Integrated Application Of Groundnut Haulm Compost With Different Biofertilizers Enhancing Soil Health And Microbial Population

[1]Mathivanan J and [2]Jayaraman P
[1]Research Scholar, Department of Botany, Research and Development Centre, Bharathiyar University, Coimbatore.
[2]Assistant Professor, Department of Botany, Govt. Arts College, Nandhanam, Chennai.

ABSTRACT: ***The field experiment to study the "Comparative efficiency of groundnut haulm compost and biofertilizers on soil physico chemical properties and microbial population of soil was conducted in Arunagirimangalam village, Thiruvanamalai Disrtict. Treatments were groundnut haulm compost single, combined application of different Biofertilizers FYM, Azotobacter, Azospirillum, Phosphobacteria, Rhizobium and control. The obtained results on physiochemical properties of soil and microbial properties revealed the response of groundnut haulm compost, groundnut haulm compost mixed with different biofertilizers a treatment was better compared to control in 15, 30, 60 and 90 DAS observation. Physical properties such as pH and EC increased after groundnut haulm compost mixed with Rhizobium application. Bulk density was reduced after treatment indicating increased soil organic carbon, NPK content, macronutrients (Fe (Iron), Mn (Manganese), Cu (Copper) and Zn (Zinc)) and microbial population. The minimum physiochemical and microbial properties were observed in control. In general, the groundnut haulm compost and mixed with Rhizobium treatment a good performance could be achieved in better growth of groundnut.***

Keywords: Biofertilizers, Helianthus annuus, Groundnut, Micronutrients, Rhizobium, Microbial population.

I. INTRODUCTION

Groundnut as well as peanut (*Arachis hypogaea* L.) is an important oilseed crop belonging to the family Leguminosae. It is mainly grown as oilseed, cash crop and animal feed and fourth-largest oilseed crop into the humanity. The characteristic of the Leguminosae plant is able to form nodules. Nodule is a small bulge in the root portion formed by nitrogen fixing bacterial infection mutuality symbiosis with legume plants. Nodules capable of N fixation from the air, so that the soil is able to meet most of the needs of the fixation of nitrogen from the results[1]. The low productivity in India is mainly due to poor soil fertility, deterioration of soil physical properties, monocropping, irregular rainfall and frequent occurrence of dry spells, imbalanced use of organic and inorganic fertilizers for plant nutrients. On one hand, the production and use of chemicals till different harmful effects on the agricultural ecosystem such as degradation of the soil, loss of crop genetic diversity, reduction in loam microbial diversity, pollution of ground water resources, and pollution of the atmosphere[2].

The haulm compost application can improve net production and save cultivable lands from chemical fertilizer and pollution and manure a good environment[3]. Now days, the application of organic fertilizers, such as manure, crop residues and compost, has been practiced for a long time in order to increase the amount of microorganisms present in the soil, soil fertility and agricultural productivity[4]. According to Adeniyan *et al*., (2011) investigated the effects of different organic manures and NPK fertilizer for improvement of soil chemical properties and maize traits in two different soil and concluded that application of organic manures enhanced soil organic carbon, total N, available P and exchangeable K better than NPK fertilizer in both soil, however the application of chemical fertilizer achieved the highest amount of dry mater and yield of maize. It was also noticed that the application of organic manure and FYM improved the soil physico - chemical properties such as soil pH, soil moisture availability, organic carbon and nutrient status of the soil in twenty five years old apple orchards[6]. Keeping this in view, a field experiment was conducted to study the effect of groundnut haulm compost single, groundnut haulm compost combined application of different Biofertilizers FYM, *Azotobacter*, *Azospirillum*, *Phosphobacteria*, *Rhizobium* on physico-chemical properties and microbial population of soil.

II. MATERIALS AND METHODS

The experiment was laid out in Randomized Block Design with three replications and eleven different treatments. The field was properly leveled and each plot (2.5 × 2.5 m size) was earmarked with raised bunds all around to minimize the movement of nutrient. In each treatment, T1-Control, T2-1 tonne ha-1 haulm compost, T3-1 tonne ha-1 haulm compost + FYM, T4-2 tonnes ha-1 haulm compost, T5-2 tonnes ha-1 haulm compost + *Azotobacter*, T6-3 tonnes ha-1 haulm compost, T7-3 tonnes ha-1 haulm compost + *Azospirillum*, T8-4 tonnes ha-1 haulm compost, T9-4 tonnes ha-1 haulm compost + *Phosphobacteria*, T10-5 tonnes ha-1 haulm compost, T11-5 tonnes ha-1 haulm compost + *Rhizobium* the soil samples were collected at after harvesting groundnut (*Arachis hypogaea* L.) and pH, organic carbon, nitrogen, phosphorus and potassium were estimated and their microflora like bacteria were enumerated.

The soil samples were suspended in distilled water in 1:2 ratio (w/v) and the pH was determined using Elico digital pH meter. The organic carbon was determined by the wet digestion method[7]. The available nitrogen was estimated by alkaline permanganate method[8]. The available phosphorous and potassium were estimated by colorimetric method[9] and Flame photometer[10], respectively.

The microbial population in the soil was enumerated by serial dilution and plating the appropriate dilutions in different agar media. Aliquots of 1 ml of appropriate dilutions were plated in the nutrient agar[11]. The plates were incubated at room temperature (30±2ºC) for 3 days. The colonies were counted and expressed as population per gram on oven dry basis.

2.1 Statistical analysis

A one-way analysis of variance (ANOVA) was performed to determine the effect of groundnut haulm compost combined with different fertilizer treatments on soil microbial population and physicochemical properties of soil. The level of significance referred in the results is $p< 0.05$.

III. RESULTS AND DISCUSSION

The observation on soil pH as influenced by different combinations of groundnut haulm compost and different biofertilizers was showed in Fig 1. The results revealed that the initial (control) soil pH 6.8 which increased significantly with the addition of groundnut haulm compost mixed with different biofertilizers FYM, *Azotobacter*, *Azospirillum*, *Phosphobacteria* and *Rhizobium*. A slight increase in soil pH was observed in treatment having combined application of groundnut haulm compost mixed with *Rhizobium* (7.3) as compared to treatment without inoculation control. The enhancement of pH value under the treatment of organic manures might be due to release of different salts which acts buffering agent to enhance the soil pH towards neutrality accordance with[12]. It has been observed in a soil sample study that the highest microbial population was observed in soil sample with the range of pH=7–7.4 and it starts decrease more than 8 or in acidic pH[13]. Low pH value for FYM is very valuable for calcareous soils[14].

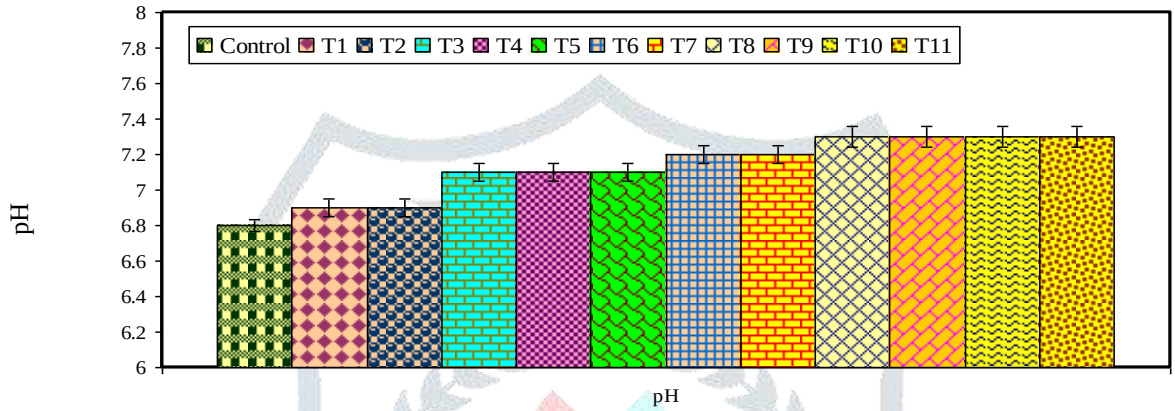

Figure.1 Effect of groundnut haulm compost and different biofertilizers on pH of soil.

Soil organic carbon content was significantly impact by haulm compost mixed with different biofertilizers FYM, *Azotobacter*, *Azospirillum*, *Phosphobacteria* and *Rhizobium* depicted in Figure 2. With respect to the soil organic carbon ranged from 0.25 to 0.37 compare with control. However, the highest significance was observed in haulm compost mixed with *Rhizobium* alone (T11) (0.0.37) followed by another haulm compost single and mixed with different biofertilizers, whereas the lowest was observed in control (0.22). Soil organic matter was decreased by chemical fertilizer application but was increased with all types of organic manure application[15]. An other [16] also found that significant increase in organic carbon due to application of FYM may be attributing to excessive microbial activity of soil. Further more[17] found that the four years application of FYM at the rate of 10 and 15 kg/ha had improved total N of the soil, organic carbon, available P, K and Mg when compared to the plants lacking FYM application in the 0 – 20 cm soil depth.

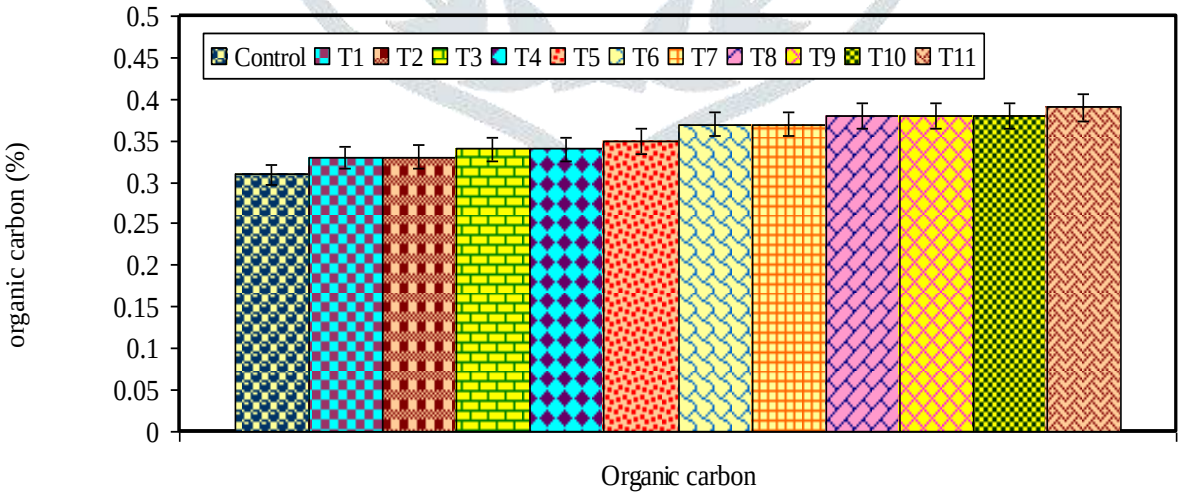

Figure.2 Effect of groundnut haulm compost and different biofertilizers on physical and chemical properties of soil after crop harvest.

Results of post harvest analysis of macronutrients (Nitrogen, Phosphorus and Potassium) of soil are presented in Fig 3. There was significant increase in the soil available Nitrogen, Phosphorus and Potassium in the groundnut haulm compost mixed with different biofertilizers FYM, *Azotobacter*, *Azospirillum*, *Phosphobacteria* and *Rhizobium* inoculated plots more than the control. The available macronutrients were higher in the haulm compost mixed with *Rhizobium* at after harvesting grondnut, respectively. The enhanced availability of soil phosphorus due to *phosphobacteria* inoculation was observed by[18]. According to [19],the inoculation of organic fertilizer

increased the N content in soil. Considerable increase was observed in nitrogen up to 30 kg/ha in case of safflower seed treatment with *Azotobacter* and *Azospirillum*[20]. [21]also discovered that the higher available P content was recorded in integrated nutrient management as compared to control.

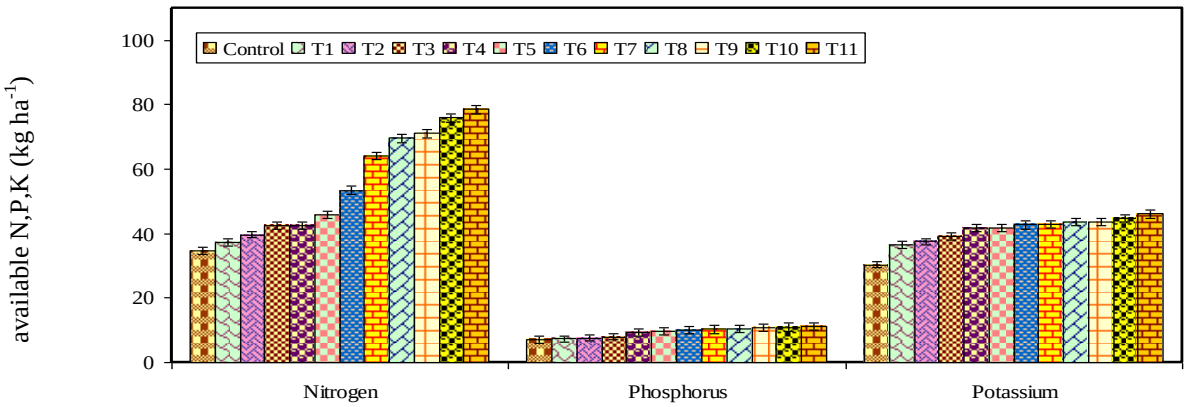

Figure.3 Effect of groundnut haulm compost and different biofertilizers on macronutrients of soil after crop harvest.

Significant improvement was observed in soil micronutrients due to applicationn of groundnut haulm compost mixed with different FYM, *Azotobacter*, *Azospirillum*, *Phosphobacteria* and *Rhizobium* Figure 4. The availability of soil Fe, Mn and Zn in the groundnut harvested soil was increased due to combined application of haulm compost mixed with *Rhizobium*, at the same time recommended amount of haulm compost mixed with FYM, *Azotobacter* which recorded maximum available Fe, Mn and Zn followed by *Azospirillum*, *Phosphobacteria* respectively. These results support those of previous studies there was positive and significant correlation among the phosphorus, iron, zinc and chlorophyll content. In other treatments significantly were increased the chlorophyll content, although this effect was not statistically significant[22]. Furthermore, [23]also suggested that the percentage increase of micronutrients (Fe and Zn) in the soil because of cyanobacteria inoculation. The recent finding[24] reported that the application of the cyanobacteria increases the zinc and iron concentration of the soil.

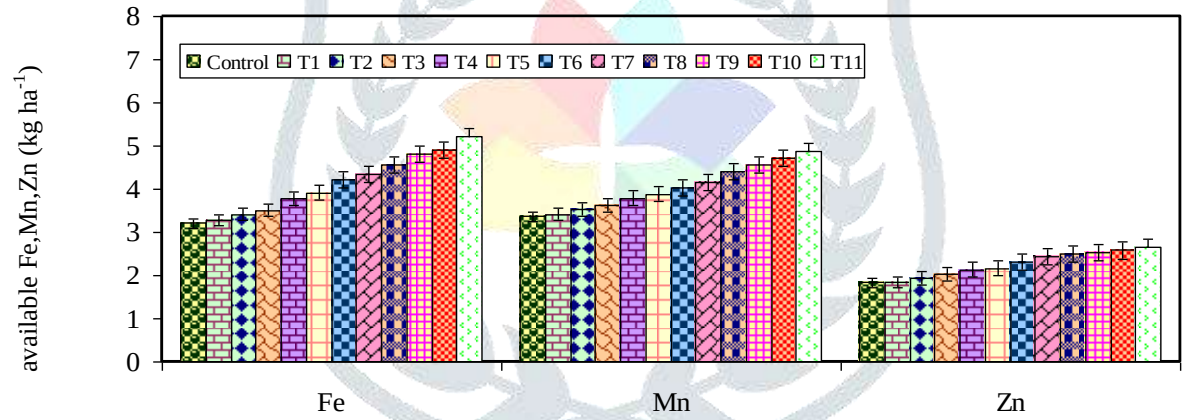

Figure.4 Effect of groundnut haulm compost and different biofertilizers on micronutrients of soil after crop harvest.

Figure. 5 represented the effects of groundnut haulm compost mixed with different biofertilizers FYM, *Azotobacter*, *Azospirillum*, *Phosphobacteria* and *Rhizobium* inoculation on the soil microorganisms was significant increase at after groundnut harvested soil. The total count of soil microorganisms was found to be maximum in application of haulm compost along with *Rhizobium*, which was statistically significantly higher than that in the control and other organic fertilizer treatments. This clearly revealed that organic material significantly increases the bacterial population soil microbial biomass has been used as an index of soil fertility which depends on nutrient fluxes[25]. [26]have also demonstrated that animal compost increased bacteria and fungi diversity by increase the carbon pool of the soil, thus improving the living environment for indigenous microbial populations. Furthermore, a positive effect of organic fertilizers on the microbial biomass, nitrogen and the carbon content in the soil was also observed by[27].

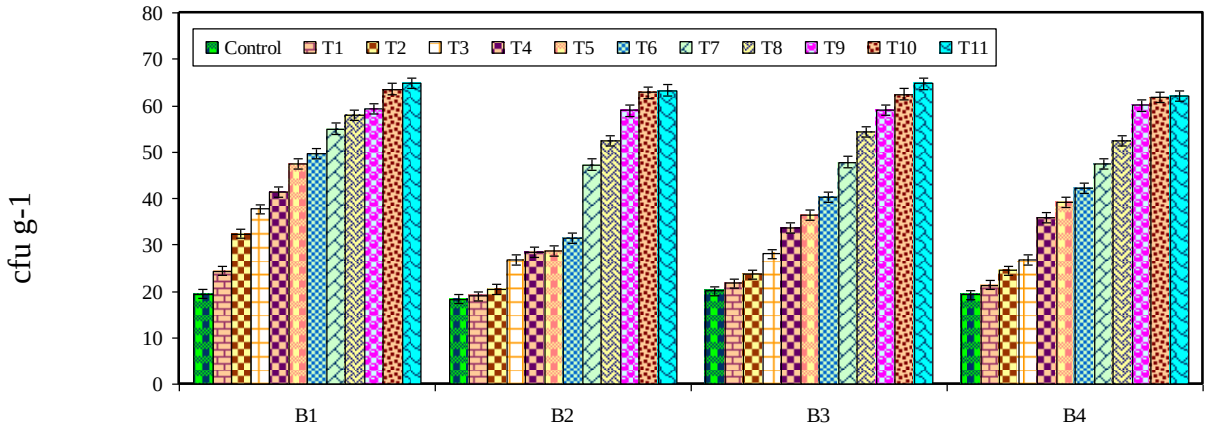

Fig.5 Effect of groundnut haulm compost and different biofertilizers on Bacterial population of soil after crop harvest.

IV. CONCLUSIONS

It is concluded that the application of groundnut haulm compost as a substitute to different bio-fertilizer play a significant role in enhancing the soil fertility in terms of macronutrients, micronutrients and microbial populaion. Microbial activity of soil was measured in terms of dehydrogenase activity. It was observed that presence of organic and biofertilizers helps in soil helped to improve soil biological properties thereby increasing the availability of nutrients in soil.

REFERENCES

[1] Islami, T and Utomo W. H. 1995. Relationships Soil, Water and Plant. IKIP Semarang Press. Semarang. [Indonesian].

[2] Chaudhry, A. N. Jilani, G. Khan, M. A. Iqbal, T. 2009. Improved processing of poultry litter to reduce nitrate leaching and enhance its fertilizer quality. Asian J Chem 21: 4997–5003.

[3] Indira, P. Lenin M and Ravi Mycin T. 2010. Efficacy of groundnut haulm compost on the growth and yield of blackgram (*Vigna mungo* L.) var. Vamban 1. Curr. Bot.1(1):01-03.

[4] Mariangela, D. Francesco, M. 2010. Long-term effects of organic amendments on soil fertility. A review. Agron. Sustain. Dev., 30(2010): 401-422.

[5] Adeniyan *et al*., (2011)

[6] Verma, M. L. Singh, C and Bhardwaj, S.P. 2009. Effects of biofertilizers on soil moisture, nutrient status and fruit productivity under organic cultivation of apple in Himachal Pradesh. Indian J. Soil Cons. 37(3): 201-205.

[7] Walkley, A and Black, I. A. 1934. An examination of Degtijareff method for determining the organic matter and proposed modification of the chromic acid titration method. Soil Science, 37 : 28-29.

[8] Subbiah, B.V and Asija, C.L. 1956. A rapid procedure for method for the estimation of available nitrogen in soils. Current Science, 25 : 259-260.

[9] Olsen, S.R. Cole, C.V. Watanabe, F. S and Dean, L.A. 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. U.S. Dept. Agrl.Circ. 939, Washington, D.C, p.24.

[10] Stanford, S and English, L. 1949. Use of flame photometer in rapid soil tests for K and Ca. Agronomy Journal, 41 : 446-447.

[11] Rangaswami, G. 1966. Agricultural Microbiology, Asia publishing house, London, p.413.

[12] Grewal, J. S. Sharma, R. C. Sud, K. C. 1981. Effect of continuous application of PK-fertilizers and farmyard manure on potato yield and some soil properties. Note. J. Ind. Soci. Soil Sci.,

[13] Mazinani1, Z. Aminafshar, M. Ahmad, Chamani, M. 2012. Effect of Azotobacter population on physico–chemical characteristics of somesoil samples in Iran. Als. Biol. Res.,3:3120-3125. ISSN 0976-1233.

[14] Karami, A. Homaeea, M. Afzalinia, S. Ruhipour, H. Basirat, S. 2012. Organic resource management: Impacts on soil aggregate stability and other soil physico-chemical properties. Agri. Ecosyst. Environ.148, 22– 28.

[15] Wells, A.T. Chan, K.Y and Cornish, P.S. 2000. Comparison of conventional and alternative vegetable farming system on the properties of a yellow earth in New South Wales. Agric. Eco. Environ., 80 (1/2): 962-966.

[16] Zhao, H. L. He, Y. H. Zhou, R. L. Su, Y. Z. Li, Y. Q. 2009. Drake S. Effects of desertification on soil organic C and N content in sandy farmland and grassland of Inner Mongolia. Catena, 77(3):187-191.

[17] Alemu and Bayu, W. 2005. Effects of farm yard manure and combined N and P fertilizers on Sorghum and soil characteristics in Northen Ethiopia. J. Sust. Agri., 26(2): 23 - 41. DOI: 10.1300/J064v26n02_04.

[18] Sundaravadivel, K. Chitdeswari, T. Subramanian, S and Krishnadoss, D. 1999. Cost effective phosphorus practices for rainfed cotton in vertisols. Madras Agricultual Journal, 86 (7-9) : 384-388.

[19] Naseri, R. Mirzaei, A. 2010. Response of yield and yield components of safflower (*Carthamus tinctorius* L.) to seed inoculation with *Azotobacter* and *Azospirillum* and different nitrogen levels under dry land conditions. American-eurasian j agric & Eniviron sci. 9:445-449. ISSN1818-6769.

[20] Wu, S.C. Cao, Z.H. Li, Z.G. Cheung, M.K.C and Wong, W.H. 2005. Effects of biofertilizer containing N fixer, P and K solubilizers and AM fungi on maize growth: a greenhouse trial. Geoderma 125:155-166.

[21] Thakur, S. B. Ghimire, S. K. Shrestha, S. M. Chaudhary, N. K. Mishra, B. Variability in groundnut genotypes for tolerance to drought. Nepal J. Sci. Tech., 2013;14(1):41–50.

[22] Zarrouk, O. Gogorcena, Y. Gomez-Aparisi, J. Betran, J. A and Moreno, M. A. 2005. Influence of Almond peach hybrids root stocks on flower and leaf mineral concentration, yield, vigourof two peach cultivars. Scientia Horticulturar 106 (4): 502-514.

[23] Cordell, D. Drangert J.O and White, S. 2009. The story of phosphorus: Global food security and food for thought. Global Environmental Change. 19: 292-305.

[24] Mulat Assmamaw. 2013. The potential of cyanobacteria biofertilizer for kale production in soils of Ziway and Yirgalem, Ethiopia. MSc. Thesis submitted to Graduate study of Hawassa University, Hawassa, Ethiopia. 88pp.

[25] Krishnakumar, S., Saravanan, A., Natarajan, S. K., Veerabadran, V. and Mani, S. 2005. Microbial population and enzymatic activity as influenced by organic farming. Res. J. Agri. Biol. Sciences. 1(1):85-88.

[26] Helgason, B. Walley, F. Germida, J. 2010. No-till soil management increases microbial biomass and alters community profiles in soil aggregates. Appl. Soil. Ecol., 46: 390–397.

[27] Cerny, J. Balík, J. Kulhánek, M. Nedvěd, V. 2008. The changes in microbial biomass C and N in long-term field experiments. Plant, Soil and Environment, 54: 212–218.