum* (Plate-3).

Isolation and identification of antagonistic bacteria

Samples were serially diluted and 0.1 ml of sample was spread on plates containing King's B medium. The isolate was purified by streaking and was maintained further. Identification of bacterial bioagent was made as per the description and physiological status suggested by Hilderband *et al.*, (1992) and identified as *Pseudomonas fluroscence.*

Isolation of coconut pathogens

The disease symptom of stem bleeding caused by *Thielaviopsis paradoxa* and bud rot caused by *Phytoptera palmivira* are depicted in Plate 1. The stem portion of the infected palm where bleeding symptoms were conspicuous was chiseled out and surface sterilized with 0.1% sodium hypochlorite followed by 3 washes in sterilized distilled water (SDW) and then the stem bits were plated on Potato Dextrose Agar (PDA) media plates for *Thielaviopsis paradoxa*. Similarly, the bud rot pathogen, *Phytophthora palmivora* from infected bud tissues were isolated on PDA and were maintained. The plates were the incubated for 3 days at 29 + 1 0c and the test pathogen was isolated by purification (Plate 3& 4).

In vitro antagonism on fungal pathogens of coconut

Dual cultures of the fungal antagonists and the test pathogens were prepared by inoculating PDA discs from the growing margins of fresh fungal cultures on to petri dishes containing PDA (Gams *et al.*, 1980) and incubating them. The dual cultures were observed for antibiosis and agar blocks from the regions where the colonies merged were observed for typical interactions under the light microscope.

In case of bacterial antagonists, 8 mm mycelia discs of the pathogens were placed individually at the center of the plates and bacterial strain was streaked at three positions 2 cm away from edge of the petri plates with PDA medium and incubated. The mycelia growths of the test pathogens were measured at 48 hrs and subsequently one week after incubation (Nandakumar *et al.*, 2000).

The fungal antagonists that have shown inhibition in dual culture studies were grown on Potato dextrose broth to test the effect of the culture filtrates (nonvolatile metabolites) on the test pathogens by food poisoning technique (Khara and Hadwan, 1990). The culture filtrates were purified either by autoclaving at 15 PSI for 15 min. The sterilized filtrate was incorporated in the medium for observing fungal growth and inhibition at different concentration (10%, 20%, 50% and 100%). The PDA mixed filtrate were poured (20 ml each) into sterilized petri-dishes and the plates were inoculated with fresh disc of the test pathogens individually.

Mycoparasitism of test pathogen isolates by fungal antagonists was studied using the dual culture technique developed by Dennis and Webster (1971) described by Sanchez *et al.*, 2007. The technique allows the researchers to understand the overall effect of biological control agents. The antagonists were grown on PDA for a period from 0 to 25 days and their effect on growth of test pathogens were tested by exposing inverted plates of freshly inoculated pathogens to plates containing antagonists cultures and sealing together by cello tape. The pathogen growth was measure after 4 days of incubation in both the cases at 29 ± 1^{o}cand percent inhibition was calculated by using the formula as given by Vincent (1947).

$$\% \text{ inhibition} = \frac{\text{Mean growth in control} - \text{Mean growth in treatment}}{\text{Mean growth in control}} \times 100$$

Results and Discussion

In vitro antagonism of *Trichoderma spp* and *Pseudonomas fluroscence* on coconut pathogens

The results on *in vitro* antagonism of biocontrol agents on coconut stem bleeding disease pathogen *Thielaviopsis paradoxa* and

bud rot disease pathogen *Phytophthora palmivora* revealed that the percent inhibition of *Thielaviopsis paradoxa* ranged from 62.90 to 69.35 % and *Phytophthora palmivora* ranged from 69.38 to 82.03 % by various biocontrol agents (Table 1). It was observed that significantly maximum growth inhibition of *Thielaviopsis paradoxa*were observed with *Trichoderma viride* to a percent inhibition of 69.35 followed by *Pseudomonas fluroscence* to 69.32 % (Plate 3) whereas *Trichoderma viridae* was effective in arresting the growth of *Phytophthora palmivora* to 82.03 % closely followed by *Trichoderma hamatum* to 75.39 % (Plate 4). The least growth inhibition of *Thielaviopsis paradoxa* & *Phytophthora palmivora* to 62.90 % and 71.87 % respectively was observed with *Trichoderma harzianum.* The results are in corroboration with earlier workers who reported the potential of biocontrolagent against coconut pathogens (Srinivasulu *et al.,* 2001; Karthikeyan *et al.,* 2005). Palanna *et al.,* (2013) reported that among the 17 biocontrol agents screened, native *Trichoderma* spp. (V2) recorded 81% reduction over control in dual culture studies against *G. applanatum. Trichoderma spp,* constitute an important microbial population residing in soil and has been exploited tremendously for management of many soil borne diseases ((Jayaratne *et al.,* 2015; Tapwal *et al.,* 2011). *Trichoderma viridae* produces several groups of antibiotics, toxins and then the growth of the pathogen is inhibited (Eziashi *et al.,* 2010). Apart from that the direct attack is called mycoparasitism which kills the pathogen by mechanical and chemical means. Also *Trichoderma* species can inhibit or reduce the growth of the pathogen through competition for space, nutrients or oxygen. *Trichorderma* is fast growing and has the ability to colonize on a wide variety of substrates that makes the organism efficient soil colonizers and bio-control agents. (Sanchez *et al.,* 2007).Priya*et al.,* 2012 reported *Pseudomonas fluroscene*, a potential inhibitory biocontrol agent against *Gnanoderma* under *in vitro* conditions. The inhibition of mycelial growth of the pathogen by *Pseudomonas fluroscence* may be due to the production of antibiotics. Production of antibiotics HCN, pyrrolnitrin, phenazine and 2, 4-diacetyl phloroglucinol and lytic enzymes by *Pseudomonas fluroscence* against fungal pathogens were reported by many workers (Ramamoorthy *et al.,* 2002; Saravanakumar *et al*., 2008). George *et al.,* (2012) screened 156 fluorescent pseudomonads against *G. applanatum* and found that 8% of the total fluorescent pseudomonads showed antagonism towards *G. applanatum* with inhibition ranging from 39 to 73%.

Effect of volatile and non-volatile metabolites of *Trichoderma* spp on coconut pathogens

It is noticed from the table 2 that the mycelial growth of *Thielaviopsis paradoxa* was suppressed when exposed to 25-day-old cultures of *Trichoderma hamatum* and *Trichoderma harzianum* with percent inhibition of 70.96 and 75.86 respectively, while *Trichoderma viride* did not inhibit the mycelial growth of *Thielaviopsis paradoxa.* None of the three *Trichoderma* spp were effective against *Thielaviopsis paradoxa* at zero and 15 days (age) of their exposure. In case of *Phytophthora palmivora*, maximum suppression was obtained with 25 days old cultures compared to zero days. *Trichoderma harzianum* of 25 days old cultures suppressed the highest percent (58.00 %) followed by *Trichoderma viride* (56.15%) and *Trichoderma hamatum* (54.00 %) while minimum suppression was noticed with zero days cultures of *Trichoderma harzianum* (16.00%).

Table.1 *In vitro* antagonism of native fungal and bacterial agents on coconut pathogens

Biocontrol agents		Per cent inhibition	
		Thielaviopsis paradoxa	*Phytophthora palmivora*
1	*T.viride*	69.35[a]	82.03[a]
2	*T. harzianum*	62.90 [d]	71.87 [c]
3	*T. hamatum*	66.13[c]	75.39 [b]
4	*P.fluorescens*	68.32[b]	69.38[d]

* Numbers in each column followed by the different letter are significantly different. Values represent the means of 6 replicates

Table.2 *In vitro* efficacy of *Trichoderma* spp for production of volatile metabolites against coconut pathogens

Biocontrol agents		Per cent volatile inhibition					
		Thielaviopsis paradoxa			*Phytophthorapalmivora*		
		Days before exposure			Days before exposure		
		0	**15**	**25**	**0**	**15**	**25**
1	*Trichoderma viride*	0	0	0[c]	16.25 [c]	25.00[c]	56.15 [b]
2	*Trichoderma harzianum*	0	0	70.94 [b]	16.00 [b]	26.25 [b]	58.00 [a]
3	*Trichodermahamatum*	0	0	75.86 [a]	18.00 [a]	27.00[a]	54.00 [c]

* Numbers in each column followed by the different letter are significantly different.Values represent the means of 6 replicates

Table.3 *In vitro* efficacy of *Trichoderma*spp for production of nonvolatile metabolites against coconut pathogens

Biocontrol agents		Per cent inhibition							
		Thielaviopsis paradoxa				*Phytophthora palmivora*			
		Concentration of culture filtrate (%)				Concentration of culture filtrate (%)			
		10	**50**	**70**	**100**	**10**	**50**	**70**	**100**
1	*T.viride*	4.76[b]	23.80 [b]	35.30 [b]	45.56 [b]	8.32 [b]	23.56 [b]	49.28 [b]	52.00[a]
2	*T. harzianum*	3.80 [b]	20.00 [c]	23.33 [c]	46.57 [b]	6.86 [c]	20.00 [c]	48.00 [c]	49.00 [b]
3	*T. hamatum*	21.11 [a]	37.78 [a]	41.11 [a]	76.67 [a]	12.36 [a]	35.25 [a]	50.25 [a]	51.00 [a]

* Numbers in each column followed by the different letter are significantly different. Values represent the means of 6 replicates.

Table.4 Effect of volatile metabolites of *P. fluorescens* on coconut pathogens

Age of antagonist (days)	Per cent inhibition of coconut pathogens	
	T. paradoxa	*P. palmivora*
0	0	0
2	0	0
4	0	0
6	17.91[a]	19 [a]
10	50 [b]	60 [b]

*Values with different superscripts are significantly different

Table.5 Effect of non- volatile metabolites of *P.fluorescens* on coconut pathogens

Age of antagonist (days)	Per cent inhibition of coconut pathogens	
	T. paradoxa	*P. palmivora*
10	5^{a}	8^{a}
20	10^{b}	10^{a}
50	40^{c}	43^{b}
100	50^{d}	52^{c}

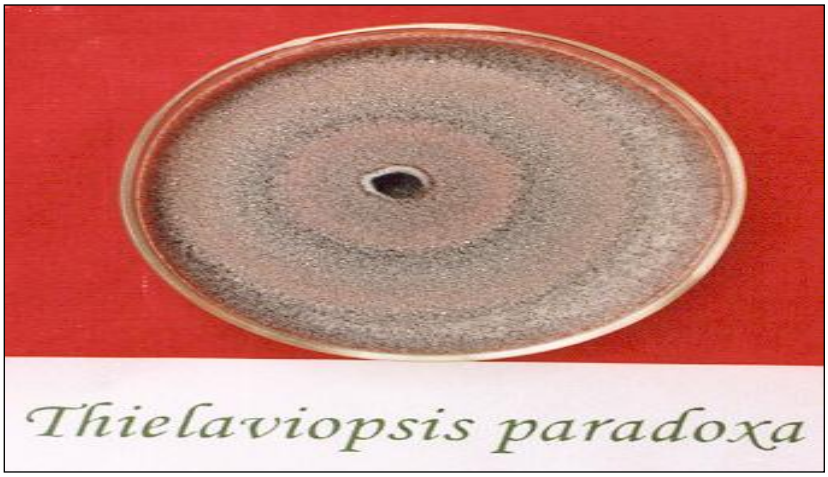
*Values with different superscripts are significantly different

Plate.1 Disease symptom of stem bleeding (*Thielaviopsis paradoxa*) on coconutpalm

Plate.2 Disease symptom of bud rot (*Phytophthora palmivora*) on coconut

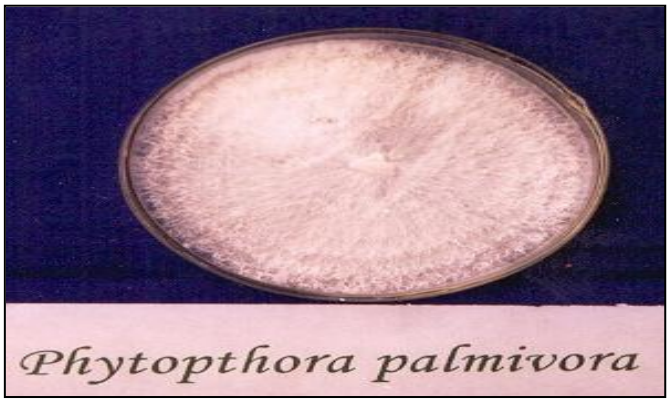
Plate.3 Native isolates of *Trichoderma spp.from* soil

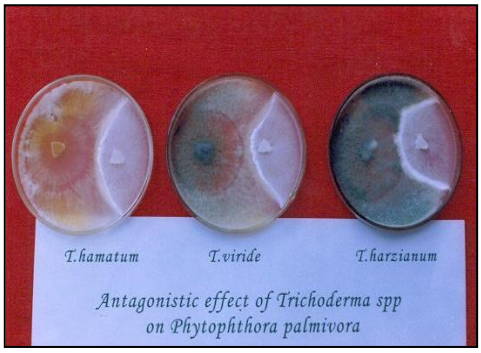
Plate.4 *In vitro* efficacy of *Trichoderma spp* and *Pseudomonas fluroscence* on *Thielaviopsis paradoxa*

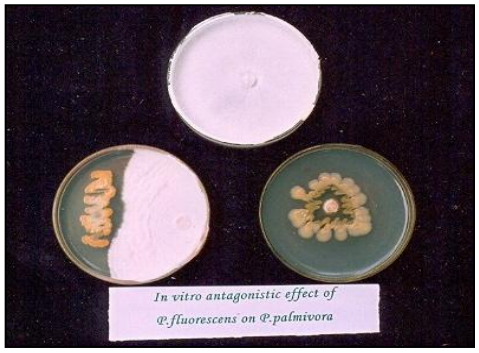



Antagonistic effect of *Pseudomonas fluroscenceon Thielaviopsisparadoxa*

Plate.4 *In vitro* efficacy of *Trichoderma spp* and *Pseudomonas fluroscence* on *Phytophthora palmivora*







A positive correlation was also obtained between inhibition of the pathogen growth and increased age of the antagonist before exposure to the pathogen. Hyphae from the exposed cultures of the test pathogens when transferred to fresh medium did not grow. The reason attributed may be due to the production of volatile metabolites by the *Trichoderma* spp *i.e. T. viride, T. harzianum* and *T. hamatum* which are both fungicidal and fungistatic (Claydon *et al.,* 1987).

In non volatile metabolites, significant inhibition on mycelial growth of *Thielaviopsis paradoxa* and *Phytophthora palmivora* pathogens was noticed with all three spices of *Trichoderma* spp at 100% concentration of culture filterate (Table 3). The mycelial inhibition of *Thielaviopsis paradoxa* ranged from minimum with *Trichoderma harzianum* (3.80%) at 10 % concentrate of culture filterate to maximum inhibition (76.67 %) at 100 % concentrate of culture filterate by *Trichoderma hamatum.* Similar observations were noticed with the inhibition of mycelial growth of *Phytophthora palmivora.* Minimum inhibition of mycelial growth of *Phytophthora palmivora* was noticed with *Trichoderma harzianum* at 10 % concentration of culture filterate (6.86) whereas maximum with 100% concentrate of culture filterate of *Trichoderma viridae* (52.00%). A positive correlation was observed between an increase in the concentration of the culture filters of *Trichoderma* spp and the per cent inhibition in mycelial growth of test pathogens The observation of this study is agreeable with Bourguington (2008) who stated that species of *Trichoderma* produces nonvolatile metabolites, such as antibiotics and enzymes, which involve in inhibiting growth of pathogenic fungi and spore germination.

Effect of volatile and non-volatile metabolites of *Pseudomonas fluorescens*

Studies on the production of volatile metabolites by *Pseudomonas fluorescens* against coconut pathogens revealed the both the pathogens *Thielaviopsis paradoxa*and *Phytophthora palmivora* were inhibited significantly when were exposed to different age old cultures of *Pseudomonas fluorescens*. The inhibition of *Thielaviopsis paradoxa* and *Phytophthora palmivora* was noticed moderately when 6 day old bacterial antagonist was used. The volatile metabolites produced by the antagonist was significantly against *Thielaviopsis paradoxa* and *Phytophthora palmivora* with 10 day old bacterial antagonist (Table 4). The non-volatile metabolites of the P*seudomonas fluorescens* against the coconut pathogens was also notice when 50% concentration and above of the culture filtrate was fortified in the medium. Significant reduction of the coconut pathogens *viz*., *Thielaviopsis paradoxa* and *Phytophthora palmivora* was noticed to a tune of 40% to 60% at a concentration of 50% culture filterate and above concentration of the bacterial antagonist (Table 5). However, the non-volatile metabolite production was not significant when 20% and less concentration of the culture filtrate of the antagonist was fortified in the medium.

In nutshell, native biocontrol agents *viz., Trichoderma viridae, T.hamatum* and *T.harzianum* screened for antagonism under *in vitro* are effective against mycelia growth of *Thielaviopsis paradoxa* and *Phytophthora palmivora* of coconut. Production and inhibitory effect of volatile substances by the antagonists found a positive correlation between inhibition of the pathogens growth and with usage of aged cultures of the antagonists before exposure to the pathogens. Antagonistic effect of culture filtrate (non-volatile metabolites) of *Trichodrema* spp against *Thielaviopsis paradoxa* and *Phytophthor apalmivora* is by poisoned food technique and inhibition of mycelia growth of test pathogens noticed with all the three species of *Trichoderma* at 100% concentration. It offers wide scope for effective management of disease at field level.

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also which is reduce the potential negative impact that energy consumption and pollution can have on the environment . Speedy implementation benefit the implementation and will protect earth. To search the goals of green Technology which are introducing sustainable living, developing reduce waste and developing renewable energy

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TEACHING LANGUAGE THROUGH LITERATURE

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Abstract:

Teaching Language through Literature develops the intellectual ability of the learners and exposes them to a variety of linguistic and literary expressions and communicative functions of language. Literature during a language classroom provides enough space for the learners to comment, justify and mirror themselves. The goal of any language should be to equip the scholar for a lifetime of communication. Literature is constituted by language and it represents one among the foremost recurrent uses of language. Language and linguistic analysis also can be used to access literature from the learner's point of view. By using literary text, the language class can end up to be lively and motivating. It is a fully integrated language plan through which the effective and creative teachers use innovative methods of teaching techniques to teach the language. It is widely acknowledged that a literary text with richness and variety are often stimulating for language learners and may be wont to elicit a good range of responses from the learners. Short story is one of the most suitable literary genres used in English teaching.

Keywords: Literature, Language, Communication, Innovative Teaching techniques,literary genre, Short story.

Introduction:

The role of literature is a basic component and source of the language curriculum and it has been gaining momentum. Literature is no doubt a potential source of learners. It leads to the flourishment of interesting ideas, learning, and improved instructions . Literature is constituted by language and it represents one among the foremost recurrent uses of language. Language and linguistic analysis also can be used to access literature from the learner's point of view. Brumfit and Carter emphasized the role of literature as "an ally of language". This technique is by no means novel, since literature has been widely used as a teaching tool in different languages teaching methods. In the grammar translation method, literature was the central component. Literary texts of the target language were read and translated, used as samples of good writing and "illustrations of the grammatical rules". The focus of this pedagogy was on form, on learning the principles of grammar and therefore the lexical items as they appeared within the text. There was no literary interest, nor interest on content. After this method fell in disuse,

literary texts also were forgotten for teachers of second languages. For the structural approaches to teaching , literature was discredited as a tool, because it represented the old tradition. The functional-notional method ignored literature, because during this method the importance lies on communication and that they present authentic language samples. Literature was not considered either to have a communicative function or to be authentic example of language use. Nonetheless, in the last decade or so the interest in literature regarded as one of the most valuable language teaching resources available and has revived remarkably.

Teaching language through literature helps teachers first to acquaint themselves with language and develop their own competence and understand language as a social phenomenon, and not as an exclusive branch of learning. It also helps teachers to think about language as entailing social acceptability in other words; they will look to classroom language as carrying resemblance with the surface language. Nowadays, information technology and globalization necessitate the international communication in the fields of economy, trade and politics as well as the international business. Students need to study culture and language and be prepared for such communication. The modern studies in linguistics, especially sociolinguistics show that culture learning is an influential think about international communication. To this point, one can say that teaching literature or literary texts in the curriculum of the non- native learners solves the problem of relevant vocabulary for social communication and prepares students to be professional translators in different fields such as trading, business, science, law and technology. Both literature and teaching involve the event of a sense for language.

The responses of the learners to the literary texts reading and interpreting will help them to;

- develop their reading skills.
- memorize useful quotations and expressions.
- integrate language skills like listening and reading as receptive skills and speaking and writing as productive skills.
- be exposed to the conversations and the dialogues which are actually used in the outside world. These dialogues and conversations create a situation inside the classroom for using language which the learner might need outside within the society.

In learning language, the ideal way to increase understanding of verbal / nonverbal aspects of communication in the country within which that language is spoken - a visit or an extended stay - is just not probable. literary works, such as novels, plays, short stories etc, facilitate understanding how communication takes place in a particular country. Though the planet of a completely unique , play, or story is an imaginary one, it presents a full and vibrant setting during which characters from many social / regional backgrounds can be described. A reader can discover the way the characters perceive the world outside (i.e. their thoughts,

feelings, customs, traditions, possessions; what they buy, believe , fear, enjoy; how they speak and behave in several settings. Literature is probably best considered a complement to other materials wont to develop the foreign learner's understanding into the country whose language is being learned. Also, literature adds tons to the cultural grammar of the learners. English literature has the supremacy over language learning. Short stories can be used for enhancing students' language skills. Since it is short, and aims at giving a 'single effect', it is easy for the students to follow the story line of the work. Short story is one of the most suitable literary genres to use in English teaching which is supported by Collie and Slater (1991: 196) who listed four advantages of using short stories for language teachers.

- short stories are practical as their length is long enough to cover entirely in one or two class sessions.
- short stories are not complicated for students to work with on their own.
- Third, short stories have a variety of choice for different interests and tastes.
- short stories can be used with all levels (beginner to advance), all ages (young learners to adults) and all classes.

The use of short-story in English teaching should be aimed to encourage the scholars to use what they need previously learnt. By doing this, the training process are going to be student-centered. Short stories allow teachers to show the four skills (LSRW) to all or any levels of language proficiency. Some practical suggestions should be considered as below: a)Strong lines: Students are required to read a brief story beforehand. In the class, however, they're not allowed to seem at the story when following this activity. - within the class, teacher asks students to possess a fast check out the entire story and underline —strong lines that's the words and expressions that they like or that disturb them. - Divide the category into groups of three or four and ask students to share the strong lines with other members in their group.

. b) Storytelling: - Students are required to read the short story beforehand. - The teacher picks up 10-15 words from the passage. Write the words (in the sequence of Occurrence in the text) on the board. - Give students one minute to memorize the words. - Cross out all the words. Ask students to rewrite the words so as within 1 minute. - Check students' word list. Those who can write the most words are the winners.

c) Gap filling: Students are required to read the story beforehand. In the class, however, they're not allowed to seem at the story when following this activity. - Teacher prepares another copy of the text during which there are some gaps for the scholars to fill in. The gaps are often passive vocabulary, adjective vocabulary, etc. so that students will have a chance to revise the lexis later. - Ask students to fill within the gaps, exchange the answers in pair/group. - Remind them of the related grammatical focus. Give them an opportunity to hammer in the language/grammar if possible. Example: Teacher can skip the relative pronouns (who, which, where, when...) or adjectives of describing the people (Later, ask students to use those adjectives to explain the characters in the story.)

MUTUAL FUNDS IN INDIA: CHALLENGES AND OPPORTUNITIES

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ABSTRACT

A large number of investment avenues are available for investors in India. Risk and return are the major issues which an investor faces to maximize his returns while choosing investing avenues depending on his objectives, preferences and needs. The advent of mutual funds has helped in garnering the investible funds of this category of investors in a significant way. Mutual fund is one of the most viable investment options for the small investor as it offers an opportunity to invest in a diversified, professionally managed basket of securities at a relatively low cost. Mutual funds offer different schemes for different investment objectives. ELSS funds are one of the best avenues to save tax; also the investor gets the potential upside of equity exposure. Indian investors have little information to take prudent investment decisions. Such information drought is the breeding ground for misguidance, leading the investor to opt for a particular scheme without an in-depth analysis, resulting in dissatisfaction over fund performance. The present paper aims to identify and address the challenges and opportunities in Mutual funds. The study is going to give detailed information of mutual funds to all Stake holders for their financial decisions.

INTRODUCTION

Mutual funds are one of the most well known investment choices nowadays. A mutual fund is an investment vehicle shaped when an asset management company (AMC) or fund house pools investments from a few people and institutional investors with normal investment targets. A fund supervisor, who is an account proficient, deals with the pooled investment. The person buys protections, for example, stocks and bonds that are in accordance with the investment order.

Mutual funds are an amazing investment choice for singular investors to get presentation to master oversaw portfolio . Additionally, one can expand their portfolio by investing in mutual funds as the asset allotment would cover a few instruments. Investors would be assigned with fund units dependent on the sum they spend. Every investor would henceforth encounter benefits or misfortunes that are relative to their investment. The primary expectation of the fund director is to give ideal returns to investors by investing in protections that are in a state of harmony with the fund's goals. The exhibition of mutual funds is reliant on the hidden assets.

Mutual funds, in contrast to stocks, don't invest just in a specific offer. Rather, a mutual fund plan would invest over a few investment choices to furnish investors with the most ideal returns. Additionally, investors are not needed to pick the stocks as the fund chief does the exploration and picks the best-performing instruments that can possibly offer significant yields.

The mutual fund investors are allotted with fund units relative to the sum they have invested. The returns that an investor would get will rely upon the quantity of fund units held by them. Each fund unit has introduction to all the protections that the fund administrator has decided to remember for the portfolio. Holding fund units doesn't furnish investors with the democratic privileges of any company.

By investing in mutual funds, the investors need not stress over the focus hazard as the fund director invests over a few instruments. Along these lines, investing in mutual funds is a fantastic method of broadening your investment portfolio. The cost of the fund unit of a mutual fund is alluded to as the net asset value (NAV). It is the cost at which one can purchase or sell their fund units of a mutual fund plan. The NAV of a mutual fund is determined by isolating the all out worth of assets in the portfolio, less liabilities. All mutual fund units are sold and purchased at the predominant NAV of the mutual fund.

Some common categories of mutual funds are:

- **Equity funds** - funds that invest only in stocks and other equity instruments
- **Debt funds** - funds that invest only in fixed income instruments
- **Money market funds** - funds that invest in short-term money market instruments
- **Hybrid funds** - funds that divide investments between equity and debt to create a balance

REVIEW OF LITERATURE

Anagol et al. (2013), assessed a significant Indian investor security change that decreased commissions attached to mutual fund deals by restricting the circulation expenses that mutual funds had recently reserved for commissions. They distinguished the strategy sway by contrasting funds charging high versus low dispersion expenses pre-change. The scientists contended that in opposition to industry asserts that restricting commissions would drastically lessen mutual fund investment; there was no proof that the change decreased asset development in mutual funds.

Zechner et al., (2011) study the interface among delegates and portfolio directors (counting mutual funds) and investors. There are regularly different budgetary counsels between portfolio directors and investors. Portfolio directors pay huge "payoffs" to repay consultants for value separation or advertising. Payoff installments increment portfolio supervisor charges and diminish returns. Portfolio chief rivalry decreases payoffs, yet expands autonomous warning administrations. The examination centers around monetary delegates as particular operators and the financial jobs they play.

Khorana et al. (2005) it is imperative to ask into the reasons for this slanted investor interest rate. There are a few elements which might clarify this variety. Cross-country examines have brought up that laws, guidelines and administration, flexibly side 6 elements, request side variables and mechanical issues could all influence the size of mutual industry in a given nation.

World Bank, (2012) it is notable that mutual funds offer their investors benefits hard to acquire through other investment vehicles. Advantages, for example, broadening, admittance to value and obligation markets at low exchange expenses and liquidity are whatever points of interest. Given these advantages, one would envision that Indian family units, described with net home-grown reserve funds of near 28% of the all out GDP.

RESEARCH METHODOLOGY

This is a theoretical research paper, where secondary information produced by different authors and researchers they has been used. For obtaining necessary information, various websites, journals as well as books have been explored by the researcher, which has been mentioned in the reference section.

OBJECTIVES

1. To study the opportunities of Mutual funds in India
2. To find the challenges of mutual funds in India

CHALLENGES AND OPPORTUNITIES IN INDIA

Challenges of Mutual Funds

The mutual fund market in India is under-penetrated. You may see a ton of opportunities for a few kinds of market players. This is for every one of the individuals who wish to purchase and sell the items and offers from financial undertakings. Some of them additionally make a situation of a few detours. The market plays do this to get the opportunities into the ideal potential. This is the place the open door zone funds have dynamic investment. However, to arrive at the financial objectives one needs to confront the difficult occasions. Let us discover a portion of the challenges:

Challenges with distribution channels distribution of the mutual fund item is an extraordinary challenge. Thus, there were limitations in the section load for mutual funds and striking changes. Because of the absence of motivation for the people who attempt to sell mutual fund units and protection business, there was exceptionally moderate development in the mutual fund industry. Subsequently, the quantity of autonomous financial counsellors and different wholesalers has taken a break in sending the mutual fund units to the said investors. Additionally, they withdrew from the market without considering future market advancement. Besides, financial data was absent.

There were noteworthy changes in the commission structures to make some adjustment in the business motivation designs directly from the customary front end plans to the path direction. This is the place the corporate funds were absent.

1. Issues with the investors

- The certainty level of the investor is a significant thought when you bargain in accomplishment in a mutual fund. Or maybe it is imperative to adjust investor premiums. The most crude mutual fund company, UTI was seen to make a full marketing network of assortment focuses, boss agents just as the establishment workplaces all through the nation. However, they didn't know about the correct investment decision.

- Compared to other mutual fund organizations, UTI has the best and interesting quality. UTI can prepare an entirety of Rs 75159 crore of its investable funds. In any case, other mutual funds don't have such limit. The retail and institutional investors were additionally under extraordinary tension. This has made unfamiliar investors from getting inside.

- The issue that is looked by the investor is the way that the mindfulness among them was very immaterial. They likewise were the devotee of the way that the funds having a place with LIC, UTI, and so on were administered by the focal government. The funds accessible in the investor sections were not distributed. It was hard to adjust investor premiums.

2. India with an undiscovered market

Of the Indian populace is under-banked. Likewise, financial incorporation is very low. The unfamiliar firms couldn't attack. Likewise, there were chances for additional penetration. The principle issue is the degree of under penetration in the market. Likewise, a large portion of the investments and reserve funds are changed over into land and gold. Hence, there are no degrees for the capital market. The asset management item came very late. In any case, the asset management industry added to the country's economy.

3. Financial ignorance/low degree of mindfulness

- Low consciousness of financial education can be one of the challenges of the mutual fund industry. Regardless of whether individuals can invest, they preferably go for different kinds of reserve funds rather over placing their cash in mutual funds for the following scarcely any years. They didn't know that mutual fund units additionally have profit alternatives. Investors ready to take up the development alternative can without much of a stretch pull out all the stops. However, nobody wishes to have inorganic development. There can be different purposes for it. One of the significant reasons is the mindfulness about the mutual fund. A large portion of individuals have the conclusion that investing in mutual funds implies placing cash in high danger. These sorts of client experience make an effect of lower financial education.

- The monetary strategy of the legislature was not suitable. There were inorganic development opportunities in the economy which was not coordinating with the all out cost proportion. The warning administrations were available to help. However, the flexibly chain has a descending incline.

4. Execution related issue

The challenge which is looked by the whole mutual fund industry is the presentation. A large portion of the investors are worried about the security of the chief total that they have invested. Subsequently, there was expanded cooperation in the security market. The desires that they have with the sum are:

- Long term development opportunities
- Regular return
- Tax benefits, and so on.

The financial segment has thought of more business scope with the consideration of mutual funds. The planning of the mutual fund is finished with the advantages which the investors wish to have. However, there was some disturbance in its acknowledgment in the financial market. Therefore, the exhibition of the mutual fund got a descending incline. The private banks didn't think of its working model. Normally, the private funds were missing concerning their operational change.

Opportunities of Mutual Funds

1. The mutual fund has low penetration

Famous chart and discoveries of the prominent researchers show that regardless of whether the mutual fund has a growth of 20% however the quantity of investors engaged with the cycle is only 2 crores. Consequently, the open door for individuals to become investors and returning benefit through the mutual fund is very high. Or maybe the growth opportunities are rising. It is critical to zero in on the B30 class of urban areas.

2. The development towards the market-connected items

The time pass and more individuals are getting instructed about the financial market, there is a move in the investment funds directly from the gold and genuine bequests to the financial assets. Likewise, a large portion of individuals today are in a view that little measure of danger is fine to gain a better yield from the financial assets.

3. Working class economy help

The country comprises of individuals having a place with an alternate class of salary. However, among them, singular investors having a place with the working class economy are

very high. Additionally, after the mutual fund industry has demonstrated its value among a portion of the retail investors, the vast majority of the working class individuals began investing in the mutual fund. Therefore, their monetary status has ascended from the center salary gathering to the upper-working class pay gathering. In any case, the retail investors came into notice.

4. The development towards market-connected items

It has been seen in a few diagrams that the move of the individuals' investment in gold, land is moved to the financial assets. The asset management Co Ltd has the assets administrator who can direct you directly from the proposition stage. Individuals have chosen to pick investment in the market connected item instead of investment in unlinked ones. This can give you opportunities with market extension. Additionally, the cost has become very high nowadays. The loan fee likewise gets diminished in the proper way. Subsequently, individuals have the acknowledgment that some measure of danger factor is very significant for gainful growth. In this way, items like mutual funds structure their value.

5. Retirees and the millennial

The time pass, the number of inhabitants in senior residents continued expanding. According to the gauge, India is required to have an absolute populace of around 3.5 crores before the finish of 2030. Be that as it may, they have an ascent in clinical costs and furthermore have an absence of federal retirement aide. Accordingly, they need great financial help through which they can remain well for the remainder of their lives.

- One-third of the complete populace in the country is of Millennials. Hence, they also have a place with one of the investor's sections. According to the report distributed by Deloitte over 70% of the all out family pay incorporates 46% of the workforce. Along these lines it is very evident that this fragment of the populace accompanies a huge growth opportunity.

- The fund can contribute well in both the instances of retirees just as recent college grads.

CONCLUSION

One of the prime reasons why the mutual fund industry faces greatest challenge is absence of goal just as examination/improvement on the mutual funds. This additionally has interfered with the pattern of investment in mutual funds through the middle people. In any case, the genuine investigations were led all through the globe on mutual funds. The investigations were fundamentally gathered in the India as the accessibility of information over yonder was very high. Be that as it may, it required significant investment even in the India. According to the information distributed in different financial diaries, the primary genuine scholarly investigation on Mutual funds was watched 40 years after the improvement of the mutual fund. However, the nation India needed execution in the mutual fund industry. Additionally, the absence of information is one of the issues.

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CHARACTERISTICS DIAGNOSIS OF WHITE BLOOD CELLS USING CNN

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Abstract
The traditional method for many disease diagnoses require blood sample analysis in which the white blood cell play a vital role. The White Blood Cell (WBC) defend the body against infections. The shape of the cell, the size of nucleus also helps in diseases diagnosing. The technique used for blood sample diagnosis may take a very long time. In some cases, the patient may die due to the delay of the reports and disease diagnosis so, we have proposed the idea of automated diagnosis of white blood cells and predicting related disorders. . In the present days, the research in medical field has begun to take machine learning and data mining techniques for the development of software that are related in extract of information. Researchers had made important changes on the development of systems which are efficient to scrutinize different types of medical images. Machine Learning enables to learn from data and improve its efficiency.

Keywords: While Blood Cells, Machine Learning, disorders

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INTRODUCTION

White blood cells are that which provide immunity that includes in protecting the body against disease. White blood cells are produced in the bone marrow which is called as hematopoietic stem cells. Leukocytes are foundall over body that includes in the blood and lymphatic system.It iscapable of portability and defends the body against infection and disease by ingesting foreign materials by destroying the harmful cells present in the body by producing the anti-bodies. Types of WBC's are neutrophils, eosinophils, basophils, lymphocytes,
and monocytes.

In the recent years with the improvement in technology, Machine Learning (ML) and Artificial Intelligence (AI) have developed fastly . Themechanizationof ML and AI have plays a vital role in medical field like image processing, computer-aided diagnosis, image interpretation, image segmentation, image retrieval and analysis of the image. Procedures of ML are extract information from the images and represents information effectively and efficiently. The ML and AI assists the doctors for the easy diagnose of diseases and prevent them rather than taking long time. These technique increases the ability of doctors and researchers for the better analysis of the disease and the usage of modern technology and the root cause of the disease.These techniques consists of conventional algorithms like Support Vector Machine, Neural Network, and deep learning algorithms such as Convolutional Neural Network , Recurrent neural Network , Extreme Learning Model, Generative Adversarial Networks etc. Machine Learning helps the computer to learn from previous data and improve its efficiency on the dataset. Machine Learning is a branch of Artificial Intelligence and it has many applications.The discovery of blood-based diseases frequently requires theidentifying and characterizing patient blood samples. we can use automated methods to detect and classify blood cells sub types have important medical implementation. The cell types are Eosinophil, Lymphocyte, Monocyte, and Neutrophil. To classify and detect blood cells sub types we use Convolution neural networks (CNN).

Related Works

Many methods have been proposed for the white blood cells detection using various algorithms. [1]One of the method is the WBC is detected on the basis of Artificial Bee colony algorithm. Since White blood cells can be identified in elliptical shape by using thedetection ofellipse method that we can identify the elements. The artificial bee colony (ABC) algorithm is used for the automatic detection of White blood cells in the colour blood cell images, by transforming it into an maximization problem. This method consists of boundary points as an ellipses in the blood smear. The main goal isto find the resemblance of a candidate ellipse with a real WBC on the cell image. Now the final process, which consists of the two neutral functions, they are candidate thresholds and the candidate ellipses which involves using the artificial bee colony algorithm (ABC).[2]Another method uses the Genetic Algorithm (GA) and Otsu threshold method. This method is rest on image equalization in HSV color space using Otsu threshold method.This process helps in identification of the WBCs in the microscope images of blood whichare based on the merging of Otsu method and GA. After this process the count of blood cells can be identified simply. After this type of blood cells images,it should be taken into consideration along with the WBC and RBCwhich can not be classified in the normal blood. The blood cells are treated in laboratories with different methods and services.[3]The other proposed system includes WBC segmentation algorithm which is based on the sparsityand geometry constraints. This segmentation is done by the nuclei by a sparsity constraint and an image representation method andthis features of nuclei more convenient, and therefore it can be detect better. In the next step, a geometrical constraint is used to detect cells. The main idea in this process is the usage of a model fitting procedure which is used to recover cells from weak and incomplete boundaries.

Proposed Method

The proposed system comprises of classification of WBC and detection of the disorders depending on the count. The WBC are of four subtypes namely neutrophils, monocytes, lymphocytes, Eosinophils. The WBC's are identified from the microscopic blood smear images and later they are classified into subtypes. Later depending on the count of the white blood cells the disorders are identified. The general range of the subtypes are as follows:

Table 1: Types of WBC

Type of WBC	Normal percentage of overall WBC count
neutrophil	55 to 73 percent
lymphocyte	20 to 40 percent
eosinophil	1 to 4 percent
monocyte	2 to 8 percent

METHOD

In this section the dataset used, data preprocessing, data augmentation and the CNN algorithm are described. The white blood cell images are collected and are classified based on their characteristics.

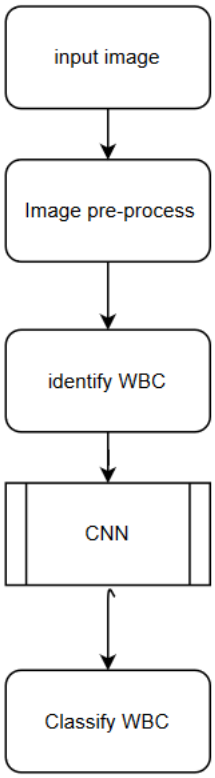

Figure 1: Flowchart of the proposed model

Data set:

The white blood cell images are obtained from the BCCD dataset which is available on the Kaggle.com website. The BCCD dataset consists of microscopic images of blood smear from which we have to distinct WBC's using data segmentation. The white blood cells are of four sub types namely neutrophils, monocytes, lymphocytes, Eosinophils.

Data Preprocessing:

The dataset are in the form of images, every image may contain noisy data than the required data.To remove the noisy data and to obtain more precise image image processing is needed. First image is converted to grey scale images to convert it into an array. Later the images are resized to remove noisy data.

Image Conversion and Augmentation: The microscopic images are converted to grey scale images using opencv module. The grey scale images are then resized to 60x60. Resizing the images removes the noisy data. The resized images are converted into an array using numpy module.

About Convolution Neural Network:

Convolution Neural Network (CNN) become commanding in different types computer works and it is showing interest towards a different types of domains, and radiology. It is a class

of deep learning methods. Convolution neural network which consists of several building blocks, they are convolution layers, pooling layers, and fully connected layers. It is mainly created to learn the features of spatial hierarchies across a back-propagation algorithm automatically.

In networks, CNN is the main grouping that is used to do image recognition and classification, detection of objects, face recognition. The CNN is widely used in the above areas.

The CNN image classifications takes an image(ex: dog, cat, tiger) as input, and it undergoes certain classification processes by using convolutional layers like pooling, full connected, Relu. Computers defines an input image in the form of an array with pixels. Based on the image resolution the computer defines an input image. By using image resolution it divides image pixels by considering certain factors height, width, dimension in the form of h*w*d.

Convolutional layer:
Convolutional layer is one of the important layers of CNN. It is the first layer that takes the characteristic of an input image. It uses the input small squares of the Convolution preservers the relationship between the pixelsby learning the image features. Convolution filters are applied by this layer simultaneously on the input image.After applying the filters on the input images, thefilters activates certain specific features. The output obtained from the previous layer will be act as an input to the next layer.

Strides:
Stride is so far the filter moves in every step along one direction. It is the number of pixels shifts for the input matrix. When the stride value is 1, then the filter will move to one pixel at a time. When the stride value is 2, then the filter will move two pixels at a time and so on.

Max Pooling:
Max pooling is an operation which is connected to CNN with convolutional layers. When this process is applied, max pooling reduces the proportions of the images. It is reduced by the number of pixels in the output which comes from the previous convolutional layer. Max pooling used for reducing the resolution of the output and helps to reduce ambiguity.

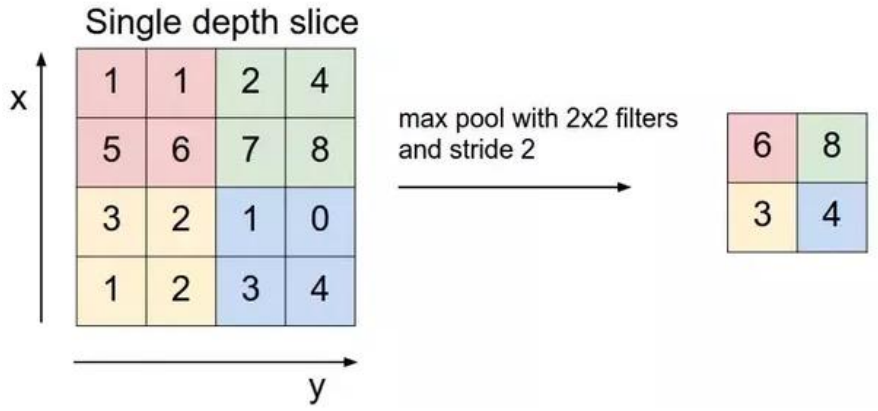

Figure 2: max pool with 2x2 filters

EXPERIMENT AND RESULT
The classification of wbc begins by taking the microscopic blood smear images as input . We have identified the WBc's from those images and further classified them depending on the shape. The CNN algorithm works on the grey scaled images which have been converted by using the opencv module. The opencv module helps in image preprocessing .The grey scaled images are cropped to determine the distinct WBC's. Later the images are converted into an array and feed to the CNN model.The dataset consist of approximately 3000 augmented images of all the four categories of white blood cells arranged in four folders. We have split the dataset into training and test data. The CNN model has got an accuracy of 97 %.

```
#count labels

sns.countplot(train_y,palette='Set3')
#we can see each categroy has equal data
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x2195d886b00>
```

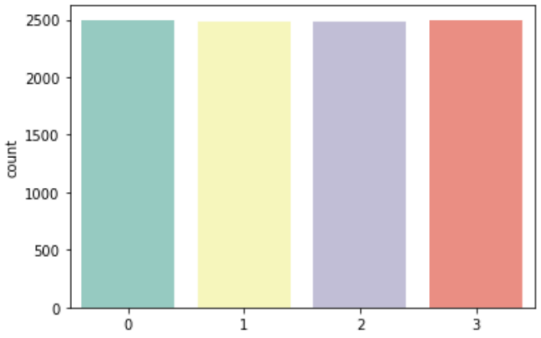

Figure 3: Bar graph representing the count of images of each class

Table 2: CNN model used for training

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 58, 58, 32)	896
max_pooling2d (MaxPooling2D)	(None, 29, 29, 32)	0
dropout (Dropout)	(None, 29, 29, 32)	0
conv2d_1 (Conv2D)	(None, 27, 27, 64)	18496
max_pooling2d_1 (MaxPooling2	(None, 13, 13, 64)	0
dropout_1 (Dropout)	(None, 13, 13, 64)	0
conv2d_2 (Conv2D)	(None, 11, 11, 128)	73856
max_pooling2d_2 (MaxPooling2	(None, 5, 5, 128)	0
dropout_2 (Dropout)	(None, 5, 5, 128)	0
flatten (Flatten)	(None, 3200)	0
dense (Dense)	(None, 64)	204864
dense_1 (Dense)	(None, 128)	8320
dense_2 (Dense)	(None, 64)	8256
dense_3 (Dense)	(None, 4)	260

Total params: 314,948
Trainable params: 314,948
Non-trainable params: 0

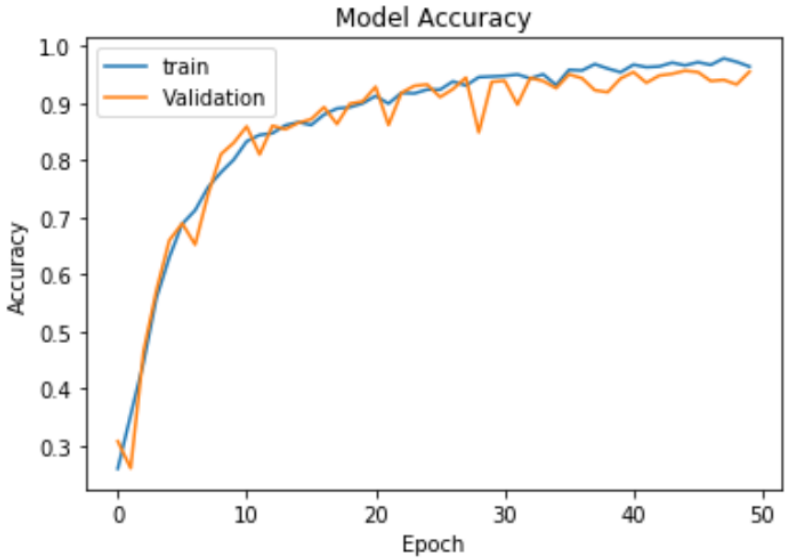

Figure 4: Accuracy graph of the model at different epoch values

CONCLUSION AND FUTURE SCOPE

In this paper , it shows the detail approach of detection of the blood cell subtype using the microscopic images . The images are taken and trained using the CNN algorithm .This model achieved the precision of 97.19% on the testing dataset. Deep learning proves significantly better than the traditional approach. The usage of the deep learning provides a scalable approach and enhanced extraction of the images. This method will reduce the work done by the pathologist. It reduces the manual errors and increases the accuracy. In the future , the enhancement of this model can be used for the automatic counting of the blood cells and the detection of the blood disorder present.

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sensors for moisture detection, it sends an alert so that necessary action can be taken immediately before the wall gets damaged. If artificial intelligence is entrenched into the home in the above case and the moisture sensors access were given to it, so that it could instantaneously contact a repair service to fix the leak, assign a deal based on existing market conditions and does the payment.

VI. Conclusion

In the near future both IoT and Artificial Intelligence (AI) will play a vital role in various ways. There are bigeminal causes which impulse the growing need for both these technologies and many industries, scientists, governments, technologists and engineers have started to enforce it in manifold circumstances. The benefits and potential opportunities of both the technologies i.e., AI and IoT can be proficient only when they are conjunctive, both at the devices end as well as at the server end and which can be called as "The Intelligence of Things".

This paper presented an overview of how IoT and AI can be merged together to make the analysis of IoT sensed data simpler and, in-turn help in taking smarter decisions. However, a lot of innovation need to take place in the areas of IoT applications combined with AI. These fields will definitely affect human life in unbelievable ways in the near future.

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In vitro and Field Efficacy of Native Biocontrol Agents on Stem Bleeding Pathogen of Coconut *Thielaviopsis paradoxa*

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A B S T R A C T

Stem bleeding disease caused by *Thielaviopsis paradoxa* is one of the major diseases of coconut in almost all the coconut growing regions of Andhra Pradesh. Bioefficacy of native bioagents *viz., Trichoderma* spp and Pseudomonas fluroscens on stem bleeding pathogen *Thielaviopsis paradoxa* under *in vitro* conditions revealed that all the three isolated native *Trichoderma* spp were found inhibitory to the mycelia growth of *Thielaviopsis paradoxa* on Potato Dexose Agar media. Maximum percent inhibition of mycelia growth of *Thielaviopsis.paradoxa* was obtained by *Trichoderma viride* (69.35%) followed by *Pseudomonas fluroscence* to 69.32 % as against only 62.90% growth inhibition of *Thielaviopsis paradoxa* by *Trichoderma harzianum.* Twelve substrates tested for mass multiplication of biocontrol agents *viz., T.viride, T.harzianum* and *T.hamatum* under *in vitro* conditions noticed that maximum mycelial growth of *Trichoderma* spp was found on 30% neem cake and 7% neem cake. Evaluation of native biogents under field conditions revealed that among the eleven treatments imposed, maximum decrease in bleeding patch (13.11 cm) was obtained with T_8 *i.e.,* basal application of *T. harzianum* (50 g) + neemcake (5kg)/year) + smearing of talc formulation of *T.harzianum* paste on stem bleeding patches) closely followed by T_7 treatment (11.55 cm) *i.e.,* basal application of *T. viride* (50 g) + neemcake(5kg)/year) + smearing of talc formulation of *T. viride* paste on stem bleeding patches) and T_9 treatment *i.e.,* basal application of *T.hamatum* (50 g) + neemcake (5kg)/year) + smearing of talc formulation of *T.hamatum* paste on stem bleeding patches) with a reduction in perimeter by 11.55cm and 8.51 cm respectively. On the other hand, un treated control palms showed an increase of 2.68 cm of perimeter of the bleeding patch. Thus, soil application of *Trichoderma* spp. along with neem cake and smearing of *Trichoderma* spp paste to the stem bleeding patches was effective in controlling the stem bleeding disease under field condition.

Introduction

Stem bleeding of coconut is a debilitating disease and is prevalent in all coconut growing regions in the tropics. The disease was first reported from Srilanka (Petch, 1906) and later reported in India (Sundararaman, 1922) and other countries. The disease is caused by a fungal pathogen, *Thielaviopsis paradoxa* (de Seynes) von Hohnel. The disease has been found to occur in all soil types, but more in laterite soils and sandy soils on the seashore or backwater areas (Nambiar, 1994). Stem bleeding disease on coconut recorded up to 15% in Andhra Pradesh (Srinivasulu *et al.,* 2005). The pathogen is a soil borne pathogen and enters the plant through growth cracks present on the stem and causes cortical decay. The disease is characterized by development of dark brown patches appearing at the basal portion of the trunk. A dark reddish brown liquid exudes from the longitudinal growth cracks present on the stem bark and form irregular streaks of exudation. These streaks may coalesce and form larger lesions. No oozing is seen from old lesions. The exudates eventually dry up to form black encrustations with brownish orange margins. The tissues beneath the discolored patch show decay. As the decay progresses, the tissues become black and fibrous. As a result of this, cavities are formed from which liquid comes out, when the bark is pressed. Severe infection may lead to reduced yield and death of young palms. Symptoms also occur on crown region. The outer whorl of leaves becomes yellow rather prematurely, droop and finally dry up. The trunk gradually tapers towards the apex and the crown size is reduced. The bleeding patches spread spirally about half way up the stem and sometime reach the crown and cause the death of palms. In severe cases the bleeding patches reach the crown and kill the palm.

Soil drenching with calixin 0.1% (Radhakrishnan, 1990) and root feeding with Bavistin 5% or Calixin 5% (Ramanujam *et al,* 1993), have been found to reduce the disease to some extent. Sudarshan *et al*.(2019) reported that Difenoconazole 25% EC @ 0.1%,Propiconazole 25% EC@0.1%, Tebuconazole 25.9% EC @ 0.15% and Thiophanate Methyl 70%WP @ 0.28% has recorded cent per cent inhibition. Though chemical treatments inhibit the pathogen, but biological control is an eco-friendly, long-lasting, highly effective method for the elimination of soil borne pathogens and a good alternative for the chemical and physical treatments. The literature revealed that the pathogen can be successfully controlled by *Trichoderma viride* under *in vitro* conditions (Jayaratne *et al.,* 2015; Ranjana Chakrabarty *et al.,* 2013; Tapwal1 *et al.,* 2011).

Several authors reported about the soil application of neem cake will reduce the intensity of pathogen (Kartikeyan *et al.,* 2005; Hoitink *et al*., 2006; Darmono and Purwantara, 2006). But there is very sparse literature on field efficacy of native bioagents in control of stem bleeding disease in coconut. The present study was carried out to investigate the role of bioagents in inhibiting the growth of the fungus in *in vitro* and field condition in controlling the disease.

Materials and Methods

Isolation of coconut pathogens

The disease symptom of stem bleeding caused by *Thielaviopsis paradoxa* is depicted in Plate 1. The stem portion of the infected palm where bleeding symptoms were conspicuous was chiseled out and surface sterilized with 0.1% sodium hypochlorite followed by 3 washes in sterilized distilled water (SDW) and then the stem bits were plated on Potato Dextrose Agar (PDA) media plates for

Thielaviopsis paradoxa. The plates were then incubated for three days at 29 + 1 0c and the test pathogen was isolated by purification .

Isolation and identification of antagonistic fungi from rhizospheric region of coconut

Soil samples were collected from rhizospheric region of coconut in Iragavaram and Undaraivaram mandals of West Godavari district, Andhra Pradesh. Serial dilution and plate count method was used for isolation of antagonistic fungi. The collected soil samples were subjected to serial dilutions using sterile distilled water and 0.5 ml of each sample at 10^{-3} and 10^{-4} dilutions were spread on petri-dishes containing *Trichoderma* specific medium (TSM) (Elad and Chet, 1983). Two plates were maintained for each dilution. The plates were then incubated at 28^{o}C and were examined after four days. Hyphal tip method was adopted for pure culture of organisms. The isolated antagonistic fungi were identified up to the level of genus or species based of growth, color, philides characters on PDA medium.

Isolation and identification of antagonistic bacteria

Samples were serially diluted and 0.1 ml of sample was spread on plates containing King's B medium. The isolate was purified by streaking and was maintained further. Identification of bacterial bioagent was made as per the description and physiological status suggested by Hilderband *et al.*, (1992) and identified as *Pseudomonas fluroscence.*

In vitro antagonism on fungal pathogens of coconut

Dual cultures of the fungal antagonists and the test pathogen were prepared by inoculating PDA discs from the growing margins of fresh fungal cultures on to petri dishes containing PDA (Gams *et al.*, 1980) and incubating them .The dual cultures were observed for antibiosis and agar blocks from the regions where the colonies merged were observed for typical interactions under the light microscope.

In case of bacterial antagonists, 8 mm mycelia discs of the pathogens were placed individually at the center of the plates and bacterial strain was streaked at three positions 2 cm away from edge of the petri plates with PDA medium and incubated. The mycelia growths of the test pathogens were measured at 48 hrs and subsequently one week after incubation (Nandakumar *et al.*, 2000).

Mycoparasitism of test pathogen isolates by fungal antagonists was studied using the dual culture technique developed by Dennis and Webster (1971) described by Sanchez *et al.*, 2007. The antagonists were grown on PDA for a period from 0 to 25 days and their effect on growth of test pathogens were tested by exposing inverted plates of freshly inoculated pathogens to plates containing antagonists cultures and sealing together by cello tape. The pathogen growth was measure after 4 days of incubation in both the cases at 29 ± 1^{o}c and percent inhibition was calculated by using the formula as given by Vincent (1947).

$$\% \text{ inhibition} = \frac{\text{Mean growth in control} - \text{Mean growth in treatment}}{\text{Mean growth in control}} \times 100$$

Mass multiplication of *Trichoderma* spp

The antagonistic fungi *viz.*, *T.viride, T.harzianum* and *T.hamatum,* were tested for mass multiplication on coconut leaf bits, coconut coir, coconut dry leaf powder, oil palm stem bits, oil palm leaf bits, farm yard manure, redgram, bajra, bengal gram, wheat

grain, 30% neem cake and 7% neem cake. One hundred gram of each substrate was weighed in conical flasks (500 ml) containing 2% sucrose solution and kept undisturbed for 24 hours. Later, the excess water was drained out and the flasks were autoclaved and subsequently seeded with mycelial bits of *Trichoderma* spp. The flasks were then incubated at 28 ± 1°c for 7 days and the observations were recorded.

Assessment of *Trichoderma* spp population in neemcake

One gram of sample from developed talc formulation in neemcake was derived at regular intervals and the population (CFU) of *Trichoderma* spp. in neemcake were conducted at 10, 20, 30, 40, 50, and 60 days intervals after preparation by serial dilution plate technique in selective media for bioagents.

Talc formulation of *Trichoderma* spp

Talc formulation of native *Trichoderma* spp was prepared. Potato dextrose broth was prepared and sterilized by autoclaving at 15 PSI (121.6 °c) for 15 minutes. Eight mm diameter mycelial discs of antagonist was inoculated and incubated at 28 ± 1°c for 7 days. The homogenate (1 x 10^8 spores/ml) was mixed with talc powder at 1 : 2 ratio along with 0.5% carboxy methyl cellulose and dried in shade, following the method described by Jayarajan *et al.*, (1994) with slight modification. The product was used for soil application studies.

Field evaluation of native *Trichoderma spp.*

A field experiment was conducted at Iragavaram village, West Godavari district of Andhra Pradesh during 2014 to 2016 for two years, by imposing ten treatments along with untreated control in coconut cultivar East Coast Tall. The palms were well managed with regular package of practices given by DrYSRHU, Venkaramannagudem. Ten treatments were imposed along with untreated control in Randomized Block Design with three replications and three palms per replication.

Treatment details were given in Table 1.

The talc powder formulations of the bioagents contained a spore load of 625 x 10^3 cfu g^{-1} powder was used for study. Treatments containing basal application of either neem cake alone or in combination with *Trichoderma* spp were imposed by making basins at a diameter of 2m from the stem at a depth of 15 cm and were immediately covered with soil and irrigated. Talc formulations were also smeared on the bleeding patches. Bleeding patches of nearly equal size were selected for the palms and perimeter of the bleeding patches was taken into account for judging the degree of disease incidence and one conspicuous bleeding patch was selected for each palm imposing treatments on the stem keeping in view the chances of appearance of more than one bleeding patch on the same stem. Initial perimeter on the bleeding patches was recorded prior to imposing the treatments and subsequent observations were made at monthly intervals. The efficacy of the treatments was determined by comparing the reduction in the perimeter of the bleeding patch after recording the final observations after 12 months.

Results and Discussion

Isolation of coconut pathogens

Isolation carried out from the diseased tissues yielded a pathogenic isolate of *Thielaviopsis paradoxa* (Plate 1). The hyphae were pale brown with cylindrical to oval endoconodia. Chalamydospore production is terminal, in

chain and they are thick walled, obovate to oval, *p. palmivira* mycelium is typical non-septate and hyaline, intercellular in the tissue drawing its nutrients through haustoria. It develops rapidly to cover the host tissue with a cottony growth, especially during highly humid condition (Plate 2). The sporangiophores are simple or branched and the sporangia are pear-shaped, with prominent papillae. They are formed singly at the tips of conidiophores, and are hyaline and thin walled, measuring 38-72 x 33-42µ. They germinate by releasing motile zoospores through the papillary opening.

In vitro antagonism of *Trichoderma spp* and *Pseudonomas fluroscence* on coconut stem bleeding pathogens

The results on *in vitro* antagonism of biocontrol agents on coconut stem bleeding disease pathogen *Thielaviopsis paradoxa* (Fig 1) revealed that the percent inhibition of *Thielaviopsis paradoxa* ranged from 62.90 to 69.35 % . It was observed that significantly maximum growth inhibition of *Thielaviopsis paradoxa* were observed with *Trichoderma viride* to a percent inhibition of 69.35 followed by *Pseudomonas fluroscence* to 69.32 % (Plate 3a & Plate 3b).The least growth inhibition of *Thielaviopsis paradoxa* to 62.90 % was observed with *Trichoderma harzianum.* The results are in corroboration with earlier workers who reported the potential of biocontrol agent against coconut pathogens (Jayaratne *et al.,* 2015; Tapwal1 *et al.,* 2011). Sudarshan *et al.,* 2019 reported that *Trichoderma viridae* was found to be most effective on *Thielaviopsis paradoxa* with 61.62% inhibition followed by *T. harzianum* and *T. virens* with 60.80 and 59.49 per cent inhibition respectively. *Trichoderma viridae* produces several groups of antibiotics, toxins and then the growth of the pathogen is inhibited (Eziashi *et al.,* 2010). Also it can inhibit or reduce the growth of the pathogen through competition for space, nutrients or oxygen. Priya *et al.,* 2012 reported *Pseudomonas fluroscene,* a potential inhibitory biocontrol agent against *Gnanoderma* under *in vitro* conditions. The inhibition of mycelial growth of the pathogen by *Pseudomonas fluroscence* may be due to the production of antibiotics. Production of antibiotics HCN, pyrrolnitrin, phenazine and 2, 4-diacetyl phloroglucinol and lytic enzymes by *Pseudomonas fluroscence* against fungal pathogens were reported by many workers (Ramamoorthy *et al* 2002; Saravanakumar *et al*., 2008).

Substrate for mass multiplication of *Trichoderma* spp

Twelve substrates were tested for mass multiplication of biocontrol agents *viz., Trichoderma viride, T.harzianum* and *T.hamatum* (Table-2). Among the substrates tested, maximum mycelial growth of *Trichoderma* spp. was found on 30% neem cake, 7% neem cake, oil palm stem bits, oil palm leaf bits and wheat grains followed by FYM and coconut fresh leaf bits. However, slight mycelial growth of *Trichoderma* spp was recorded on redgram and bajra, whereas no mycelial growth was noted on coconut coir and coconut dry leaf powder. The results were in tune with the findings of Bhasakaran, 1990, Mohiddin *et al.,* 2017,). Rini and Sulochana (2007) reported that pre-boiled sorghum grains, coir pith + neem cake (1:1), cow dung + neem cake (1:1) + wheat flour (10%) maintained high populations of *T. harzianum* and *T. viride* within 10 days of inoculation. Ajay Tomer *et al.,* (2016) noticed very high level of population dynamics and quite longer shelf life of *T. harzianum i.e.* for 150 days in a substrate of mixture of de-oiled cakes of neem, jatropha, mahua and karanjaes with sorghum grains and wheat bran. Several workers also reported that neem cake encouraged the saprophytic soil microflora especially *Trichoderma* in coconut basins.

Assessment of *Trichoderma* spp population in neem cake

To test the population built-up of *Trichoderma* spp. under *in vitro* conditions, the effective bioagents were mixed with sterilized and unsterilized neemcake separately and heaped for different days. The population of bioagents was assessed at 10, 20, 30, 40, 50 and 60 days interval and the results showed that 20 days incubation period buildup good population of *Trichoderma* spp. in both sterilized and unsterilized neem cake. Maximum number of colonies of *Trichoderma* spp was observed more in sterilized neem cake than unsterilized neem cake (Table 2). The results were on par with the findings of Bhaskaran (1990),who reported that *T.harzianum* and *T.hamatum* were found to be antagonistic to *G.lucidum* and application of neem cake (5 or 10 kg / palm / year) encouraged the saprophytic soil micro flora especially *Trichoderma* in coconut basins and was effective in the control of *Ganoderma* wilt.

Table.1 Substrate for mass multiplication of *Trichoderma* spp

Substrate	Mycelial growth (after 7 days)		
	T.viride	***T.harzianum***	***T.hamatum***
30% neem cake	+++	+++	+++
7% neem cake	+++	+++	+++
Farmyard manure	++	++	++
Coconut coir	--	--	--
Coconut dry leaf powder	--	--	--
Coconut fresh leaf bits	++	++	++
Oil palm stem bits	+++	+++	+++
Oil palm leaf bits	+++	+++	+++
Wheat grains	+++	+++	+++
Bengal gram	++	++	++
Red gram	+	+	+
Bajra	+	+	+

-- No growth; + Slight growth; ++ Moderate growth; +++ Maximum growth

Table.2 Population load of biocontrol agents in neem cake under sterilized and unsterilized conditions

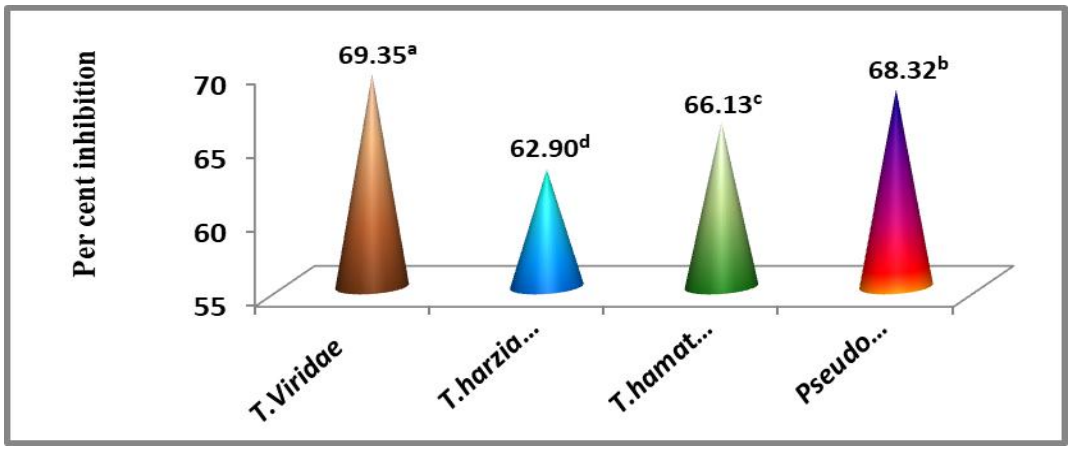
Isolate	Neem cake unsterilized (Cfu x 10^{-4})						Neem cake sterilized (Cfu x 10^{-4})					
	Day's intervals											
	10	**20**	**30**	**40**	**50**	**60**	**10**	**20**	**30**	**40**	**50**	**50**
T.viride	4	31	22	9	5	2	20	48	43	29	17	11
T.harzianum	5	28	24	8	6	0	19	44	37	26	20	10
T.hamatun	7	32	22	10	5	2	23	51	42	31	26	14

Table.3 Field efficacy of *Trichoderma* spp on stem bleeding disease in coconut

Treatments		**Perimeter of the exudation patch(cm)**		
		Initial	**Final**	**Decrease/Increase**
T_1	Basal application of *T. viride* (50 g) + neem cake (5kg/palm)	8.11	2.22	-5.88
T_2	Basal application of *T. harzianum* (50 g) + neem cake(5kg/palm)	8.70	3.88	-4.88
T_3	Basal application of *T. hamatum* (50 g) + neem cake(5kg/palm)	6.22	2.77	-3.44
T_4	Smearing of talc formulation of *T.viride* paste on stem bleeding patches	8.22	0.77	-7.44
T_5	Smearing of talc formulation of *T.harzianum* paste on stem bleeding patches	7.77	0.22	-7.55
T_6	Smearing of talc formulation of *T.hamatum* paste on stem bleeding patches	8.22	4.77	-3.44
T_7	Basal application of *T. viride* (50 g) + neemcake (5kg/palm) + Smearing of talc formulation of *T.viride* paste on stem bleeding patches	14.77	3.22	-11.55
T_8	Basal application of *T. harzianum* (50 g) + neem cake(5kg/palm) + Smearing of talc formulation of *T.harzianum* paste on stem bleeding patches	15.77	2.66	-13.11
T_9	Basal application of *T. hamatum* (50 g) + neem cake(5kg/palm)+ Smearing of talc formulation of *T.hamatum* paste on stem bleeding patches	13.84	5.33	-8.51
T_{10}	Neem cake 5 kg / palm/year	12.26	4.0	-2.26
T_{11}	Untreated control	5.68	8.36	+2.68
			CD (p=0.05)	**1.32**

(- = Decrease or reduction) ,(+ = Increase)

Fig.1 *In vitro* antagonism of native fungal and bacterial agents on coconut stem bleeding pathogen



* Numbers in each column followed by the different letter are significantly different. Values represent the means of 6 replicates.

Plate.1 Stem bleeding patch on the trunk of coconut palm

Plate.2 Stem bleeding disease pathogen

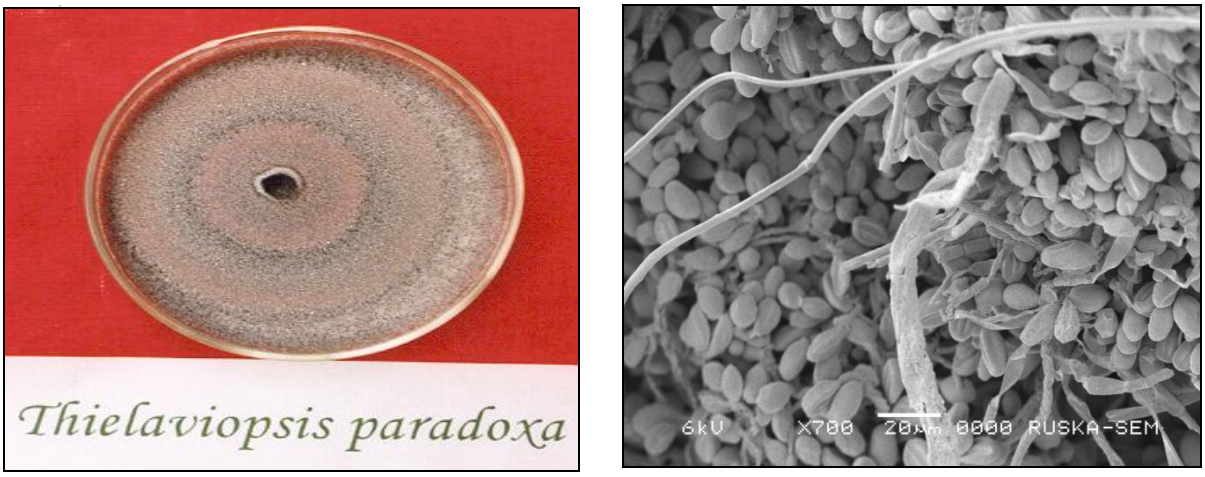


Plate.3a *In-vitro* efficacy of *Trichoderma* spp on *T. paradoxa*

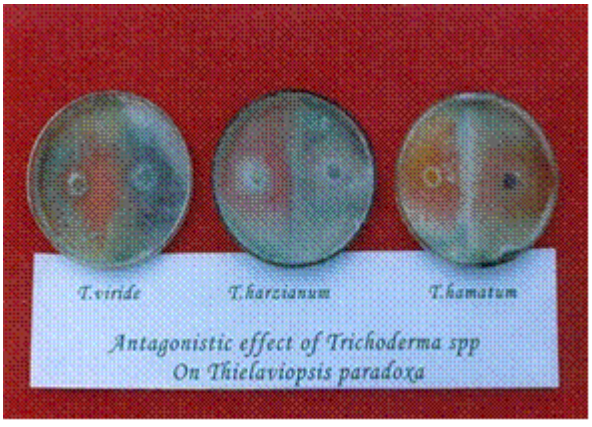


Plate.3b *In-vitro* efficacy of *P.fluorescens* on *T. paradoxa*

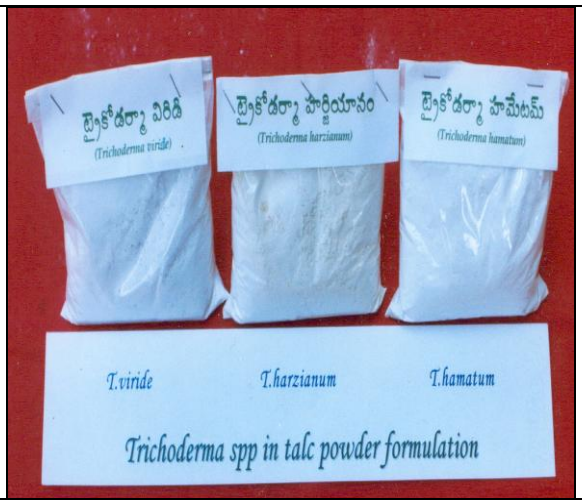


Plate.4 Talc formulation of *Trichoderma* spp.

Plate.5 Smearing of talc formulation of *T.viride* paste on stem bleeding patches

Plate.5 Basal application of *T. viride* (50 g) + Neemcake (5kg)/year

Field efficacy of native bioagents on coconut stem bleeding pathogen *Thielaviopsis paradoxa*

The results of the field experiment indicated that all three *Trichoderma spp* were effective against stem bleeding disease. It was observed from the table 3 and plate 4 & 5, that there was decrease of perimeter of the exudation patch(cm) in all the treatments except in T_{11}-untreated control where the perimeter of the exudation patch increased by 2.68 cm. The reduction of exudation patch(cm) ranged from minimum of 2.26cm with T_{10} treatment *i.e.,* application of neem cake @ 5kg/pal/year) to maximum of 13.11cm with T_8 treatment *i.e.,* basal application of *T. harzianum* (50 g) + neem cake (5kg)/year + smearing of talc formulation of *T.harzianum* paste on stem bleeding patches).Among the different treatments imposed, maximum decrease in bleeding patch (13.11 cm) was obtained with T_8 *i.e.,* basal application of *T. harzianum* (50 g) + neemcake (5kg)/year) + smearing of talc formulation of *T. harzianum* paste on stem bleeding patches) closely followed by T_7 treatment (11.55 cm) *i.e.,* basal application of *T. viride* (50 g) + neemcake (5kg)/year) + smearing of talc formulation of *T. viride* paste on stem bleeding patches) and T_9 treatment *i.e.,* basal application of *T.hamatum* (50 g) + neemcake (5kg)/year) + smearing of talc formulation of *T.hamatum* paste on stem bleeding patches) with a reduction in perimeter by 11.55cm and 8.51 cm respectively. The results were in tune with the finding of Srinivasulu and Raghava Rao (2009), who reported that the application of *Trichoderma* spp. caused lysis of mycelium of Ganoderma lucidum. Furthermore, they have found that the application of T. harzianum/T. viride/T. hamatum pasted over bleeding patches and soil application of the bioagents @ 50 g in 5 kg neem cake has reduced the perimeter of the Ganoderma wilt patches on coconut trees.

Neeraja *et al.,* (2018) soil application of talc based formulation of 125 g each of *Trichoderma reesei* and *Pseudomonas fluorescens* + 5 kg of neemcake/palm at yearly interval was effective in managing the Basal stem rot disease (Ganoderma wilt). Soil application of 125 g of each *Trichoderma reesei* and *Pseudomonas* sp along with neem cake 5 kg per palm per year reduced the disease incidence and increased the nut yield of coconut (Manjunath *et al.,* 2019).

In the present study, the decrease of bleeding patches was observed and the reason attributed may be when the biocontrol agents applied to the bleeding patches, they established on the rotted region at the expense of the pathogen and sporulate there by caused amelioration of the tissue from further rotting by the stem bleeding pathogen *Thielaviopsis paradoxa. Trichoderma* spp had shown inhibitory effect on stem bleeding disease pathogen *Thielaviopsis paradoxa* by production of volatile and non-volatile metabolites that are antagonistic to the pathogen besides mycoparasitism. Soil application of *Trichoderma* spp along with neem cake favours the population built up of *Trichoderma* spp. in the soil, thereby causing reduction in the *Thielaviopsis paradoxa* population and subsequently the disease spread. This is evident from the fact that all the treated palms have contained only one spot and no further appearance of the bleeding patches except in control palms where the number of bleeding patches increased from 1 to 4 minute specks. The reason attributed may be the treatments containing *Trichoderma* spp either by smearing of *Trichoderma* spp. paste on stem bleeding patches along with soil application with neem cake was effective in controlling the further spread of the disease. Neem cake is suitable substrate for multiplication of *Trichoderma* spp (Srinivasulu *et al.,* 2004a) and is also inhibitory to the growth of *T.paradoxa*

(Ramanujam *et al.,* 2002). However, neem cake when applied alone was effective in checking the inoculums load of *Thielaviopsis paradoxa* in an indirect way probably through increasing the population load of the existing antagonistic mycoflora thereby preventing the further spread of the diseased perimeter of the bleeding patch. On the other hand, control palms recorded an increase in the disease severity as indicated by an increase in perimeter of the bleeding patch. The results of the fields experiment offer a scope for an easy and effective management of the stem bleeding disease at field level by the coconut farmers.

It is concluded that in nutshell, native biocontrol agents *viz., Trichoderma viridae, Trichoderma.hamatum* and *Trichoderma harzianum* screened for antagonism under *in vitro* are effective against mycelia growth of stem bleeding pathogen *Thielaviopsis paradoxa.* Under field conditions, basal application of *T.harzianum* (50 g) or *Trichoderma viridae* (50g) with neem cake (5kg/palm) in combination with smearing of talc formulation of *Trichoderma harzianum* or *Trichoderma viridae* paste on stem bleeding patches were effective in controlling the stem bleeding of coconut.

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