# Trends in the Growth of Literature on Genetic Engineering (1989-2013)

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*Abstract* – **This paper presents a scientometric analysis of the growth of literature output in the field of Genetic Engineering using MEDLINE data which are covered in the Pubmed. The literature covered in the database for the period 1989-2013 was considered. It covered the maximum of 191089 records during the study period from 1989 to 2013. It is found that the annual growth rate of literature in a particular field of knowledge is uniform and measure the rate of growth from year after year, the application of RGR and Dt are quite appropriate. The RGR has shown a decreasing trend and Doubling Time shown an increasing trend. It is also found that the annual growth rate of literature of journal articles in a particular field the RGR has shown a decreasing trend and Doubling Time shown an increasing trend. Genetic Engineering research indicates a different picture when the RGR and Dt were calculated by year-wise both in terms of number of papers and number of pages. It is found that the year wise calculation of RGR and Dt for Indian output has shown fluctuation trends throughout the study period.**

*Keywords:* **Fee Based, Library Services, University Libraries, Service charging.**

## I. Introduction

This study was aimed to examine quantitatively the growth of literature in the field of 'Genetic Engineering' using MEDLINE data which are covered in the Pubmed. One of the most obvious features of science in recent years has been its rate of growth. Scientific growth has involved not only increase in manpower and finance[1]. The flood of papers represents one aspect of the general growth of scientific communication.

Wooster (1970)[2] has estimated the number of journals that existed in the world at any one time, where as some estimates of the number of papers published annually at various times was done by Vickery (1968)[3] and Martyn (1973)[4]. Gottschalk and Desmond (1963)[5] have also estimated the number of scientific and technical journals existed in the World. Growth studies in other scientific areas included the work of Baker (1976)[6] in chemistry, Conard (1957)[7] in biology, May (1966)[8] and Lamb (1971)[9] in mathematics, Sengupta (1973) in microbiology[10], physiology[11], and biochemistry[12].

## II. Literature Review

The growth of literature and its doubling time results in the field of Science and Technology[13] and Biological science literature in India during the period 1965-1989[14] has been analysed by Maheswarppa and Ningoji (1992 and 1993) with exponential, logistic and linear patterns of analysis and found that none of the patterns has been followed in the output. Aleixandre et al. (1995)[15] have conducted a study of the Spanish publications on AIDS, covering 2013 items, of which 1821 journal papers and 192 books. Their study confirmed exponential growth of publication since 1983 and the growth was similar to the trend observed in other countries. Karki, Garg, and Sharma (2000)[16] examined

the research productivity on Indian Organic Chemistry during the period 1971-1989 using *Chemical Abstracts*. They attempted to quantify the national contribution to world efforts and identified areas of relative strength and weakness, and also modeled the growth of Indian Organic Chemistry to world Organic Chemistry output as a whole, and in subfields, where the AI (Activity Index) for the world and India were similar. An attempt was made by Macias-Chapula (2000)[17] to identify the patterns of the growth in AIDS literature, as well as the types of documents published, authorship pattern, institutional affiliations of authors, and subject content. Rajendran, Ramesh Babu and Gopalakrishnan (2005)[18] analysed the global output of "fiber optics" research. Articles covered in the Ei-Tech Index database covering the period of 1999-2003 have been studied. Growth of literature by year wise, country wise, authorship pattern, bibliographic forms, ranking of core journals and nature of research have been analysed. Ramesh babu and Ramakrishnan (2007)[19] studied the growth of literature on "Hepatitis" and Ramakrishnan and Thavamani (2013)[20] in the field of "Hepatitis-C"

### III. GENETIC ENGINEERING

Genetic Engineering, also called genetic modification, is the direct manipulation of an organism's genome using biotechnology. New DNA may be inserted in the host genome by first isolating and copying the genetic material of interest using molecular cloning methods to generate a DNA sequence, or by synthesizing the DNA, and then inserting this construct into the host organism. Genes may be removed, or "knocked out", using a nuclease. Gene targeting is a different technique that uses homologous recombination to change an endogenous gene, and can be used to delete a gene, remove exons, add a gene, or introduce point mutations.[21]

A huge number of articles, papers, reports and so on are being published on research work in Genetic Engineering. Since there is a continuous publication of information in this field, it is necessary to study quantitatively the output of literature by applying Scientometric techniques. It would benefit to identify the growth rate of literature in the field of Genetic Engineering.

### IV. OBJECTIVES OF THE STUDY

(1) To examine the year wise growth of Genetic Engineering literature output.

(2) To analyse the Indian literature on "Genetic Engineering".

(3) To quantify the Research output in Journal Articles in terms of total pages.

### V. LIMITATION

This study is confined to a period from 1989 to 2013 using MEDLINE data which covered in Pubmed only.

### VI. METHODOLOGY

The records published during the year 1989 to 2013 in the field of Genetic Engineering in the MEDLINE data which are covered in the Pubmed (www.pubmed.com) which is a free resource that is developed and maintained by the National Center for Biotechnology Information (NCBI), at the U.S. National Library of Medicine (NLM), located at the National Institutes of Health (NIH) was searched and bibliographic details like author, title, publication type, language, year; address of the contributors, country of publications, source etc. were collected.

The retrieved records were converted into FoxPro and loaded in SPSS for the purpose of analysis. The keyword 'Genetic Engineering' has been used for extracting the number of records available in the above said database. The data thus collected from the source database on the literary production of 'Genetic Engineering' for the period 1989 - 2013 has been analysed by using bibliometric indicators such as Relative Growth Rate (RGR) and Doubling Time (Dt).

### VII. ANALYSIS AND DISCUSSION

The literature has been classified in Table 1 according to year of publication. It is found that there is a gradual growth of literature in the subject of study by year after year. The year 2012 has marked a maximum of 6.3% out of total productivity in the study period. (Fig.1)

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TABLE 1 QUANTUM OF LITERATURE PUBLISHED IN GENETIC ENGINEERING BY YEAR WISE

| S.No. | Year | Frequency | % | Cumulative % |
|-------|------|-----------|-----|--------------|
| 1 | 1989 | 534 | .3 | .3 |
| 2 | 1990 | 1297 | .7 | 1.0 |
| 3 | 1991 | 2480 | 1.3 | 2.3 |
| 4 | 1992 | 3171 | 1.7 | 3.9 |
| 5 | 1993 | 3854 | 2.0 | 5.9 |
| 6 | 1994 | 4420 | 2.3 | 8.2 |
| 7 | 1995 | 4916 | 2.6 | 10.8 |
| 8 | 1996 | 5158 | 2.7 | 13.5 |
| 9 | 1997 | 5668 | 3.0 | 16.5 |
| 10 | 1998 | 6877 | 3.6 | 20.1 |
| 11 | 1999 | 7574 | 4.0 | 24.0 |
| 12 | 2000 | 8966 | 4.7 | 28.7 |
| 13 | 2001 | 8889 | 4.7 | 33.4 |
| 14 | 2002 | 9115 | 4.8 | 38.2 |
| 15 | 2003 | 9535 | 5.0 | 43.1 |
| 16 | 2004 | 9918 | 5.2 | 48.3 |
| 17 | 2005 | 10185 | 5.3 | 53.7 |
| 18 | 2006 | 9901 | 5.2 | 58.9 |
| 19 | 2007 | 10339 | 5.4 | 64.3 |
| 20 | 2008 | 10835 | 5.7 | 69.9 |
| 21 | 2009 | 11050 | 5.8 | 75.7 |
| 22 | 2010 | 11656 | 6.1 | 81.8 |
| 23 | 2011 | 11789 | 6.2 | 88.0 |
| 24 | 2012 | 12105 | 6.3 | 94.3 |
| 25 | 2013 | 10857 | 5.7 | 100.0 |
| Total | | 191089 | 100.0 | |

The analysis of data on the literary output in Genetic Engineering has been done with parameters such as Relative Growth Rate (RGR) and Doubling Time (Dt).

It is seen from Table 2 that there is decreasing trend in RGR by year wise. It is noticed that there is a decreasing trend in the year wise RGR in the field of Genetic Engineering research output. The RGR in the year 1990 is 1.23 which has been gradually decreased to 0.06 in 2013 (Figure 2).

Similarly the Dt has shown an increasing trend. The Dt for the year 1990 was 0.56 and enhanced gradually to 11.46 in 2013 (Figure 3).

It was thought appropriate to calculate and analyse the RGR and Dt for Indian output on Genetic Engineering research. Accordingly the data has been analysed and presented in Table 3. It is found from Table 3 that the year wise calculation of RGR and Dt for Indian output has shown fluctuation trends throughout the study period. The RGR has been decreased from 1991 (1.79) to 1993 (0.47).

TABLE II RGR AND DT FOR GENETIC ENGINEERING RESEARCH OUTPUT BY YEAR-WISE

| S.No. | Year | Quantum of Output | Cumulative Total of Output | $W_1$ | $W_2$ | $1 - 2^{\overline{R}^{(aa^{-1}\ year^{-1})}}$ RGR | Dt(a) |
|---|---|---|---|---|---|---|---|
| 1 | 1989 | 534 | 534 | | 6.28 | | |
| 2 | 1990 | 1297 | 1831 | 6.28 | 7.51 | 1.23 | 0.56 |
| 3 | 1991 | 2480 | 4311 | 7.51 | 8.37 | 0.86 | 0.81 |
| 4 | 1992 | 3171 | 7482 | 8.37 | 8.92 | 0.55 | 1.26 |
| 5 | 1993 | 3854 | 11336 | 8.92 | 9.34 | 0.42 | 1.67 |
| 6 | 1994 | 4420 | 15756 | 9.34 | 9.66 | 0.32 | 2.13 |
| 7 | 1995 | 4916 | 20672 | 9.66 | 9.94 | 0.28 | 2.51 |
| 8 | 1996 | 5158 | 25830 | 9.94 | 10.16 | 0.22 | 3.16 |
| 9 | 1997 | 5668 | 31498 | 10.16 | 10.36 | 0.20 | 3.51 |
| 10 | 1998 | 6877 | 38375 | 10.36 | 10.56 | 0.20 | 3.55 |
| 11 | 1999 | 7574 | 45949 | 10.56 | 10.74 | 0.18 | 3.95 |
| 12 | 2000 | 8966 | 54915 | 10.74 | 10.91 | 0.17 | 3.99 |
| 13 | 2001 | 8889 | 63804 | 10.91 | 11.06 | 0.15 | 4.51 |
| 14 | 2002 | 9115 | 72919 | 11.06 | 11.20 | 0.14 | 5.05 |
| 15 | 2003 | 9535 | 82454 | 11.2 | 11.32 | 0.12 | 5.78 |
| 16 | 2004 | 9918 | 92372 | 11.32 | 11.43 | 0.11 | 6.10 |
| 17 | 2005 | 10185 | 102557 | 11.43 | 11.54 | 0.11 | 6.41 |
| 18 | 2006 | 9901 | 112458 | 11.54 | 11.63 | 0.09 | 7.67 |
| 19 | 2007 | 10339 | 122797 | 11.63 | 11.72 | 0.09 | 7.85 |
| 20 | 2008 | 10835 | 133632 | 11.72 | 11.80 | 0.08 | 8.37 |
| 21 | 2009 | 11050 | 144682 | 11.8 | 11.88 | 0.08 | 8.42 |
| 22 | 2010 | 11656 | 156338 | 11.88 | 11.96 | 0.08 | 8.69 |
| 23 | 2011 | 11789 | 168127 | 11.96 | 12.03 | 0.07 | 9.56 |
| 24 | 2012 | 12105 | 180232 | 12.03 | 12.10 | 0.07 | 9.62 |
| 25 | 2013 | 10857 | 191089 | 12.1 | 12.16 | 0.06 | 11.46 |

In 1994 it has been enhanced to 0.60, and since then there is fluctuation up to 2013 (0.11) (Figure 4). There was nil record in the year 1989.

The Dt also fluctuated from year after year. The Dt increased from 0.39 in 1991 to 1.47 in 1993 and it has gone down to 1.16 in 1994. Since then, there is fluctuation by year after year (Figure 5).

TABLE III RGR AND DT FOR GENETIC ENGINEERING RESEARCH OUT PUT IN INDIA

| S.No. | Year | Quantum of Output | Cumulative Total of Output | $W_1$ | $W_2$ | $1 - 2\dfrac{\overline{R}^{(aa^{-1}\ year^{-1})}}{RGR}$ | Dt(a) |
|---|---|---|---|---|---|---|---|
| 1 | 1989 | 0 | 0 | | | | |
| 2 | 1990 | 1 | 1 | | 0.00 | 0.00 | 0.00 |
| 3 | 1991 | 5 | 6 | 0 | 1.79 | 1.79 | 0.39 |
| 4 | 1992 | 4 | 10 | 1.79 | 2.30 | 0.51 | 1.35 |
| 5 | 1993 | 6 | 16 | 2.3 | 2.77 | 0.47 | 1.47 |
| 6 | 1994 | 13 | 29 | 2.77 | 3.37 | 0.60 | 1.16 |
| 7 | 1995 | 8 | 37 | 3.37 | 3.61 | 0.24 | 2.88 |
| 8 | 1996 | 4 | 41 | 3.61 | 3.71 | 0.10 | 6.69 |
| 9 | 1997 | 10 | 51 | 3.71 | 3.93 | 0.22 | 3.12 |
| 10 | 1998 | 13 | 64 | 3.93 | 4.16 | 0.23 | 3.03 |
| 11 | 1999 | 5 | 69 | 4.16 | 4.23 | 0.07 | 9.35 |
| 12 | 2000 | 11 | 80 | 4.23 | 4.38 | 0.15 | 4.56 |
| 13 | 2001 | 9 | 89 | 4.38 | 4.49 | 0.11 | 6.38 |
| 14 | 2002 | 22 | 111 | 4.49 | 4.71 | 0.22 | 3.16 |
| 15 | 2003 | 21 | 132 | 4.71 | 4.88 | 0.17 | 4.01 |
| 16 | 2004 | 9 | 141 | 4.88 | 4.95 | 0.07 | 10.08 |
| 17 | 2005 | 15 | 156 | 4.95 | 5.05 | 0.10 | 6.94 |
| 18 | 2006 | 13 | 169 | 5.05 | 5.13 | 0.08 | 8.67 |
| 19 | 2007 | 23 | 192 | 5.13 | 5.26 | 0.13 | 5.44 |
| 20 | 2008 | 27 | 219 | 5.26 | 5.39 | 0.13 | 5.37 |
| 21 | 2009 | 31 | 250 | 5.39 | 5.52 | 0.13 | 5.27 |
| 22 | 2010 | 32 | 282 | 5.52 | 5.64 | 0.12 | 5.68 |
| 23 | 2011 | 28 | 310 | 5.64 | 5.74 | 0.10 | 7.18 |
| 24 | 2012 | 30 | 340 | 5.74 | 5.83 | 0.09 | 7.79 |
| 25 | 2013 | 39 | 379 | 5.83 | 5.94 | 0.11 | 6.44 |

It is seen from Table 4 that there is decreasing trend in RGR by year wise. It is noticed that there is a decreasing trend in the year wise RGR in the field of Genetic Engineering research output. The RGR in the year 1990 is 1.34 which has been gradually decreased to 0.06 in 2013 (Figure 6).

Similarly the Dt has shown an increasing trend. The Dt for the year 1990 was 0.52 and enhanced gradually to 10.85 in 2013 (Figure 7).

TABLE IV RGR AND DT FOR JOURNAL ARTICLES IN GENETIC ENGINEERING RESEARCH

| S.No. | Year | Quantum of Output | Cumulative Total of Output | $W_1$ | $W_2$ | $1 - 2^{\overline{R}^{(aa^{-1}\ year^{-1})}}$ RGR | Dt(a) |
|---|---|---|---|---|---|---|---|
| 1 | 1989 | 401 | 401 | | 5.99 | | |
| 2 | 1990 | 1124 | 1525 | 5.99 | 7.33 | 1.34 | 0.52 |
| 3 | 1991 | 2302 | 3827 | 7.33 | 8.25 | 0.92 | 0.75 |
| 4 | 1992 | 2896 | 6723 | 8.25 | 8.81 | 0.56 | 1.23 |
| 5 | 1993 | 3492 | 10215 | 8.81 | 9.23 | 0.42 | 1.64 |
| 6 | 1994 | 3981 | 14196 | 9.23 | 9.56 | 0.33 | 2.10 |
| 7 | 1995 | 4435 | 18631 | 9.56 | 9.83 | 0.27 | 2.54 |
| 8 | 1996 | 4781 | 23412 | 9.83 | 10.06 | 0.23 | 3.00 |
| 9 | 1997 | 5192 | 28604 | 10.06 | 10.26 | 0.20 | 3.44 |
| 10 | 1998 | 6282 | 34886 | 10.26 | 10.46 | 0.20 | 3.47 |
| 11 | 1999 | 6796 | 41682 | 10.46 | 10.64 | 0.18 | 3.90 |
| 12 | 2000 | 7252 | 48934 | 10.64 | 10.80 | 0.16 | 4.38 |
| 13 | 2001 | 8132 | 57066 | 10.8 | 10.95 | 0.15 | 4.56 |
| 14 | 2002 | 8038 | 65104 | 10.95 | 11.08 | 0.13 | 5.18 |
| 15 | 2003 | 8275 | 73379 | 11.08 | 11.20 | 0.12 | 5.62 |
| 16 | 2004 | 7643 | 81022 | 11.2 | 11.30 | 0.10 | 6.76 |
| 17 | 2005 | 8001 | 89023 | 11.3 | 11.40 | 0.10 | 7.17 |
| 18 | 2006 | 7923 | 96946 | 11.4 | 11.48 | 0.08 | 8.46 |
| 19 | 2007 | 8564 | 105510 | 11.48 | 11.57 | 0.09 | 8.01 |
| 20 | 2008 | 9186 | 114696 | 11.57 | 11.65 | 0.08 | 8.66 |
| 21 | 2009 | 9440 | 124136 | 11.65 | 11.73 | 0.08 | 8.76 |
| 22 | 2010 | 10019 | 134155 | 11.73 | 11.81 | 0.08 | 9.03 |
| 23 | 2011 | 10296 | 144451 | 11.81 | 11.88 | 0.07 | 9.80 |
| 24 | 2012 | 10770 | 155221 | 11.88 | 11.95 | 0.07 | 9.54 |
| 25 | 2013 | 9808 | 165029 | 11.95 | 12.01 | 0.06 | 10.85 |

The year wise calculation of RGR and Dt for the total pages in Genetic Engineering research has been presented in the Table 5.  It is seen from the Table 5 that there is a decreasing trend in RGR by year after year.  It was 1.36 in the year 1990 and since then it is gradually decreasing and in 2013 it was 0.06 except few years. (Figure 8).

Similarly Dt also shows an increasing trend.  It was 0.51 in 1990 and increasing gradually to 11.44 for the year 2013 except few years. (Figure 9).

TABLE V RGR AND DT FOR TOTAL PAGES IN GENETIC ENGINEERING RESEARCH

| S.No. | Year | Quantum of Output | Cumulative Total of Output | $W_1$ | $W_2$ | $1 - 2^{\overline{R}^{(pp^{-1}\ year^{-1})}}$ RGR | Dt(p) |
|---|---|---|---|---|---|---|---|
| 1 | 1989 | 3830 | 3830 | | 8.25 | | |
| 2 | 1990 | 11028 | 14858 | 8.25 | 9.61 | 1.36 | 0.51 |
| 3 | 1991 | 19081 | 33939 | 9.61 | 10.43 | 0.82 | 0.84 |
| 4 | 1992 | 23458 | 57397 | 10.43 | 10.96 | 0.53 | 1.31 |
| 5 | 1993 | 31424 | 88821 | 10.96 | 11.39 | 0.43 | 1.60 |
| 6 | 1994 | 36066 | 124887 | 11.39 | 11.74 | 0.35 | 2.01 |
| 7 | 1995 | 41128 | 166015 | 11.74 | 12.02 | 0.28 | 2.48 |
| 8 | 1996 | 41619 | 207634 | 12.02 | 12.24 | 0.22 | 3.10 |
| 9 | 1997 | 44185 | 251819 | 12.24 | 12.44 | 0.20 | 3.53 |
| 10 | 1998 | 56608 | 308427 | 12.44 | 12.64 | 0.20 | 3.48 |
| 11 | 1999 | 62615 | 371042 | 12.64 | 12.82 | 0.18 | 3.76 |
| 12 | 2000 | 87987 | 459029 | 12.82 | 13.04 | 0.22 | 3.20 |
| 13 | 2001 | 75959 | 534988 | 13.04 | 13.19 | 0.15 | 4.62 |
| 14 | 2002 | 77224 | 612212 | 13.19 | 13.32 | 0.13 | 5.14 |
| 15 | 2003 | 82060 | 694272 | 13.32 | 13.45 | 0.13 | 5.31 |
| 16 | 2004 | 86630 | 780902 | 13.45 | 13.57 | 0.12 | 5.86 |
| 17 | 2005 | 87801 | 868703 | 13.57 | 13.67 | 0.10 | 6.62 |
| 18 | 2006 | 86700 | 955403 | 13.67 | 13.77 | 0.10 | 6.94 |
| 19 | 2007 | 90589 | 1045992 | 13.77 | 13.86 | 0.09 | 7.66 |
| 20 | 2008 | 97108 | 1143100 | 13.86 | 13.95 | 0.09 | 7.76 |
| 21 | 2009 | 108669 | 1251769 | 13.95 | 14.04 | 0.09 | 7.69 |
| 22 | 2010 | 97921 | 1349690 | 14.04 | 14.12 | 0.08 | 9.19 |
| 23 | 2011 | 99538 | 1449228 | 14.12 | 14.19 | 0.07 | 10.41 |
| 24 | 2012 | 102342 | 1551570 | 14.19 | 14.25 | 0.06 | 10.70 |
| 25 | 2013 | 88995 | 1640565 | 14.25 | 14.31 | 0.06 | 11.44 |

It was observed from the Table 6 that year wise calculation of RGR for journal article pages is in decreasing trend from 1.38 in the year 1990 to 0.06 in 2013, of course, there are fluctuations in the years 2000, 2008 and 2009. (Figure 10).

Similarly the Dt also shows fluctuation trends. The Dt for 1990 was 0.50 and increased up to 3.77 in the year 1999. In the year 2000 it decreased to 3.46 and 7.46 in 2008 and 7.35 in 2009 and since then it shows an increasing trend (Figure 11).

TABLE VI RGR AND DT FOR JOURNAL ARTICLES PAGES IN GENETIC ENGINEERING RESEARCH

| S.No. | Year | Quantum of Output | Cumulative Total of Output | $W_1$ | $W_2$ | $1 - 2^{\overline{R}(pp^{-1}\,year^{-1})}$ RGR | Dt(p) |
|---|---|---|---|---|---|---|---|
| 1 | 1989 | 3205 | 3205 | | 8.07 | | |
| 2 | 1990 | 9503 | 12708 | 8.07 | 9.45 | 1.38 | 0.50 |
| 3 | 1991 | 17919 | 30627 | 9.45 | 10.33 | 0.88 | 0.79 |
| 4 | 1992 | 21834 | 52461 | 10.33 | 10.87 | 0.54 | 1.29 |
| 5 | 1993 | 28936 | 81397 | 10.87 | 11.31 | 0.44 | 1.59 |
| 6 | 1994 | 32421 | 113818 | 11.31 | 11.64 | 0.33 | 2.09 |
| 7 | 1995 | 37107 | 150925 | 11.64 | 11.92 | 0.28 | 2.44 |
| 8 | 1996 | 38700 | 189625 | 11.92 | 12.15 | 0.23 | 2.98 |
| 9 | 1997 | 41957 | 231582 | 12.15 | 12.35 | 0.20 | 3.42 |
| 10 | 1998 | 53066 | 284648 | 12.35 | 12.56 | 0.21 | 3.32 |
| 11 | 1999 | 57829 | 342477 | 12.56 | 12.74 | 0.18 | 3.77 |
| 12 | 2000 | 74287 | 416764 | 12.74 | 12.94 | 0.20 | 3.46 |
| 13 | 2001 | 70687 | 487451 | 12.94 | 13.10 | 0.16 | 4.42 |
| 14 | 2002 | 70258 | 557709 | 13.1 | 13.23 | 0.13 | 5.27 |
| 15 | 2003 | 73481 | 631190 | 13.23 | 13.36 | 0.13 | 5.53 |
| 16 | 2004 | 69160 | 700350 | 13.36 | 13.46 | 0.10 | 6.98 |
| 17 | 2005 | 71996 | 772346 | 13.46 | 13.56 | 0.10 | 7.13 |
| 18 | 2006 | 72198 | 844544 | 13.56 | 13.65 | 0.09 | 8.01 |
| 19 | 2007 | 77673 | 922217 | 13.65 | 13.73 | 0.08 | 8.20 |
| 20 | 2008 | 85156 | 1007373 | 13.73 | 13.82 | 0.09 | 7.46 |
| 21 | 2009 | 96384 | 1103757 | 13.82 | 13.91 | 0.09 | 7.35 |
| 22 | 2010 | 86625 | 1190382 | 13.91 | 13.99 | 0.08 | 8.69 |
| 23 | 2011 | 88948 | 1279330 | 13.99 | 14.06 | 0.07 | 9.65 |
| 24 | 2012 | 93427 | 1372757 | 14.06 | 14.13 | 0.07 | 9.58 |
| 25 | 2013 | 82441 | 1455198 | 14.13 | 14.19 | 0.06 | 11.43 |

## XIII. CONCLUSION

It is noticed that there is a decreasing trend in the year wise RGR in the field of Genetic Engineering research output and Dt has shown an increasing trend. The Relative Growth Rate and Doubling Time for Indian output on Genetic Engineering shows the fluctuation trends throughout the study period. The Relative Growth Rate for the Journal articles output has shown decreasing trends and on the other hand, Doubling Time is in increasing trend. The Relative Growth Rate for the total pages and journal article pages in Genetic Engineering research is in decreasing trend whereas Doubling Time is in increasing trend except few years. It was found throughout the study period that, wherever the Relative Growth Rate is at higher rate, the Doubling Time is lower.

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