Research Article

Germination Study On *Vigna radiata* L. Seeds Using Tannery Effluent Treated with Coir Pith and Nava Rasa Karaisal

S Kalaibharathi[1], R Sowmya[2] and P Malliga[2]*

[1]Department of Life Sciences, Central University of Tamil Nadu, Thiruvarur, Tamil Nadu, India
[2]Department of Marine Biotechnology, Bharathidasan University, Tiruchirappalli, Tamil Nadu, India

Abstract
In this study, the effect on treated and untreated tannery effluent on seed germination of *Vigna radiata L.* using coir pith and Nava Rasa Karaisal (NRK) was investigated. The seed germination was studied at varying concs. (12.5, 25, 50, 75 and 100%) and at different time intervals (0, 24, 48, 72 and 96 hrs.). Similarly, the morphometric parameters like radicle length and hypocotyl length were also analysed for seedling growth. The obtained results indicate that combined treatment at 12.5% conc. and 96 hrs. showed effective seed germination when compared to all other treatments.

A-Water ctrl, B-TN ctrl, C-TN+CP, D-TN+NRK, E-NRK, F-TN+CP+NRK

Keywords: Tannery effluent, Coir pith, NRK, Seed germination, *Vigna radiata*.L, hypocotyl and radicle length

***Correspondence**
Author: P Malliga
Email: malliga.p@bdu.ac.in

Introduction

Although the industrial growth in India is solving the economic problem, but has affected the ecosystem to a very large extent due to the pollutants discharged from their operation. The tannery industry is one of the prime source of industrial pollution in Tamil Nadu, India. Notably, there are several contaminated sites located in Dindigul, Vellore and Erode districts in Tamil Nadu, where more than 60% of the Indian tanneries are located [1]. The discharge of industrial effluents also brings about chemical transformation in soil due to continuous discharge of polluted water [2]. At higher pollution levels root system is extremely lost and at maturity, plant yield is much reduced [3-5]. Delayed germination and earlier leaf senescence are the two most important parameter which correspond to the final yield loss at the end of the season [6, 7]. The mitotic process is severely affected by tannery effluents which in turn reduce seed germination in extensively cultivated pulse crops [8]. The coir pith is used as a major source for reducing the amount of phenolic compounds entering the water resources. It is also used as biosorbent since it possess outstanding adsorption capacity and are cost-effective, non-toxic and biocompatible [9]. Further, coir pith improves water infiltration and nutrient availability to crops [10]. Nava Rasa Karaisal is a concoction prepared by mixing five products of cow used in traditional Indian rituals along with other ingredients. It enriches the soil and plant and provides all the nutrients required for the growth of the plant. Nava Rasa Karaisal is also a microbial consortia used in treatment for seeds, seedlings or any planting material. It is effective in protecting young roots from fungus as well as from soil-borne and seed-borne diseases that commonly affect plants after the monsoon period.

Materials and Methods

Effluent Collection

The effluent was collected from a tannery industry near Sempattu, Tiruchirappalli, Tamil Nadu, India.

Lignocellulosic Material

Coir pith was collected from coir industries near Srirangam, Tiruchirappalli, TamilNadu, India.

NRK Preparation

NRK was prepared by mixing five products of cow along with the other ingredients. Water was taken in a barrel. To this water cow dung, cow urine, milk, curd and ghee were added. This was followed by addition of gram flour, banana and hand full of fertile soil. The preparation was placed in a shaded place for 30 days and stirred well twice a day (morning and evening) for fermentation to take place. The barrel was covered with a wire mesh or net to avoid contamination from other sources.

Seed Germination

The seeds of *Vigna radiata* L. (Mung bean) purchased from local seed center were chosen for the test. The study was carried out in 05 different concs. of test solution (viz., 12.5, 25, 50, 75 & 100%) using treated and untreated tannery effluent. The seed germination and the morphometric parameter studies were carried out in glass petridishes using single layer of Whatman No.1 filter paper (125 mm diameter). The seed germination percentage was observed in each test solution at 24, 48, 72 and 96 hrs intervals. The morphometric parameters like hypocotyl length and radical length were also monitored.
The germination percentage was calculated using the formula

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds}} \times 100$$

Statistical Analysis

The effects on each parameter obtained from the experiment were studied. The data were graphically represented as mean ± S.D. All the graphs have been prepared using Microsoft Excel 2007.

Results and Discussions

Seed Germination

The results obtained after the seed germination study revealed that the extent of seed germination depends on the conc. of the tannery effluent. On 0^{th} day, no germination was observed in all the concs. But after 24 hours, seed germination was observed in control and all the treatments (**Figure 1**). However, the germination percentage was less in tannery control which might be due to the presence of toxicity of various chemicals present in the collected effluent. But the percentage of seed germination was slightly higher in coir pith treatment when compared to untreated tannery. The increase in germination percentage can be because of the adherence of toxic chemicals on the coir pith which may inturn induce the seed germination. On the other hand, no seed germination was observed at 100% conc. of NRK due to high conc. of ingredients present in NRK. The induction of germination was also observed in combined treatment with coir pith and NRK. This could be of the fact that the coir pith adsorbs tannery particles and the bacterial flora in NRK may degrade the chemical substances present in tannery effluent which might have induced seed germination when compared to all other treatments. [11] Reported similar results in their study with treatment of tannery effluent using cyanobacterium *Lyngbya sp*. with coir pith. The application of the treated tannery effluent on seed germination of *Vigna radiata L.* seeds using coir pith also supported the present results [12]. The high osmotic pressure and anaerobic conditions affect various physiological and biochemical processes of seed germination and seedling growth of *Vigna radiata*.L [13]. The results analyzed in tomato plant reported that the germination percentage of seedling length, root and shoot lengths decreased with increase in effluent conc. of the germinated seeds when compared to control [25].

Better results of seed germination were observed at lower concs., (12.5% and 25%) in all treatments after 48 hrs and 72 hrs. The tannery control showed similar observation as in the case of 24 hrs. At 12.5% conc. of coir pith treatment, the percentage of seed germination was higher (**Figures 2-4**) when compared to other concs. Similarly, the treatment with NRK also resulted in better seed germination at lower concs., which may be due to the presence of various nutrients in the diluted effluent. No growth was observed in 100% conc. of NRK. However, germination percentage was increased in combined treatment. The evidence by [14] also reported that among all the concs., the germination percentage of marigold gradually decreased as the conc. increased from 25% to 100% of treated tannery effluent. The observed results were also in concurrence with the findings of [24] where the germination studies in mung bean showed that at 50% of effluent conc. the germination percentage was 50% and at 75% and 100% conc. the germination was prevented.

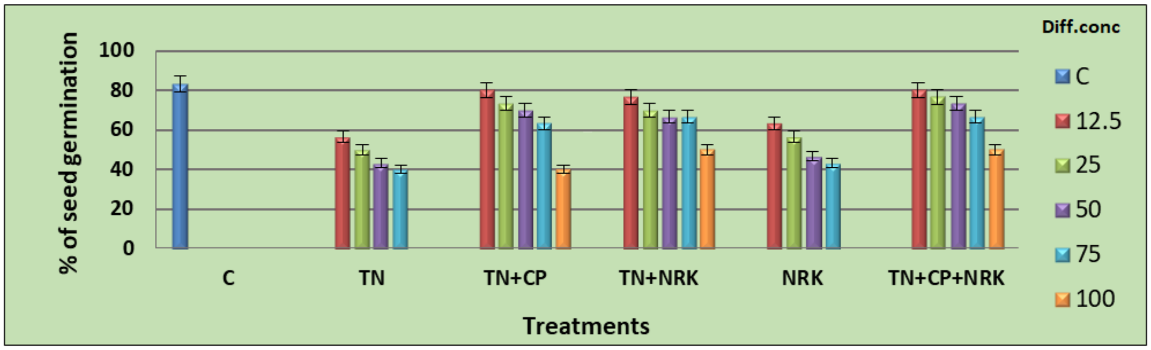

Figure 1 Effect of seed germination of *Vigna radiata.L* seeds at 24 hours
(C-Control; TN-Tannery effluent; CP-Coir Pith; NRK-Nava Rasa Karaisal)

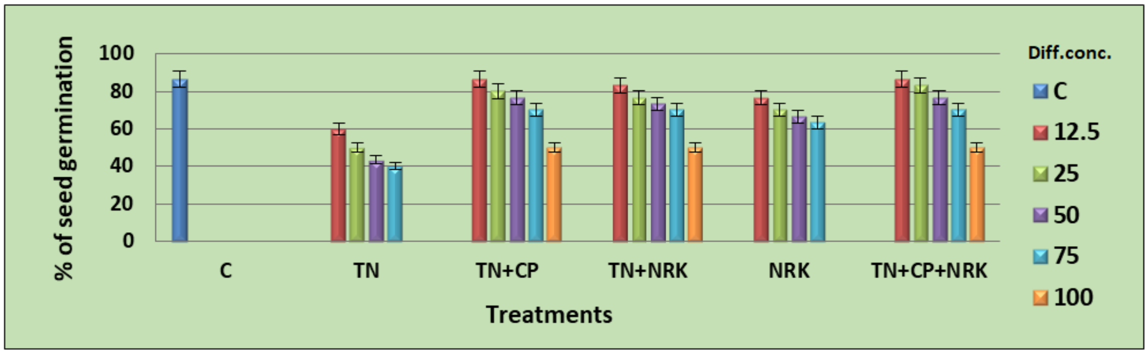

Figure 2 Effect of seed germination of *Vigna radiata.L* seeds at 48 hours
(C-Control; TN-Tannery effluent; CP-Coir Pith; NRK-Nava Rasa Karaisal)

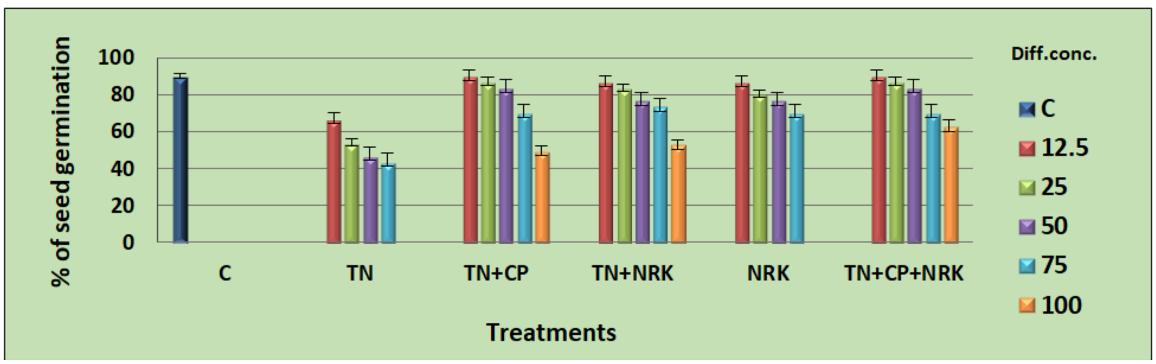

Figure 3 Effect of seed germination of *Vigna radiata.L* seeds at 72 hours
(C-Control; TN-Tannery effluent; CP-Coir Pith; NRK-Nava Rasa Karaisal)

At 96 hrs., the percentage of seed germination was maximum at lower concs. (12.5% and 25%) when compared to other concs. of all treatment (**Figures 5** and **6**). There was no drastic change observed in untreated tannery effluent. Nearly 100% seed germination was observed in water control. The germination percentage was higher in only coir pith treatment and only NRK treatment when compared to untreated effluent. However the higher conc. of only NRK (100%) treatment showed lethal effect. Similarly, the combined treatment showed maximum growth at all concs. The presence of inorganic nutrients in the diluted effluent at 25% conc. promoted the seed germination, growth and development in red gram plant [15]. Further, the results by [16] also stated that the green gram seed germination percentage was suppressed at 100% effluent conc. while in lower conc., especially, 20% effluent conc. is very effective and supported seed germination and seed growth. The evidence by [17] showed that the effect of untreated and treated tannery effluent waste water on various germination parameters of *Triticum aestivum* showed that untreated tannery waste water was highly toxic in nature and showed only 10% seed germination. But after treatment, the toxicity of tannery waste water was reduced significantly and showed more than 60% seed germination. [18] showed that the seedlings of groundnut were increased at 10% and 25% conc. of various industrial effluent treatment. Proof by [19] showed that the effluent to be toxic at higher conc. (above 25%) when compared to lower conc. where it stimulated the germination and growth of root and shoot lengths and therefore can be used as a liquid fertilizer for groundnut plant.

Figure 4 Effect of untreated and treated tannery effluent on seed germination of *Vigna radiata* L. (72 hrs.)
(A – Control, B – Tannery effluent, C – NRK, D – Tannery effluent + Coir Pith, E – Tannery effluent + NRK, F – Tannery effluent + Coir Pith +NRK)

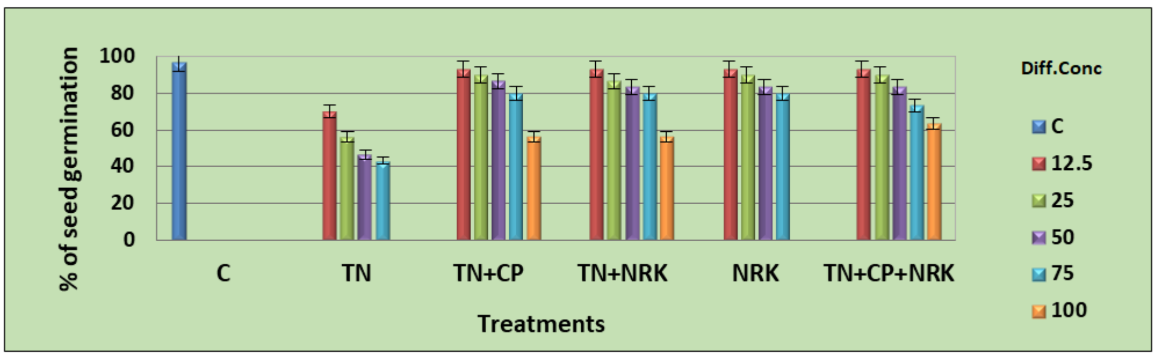

Figure 5 Effect of seed germination of *Vigna radiata*.L. seeds at 96 hours
(C-Control; TN-Tannery effluent; CP-Coir Pith; NRK-Nava Rasa Karaisal)

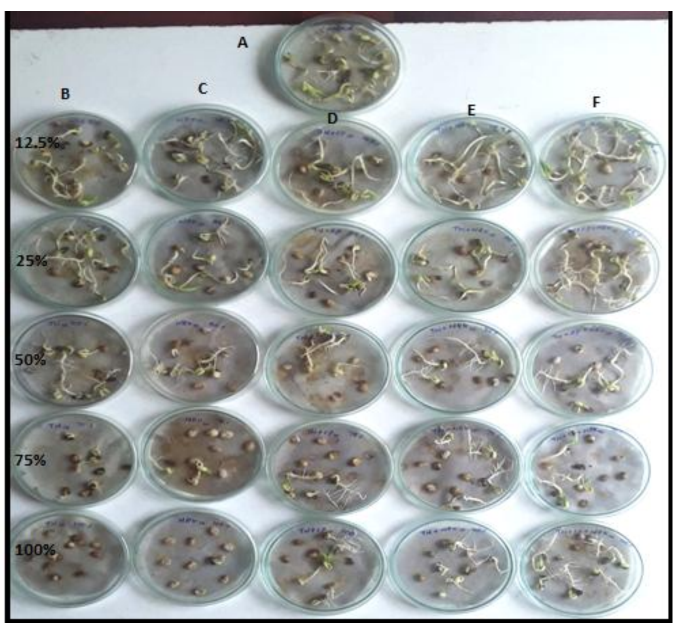

Plate 6 Effect of untreated and treated tannery effluent on seed germination of *Vigna radiata* L. (96 hrs.)
(A – Control, B – Tannery effluent, C – NRK, D – Tannery effluent + Coir Pith, E – Tannery effluent + NRK, F – Tannery effluent + Coir Pith +NRK)

Effect of Hypocotyl Length and Radicle Length

The effect on radicle length and hypocotyl length in untreated tannery effluent was minimum when compared to control (**Figures 7** and **8**) suggesting the presence of some toxic compounds which slowed down the process of germination and inturn affected the radicle and hypocotyl length. But the effect on treated tannery effluent with coir pith at lower conc. showed reduction in percentage of growth in radicle and hypocotyl length compared to water control. Similar observation was found in treatment with only NRK. On the contrary, 100% conc. of NRK showed inhibitory effect which may be due to the high conc. of the ingredients present in NRK. Approximately, similar results as water control were observed in combined treatment. These results also indicated that the treated tannery effluent has lesser deleterious effects when compared to untreated effluent on seeds of *Vigna radiata.L.* Results observed by [20] reported that at higher conc. of effluent, the root and shoot growth decreased which may be due to the reduced amount of oxygen available for germinating seeds and inturn might have restricted the energy supply resulting in retarded growth and development. Another supporting evidence states that the root which continuosly remains in direct effluent where the higher conc. could affect the cell multiplication or growth in case of *Tolypothrix tenus* [21]. Further reports by [22] analyzed that at higher conc. of sugar mill effluent treatment the root and shoot length were adversely affected and at lower conc. (10%) of effluent the root and shoot peroxidase activity were not affected when compared to control in green gram plant. The maximum root and shoot length was recorded in 25% tannery effluent when compared to control at 120 hrs. in the seedling growth study of *Crotalaria juncea Linn* [23].

The statistical analysis depicts the trend for percentage of seed germination and morphometric parameters at different concentrations and time intervals.

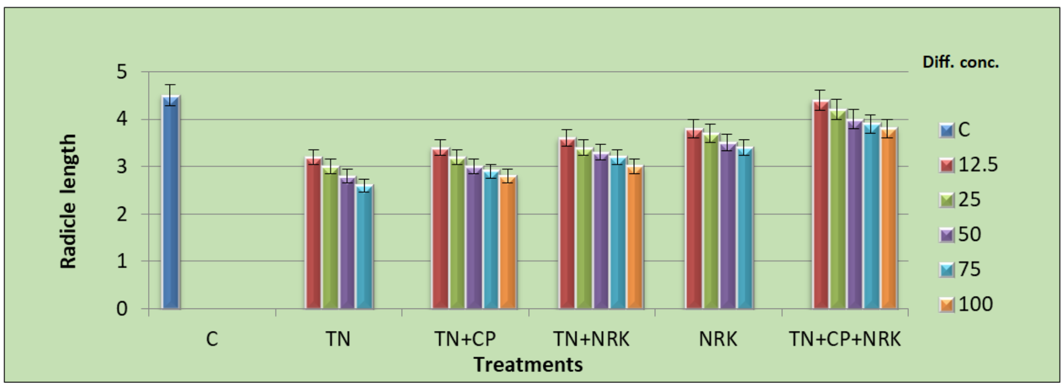

Figure 7 Effect of radicle length of *Vigna radiata* L. seeds in untreated and treated tannery effluent

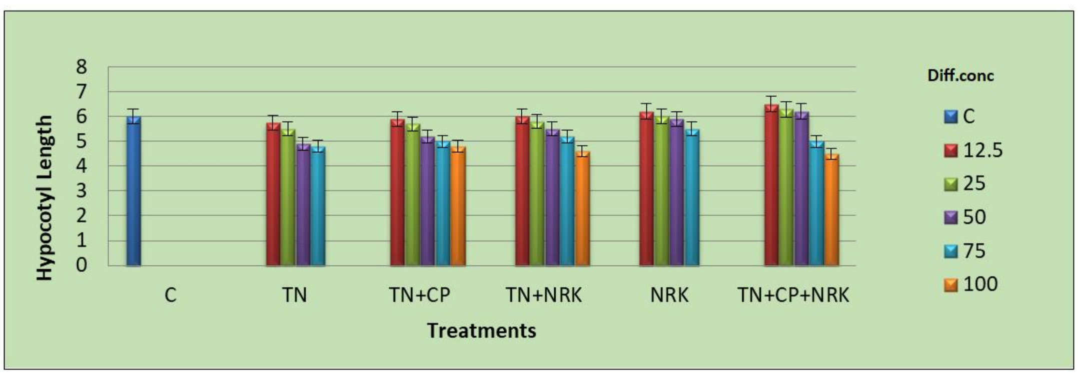

Figure 8 Effect of hypocotyl length of *Vigna radiata* L. seeds in untreated and treated tannery effluent

Conclusion

The adverse effect of tannery waste water is a challenging process for tannery industry. The result of the present study suggests a great potential of coir pith with Nava Rasa Karaisal (Combined treatment) to be used for the removal of toxicity from the tannery effluent**.** Even though no growth was observed at 100% conc. of NRK, upon dilution of the NRK medium maximum growth was observed with respect to seed germination, hypocotyl length and radicle length. The combination of coir pith and NRK improves nutrient availability to crops, helps in ammonification, nitrification and nitrogen fixation due to improved microbiological activity. Moreover, the microbial consortia in NRK enhances the seed germination, radicle and hypocotyl length further by enriching the soil and providing the required nutrients for plant growth. The outcome of this study revealed that through the application of biological methods the toxicity generated by discharge of effluents was reduced by decreasing the adverse effects and promoting the seed germination of *Vigna radiata L.* when compared to the chemical treatment methods which further pollute the soil and plant growth.

Acknowledgement

The author thanks the COIR BOARD for providing financial assistance for this project.

References

[1] K. Ramasamy and R. Naidu, ACIAR Publication, 2000, 88, p 13-21.
[2] M. Faisal and S. Husnain, Afr. J. Biotechnol., 2004, 3, 610-617.
[3] U. N Joshi, S. S. Rathore, S. K Arora, Indian. J. Environ. Prot., 1999, 19, 745-749.
[4] N.C Mondal , V.K. Saxena , S.V. Singh, Curr. Sci., 2005, 88, 1988-1994.
[5] M. Yasir , Water Soil Pollut., 2003, 3, 32-36.
[6] N.R. Bishoni, Agric. Ecosyst. Environ., 1993, 47, 47-57.
[7] R. Clemente, D.J. Walker, M.P Bernal , Environ. Pollut., 2005, 138, 46-58.
[8] M.M. Atlaf, F. Masood, Turkish Journal of Biology, 2008, 32, 1-8.
[9] A.C. Muksit and J.F. Konica, International Journal of Textile Science, 2016, 5(6), 132-140.
[10] A.J. McCarthy, M.J. Macdonald, A.J. Paterson and B.J. Paul, GenlMicrobiol., 1987, 130, 1023-1030.
[11] N.Vadivudai, R.B. Bela, K.Lakshmi and P.Malliga, Indian Journal of Research, 2015, Vol.4, Issue: 2, 9-12.
[12] K. Lakshmi and P. Malliga, International Journal of Scientific Research, 2014, Vol.3, Issue:9, 414-416.
[13] N. Ahsan, S.H. Lee, D.G. Lee, H. Lee, J.D. Bahk and B.H. Lee, Comptes Rendus Biologies., 2007, 330, 735-746.
[14] G. Balasubramanian and P. Dhevagi, Asian J. Environ. Sci., 2016, 11(2), 164-170.
[15] S. Vibha, P. Pramod, N. Gopi and C. Rajasekran, International Journal of Innovative Science, Engineering & Technology, 2015, 2 (5), 318-323.
[16] Sumangala R., N. K. Pallam, R. Harindar and M. Inayat, European Journal of Biotechnology and Bioscience, 2014, 2 (3), 1-4.
[17] S. Smiley and M. Piyush., International Journal of Basic and Applied Sciences, 2013, 2 (3), 88-93.
[18] P. Sunderamoorthy, J. Kunchithapata, P. Thamizhiniyan and S. Benkateslu., J. Ecobiol., 2007, 13 (1), 3-8.
[19] A. Selvi , E. Anjugam, R. Devi, B. Madhan, S. Kannappan and B. C. Chandrasekaran., Asian j. Exp. Biol. Sci., 2012, 3 (1), 34-41.
[20] A. Kumar, B. S. Bisht and V. D. Joshi, J. Bio. Environ. Sci., 2010, 4 (12) , 97-108.
[21] V. Kannan , M. Vijayashanthi, R. Ramesh and A. P. Arumugam, world rural observations, 2012, 2 (4), 56-59.
[22] L. Baskaran, P. Sundaramoorthy, A. L. A. Chidambaram and K. Sankar Ganesh, Botany Research International., 2009, 2 (2), 107-114.
[23] M. Mythili and Mujeera Fathima, International Journal of Development Research, 2018, Vol. 08, Issue:01, pp.18475-18478.
[24] S. Vineeta Kumari, H. 1Izharuh, Y. M. Ashutosh, K. S. Vinay, A. Zulfiqar and R. Abhay., International Journal of Latest Research in Science and Technology, 2014, 3 (4), 165- 167.
[25] Mandakini Magre and Yashwant Khillare. International Journal of Advanced Research, 2016, Volume 4, Issue 7, 617-623.

Publication History

Received	09th Mar 2019
Revised	20th Apr 2019
Accepted	05th May 2019
Online	30th May 2019