BIBLIOGRAPHY

Abou El-Magd, M. M., & Hoda, M. A. (2005). Relationships, growth, yield of broccoli with increasing N, P or K ratio in a mixture of NPK fertilizers (*Brassico oleracea* var italica plenck). ***Annals of Agriculture Science, Moshtohor***. *43*(2), 791-805.

Abou El-Magd, M. M., El-Bassiony, A. M., & Fawzy, Z. F. (2006). Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. ***Journal of Applied Sciences Research***, *2*(10), 791-798.

Adak, M. S., & Kibritci, M. (2016). Effect of nitrogen and phosphorus levels on nodulation and yield components in faba bean (*Vicia faba* L.). ***Legume Research***, *39*(6), 991-994.

Aira, M., Monroy, F., & Domínguez, J. (2006). *Eisenia fetida* (*Oligochaeta, Lumbricidae*) activates fungal growth, triggering cellulose decomposition during vermicomposting. ***Microbial Ecology***, *52*(4), 738-747.

Akbar, S. (2011). *Andrographis paniculata*: a review of pharmacological activities and clinical effects. ***Alternative Medicine Review***, *16*(1), 66-77.

Akpor, O. B., Okoh, A. I., & Babalola, G. O. (2006). Culturable microbial population dynamics during decomposition of *Theobroma cacao* leaf litters in a tropical soil setting. ***Journal of Biological Sciences,*** *6* (4), 768-774.

Ali, B., Hayat, S., Aiman Hasan, S., & Ahmad, A. (2008).A comparative effect of IAA and 4-Cl-IAA on growth, nodulation and nitrogen fixation in *Vigna radiata* (L.)Wilczek. ***Acta Physiologiae Plantarum***, *30*(1), 35-41.

Ali, S., & Kashem, M. A. (2018).Effect of vermicompost on the growth and yield of cabbage. ***Journal of Agricultural Engineering and Food Technology***, *5*(1), 45-49.

Alkooranee, J. T., Al-khshemawee, H. H., Al-badri, M. A. K., Al-srai, M. S., & Daweri, H. H. (2020). Antifungal activity and GC-MS detection of leaves and roots parts of *Chenopodium album* extract against some phytopathogenic fungi. ***Indian Journal of Agricultural Research***, *54*(1), 117-121.

Al-Tawarah, B., Alasasfa, M. A., & Mahadeen, A. Y. (2024). Efficacy of compost and vermicompost on growth, yield and nutrient content of common beans crop (*Phaseolus vulgaris* L.). ***Journal of Ecological Engineering***, *25*(2), 215- 226.

Ansari, A. A., & Kumar, S. (2010). Effect of vermiwash and vermicompost on soil parameters and productivity of okra (*Abelmoschus esculentus*) in Guyana. ***Current Advances in Agricultural Sciences***, *2*(1), 1-4.

Appleby, C. A., & Bergersen, F. J. (1980), Preparation and experimental use of leghaemoglobin. In: ***Methods for Evaluating Biological Nitrogen Fixation*** (Eds. Bergersen, F.J), John Wiley and Sons, Chichester, 315-336.

Arancon, N. Q., & Edwards, C. A. (2005).Effects of vermicomposts on plant growth. ***International symposium workshop on vermitechnology*** for Developing Countries (ISWVT 2005), November 16-18, Philippines, 16-18.

Araújo, A. S. F., Monteiro, R. T. R., & Carvalho, E. M. S. (2007).Effect of composted textile sludge on growth, nodulation and nitrogen fixation of soybean and cowpea. ***Bioresource Technology***, *98*(5), 1028-1032.

Arnon, D. E. (1949). Copper enzymes in isolated chloroplast. Polyphenoloxidase in *Beta vulgaris*. ***Plant Physiology***, *24*(1), 1-15.

Arrijani, A., & Setyawati, I. (2023). The Effect of coco peat addition in plant media on the quality and quantity of papaya seeds (*Carica papaya* L. var. calina). ***Advances in Tropical Biodiversity and Environmental Sciences***, *7*(2), 80-86.

Asami, D. K., Hong, Y. J., Barrett, D. M., & Mitchell, A. E. (2003).Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried marionberry, strawberry and corn grown using conventional, organic and sustainable agricultural practices. ***Journal of Agricultural and Food Chemistry***, *51*(5), 1237-1241.

Ashwini, K. M., & Sridhar, K. R. (2006).Evaluation of pill millipede (*Arthrosphaera magna*) compost on plant growth and dry matter yield. ***Journal of Environmental Agricultural and Food Chemistry***, *5*(2), 1323-1329.

Aydi, S., Sassi Aydi, S., Rahmani, R., Bouaziz, F., Souchard, J. P., Merah, O., & Abdelly, C. (2023). Date-palm compost as soilless substrate improves plant growth, photosynthesis, yield and phytochemical quality of greenhouse melon (*Cucumis melo* L.). ***Agronomy***, *13*(1), 1-18.

Azarpoor, E., Moradi, M., & Bozorg, H. R. (2012).Effect of vermicompost application and seed inoculation with biological nitrogen fertilizer under different plant densities in soybean (*Glycin max* L. cultivar, Williams). ***African Journal of Agricultural Research***, *7*(10), 1534-1541.

Babaeian, M., Piri, I., Tavassoli, A., Esmaeilian, Y., & Gholami, H. (2011).Effect of water stress and micronutrients (Fe, Zn and Mn) on chlorophyll fluorescence, leaf chlorophyll content and sunflower nutrient uptake in sistan region.***African Journal of Agricultural Research***, *6*(15), 3526-3531.

Badar, R., & Qureshi, S. A. (2014). Composted rice husk improves the growth and biochemical parameters of sunflower plants. ***Journal of Botany***, *2014*(1), 1-6.

Baharuddin, A. S., Kazunori, N., Abd-Aziz, S., Tabatabaei, M., Rahman, N. A. A., Ali Hassan, M., Wakisaka, M., Sakal, K., & Shirai, Y. (2009). Characteristics and microbial succession in co-composting of oil palm empty fruit bunch and partially treated palm oil mill effluent. ***The Open Biotechnology Journal***, *3*(1), 87-95.

Baharuddin, A. S., Rahman, N. A. A., Shan, U. K., Hassan, M. A., Wakisaka, M., & Shirai, Y. (2011). Evaluation of pressed shredded empty fruit bunch (EFB)-palm oil mill effluent (POME) anaerobic sludge based compost using Fourier transform infrared (FTIR) and nuclear magnetic resonance (NMR) analysis. ***African Journal of Biotechnology***, *10*(41), 8082-8289.

Baliah, T. N., & Muthulakshmi, P. (2017). Effect of microbially enriched vermicompost on the growth and biochemical characteristics of Okra (*Abelmoschus esculentus* (L.) Moench). ***Advances in Plants and Agriculture Research***, *6*(5), 147-152.

Basheer, M., & Agrawal, O. P. (2013).Effect of vermicompost on the growth and productivity of tomato plant (*Solanum lycopersicum*) under field conditions, India. ***International Journal of Recent Scientific Research,*** *3*(4), 247-249.

Bauer, A. W., Kirby, W. M., Sheris, J. C. &Jurk, M. (1996).Antibiotic susceptibility testing by a standard single disc method.***American Journal of Clinical Pathology***, *45*, 493-496.

Beykkhormizi, A., Abrishamchi, P., Ganjeali, A., & Parsa, M. (2016).Effect of vermicompost on some morphological, physiological and biochemical traits of bean (*Phaseolus vulgaris* L.) under salinity stress. ***Journal of Plant Nutrition***, *39*(6), 883-893.

Bhagat, P., Gosal, S. K., & Singh, C. B. (2016).Effect of mulching on soil environment, microbial flora and growth of potato under field conditions. ***Indian Journal of Agricultural Research***, *50*(6), 542-548.

Bhat, S. A., Singh, J., & Vig, A. P. (2017).Instrumental characterization of organic wastes for evaluation of vermicompost maturity. ***Journal of Analytical Science and Technology***, *8*(2), 1-12.

Bidyarani, N., Prasanna, R., Babu, S., Hossain, F., & Saxena, A. K. (2016). Enhancement of plant growth and yields in chickpea (*Cicer arietinum* L.) through novel cyanobacterial and biofilmed inoculants. ***Microbiological Research***, *188*(5), 97-105.

Bohme, L., Langer, U., & Bohme, F. (2005). Microbial biomass, enzyme activities and microbial community structure in two European long-term field experiments. ***Agriculture, Ecosystems & Environment***, *109*(1), 141-152.

Bokhtiar, S. M., Gafur, M. A., & Rahman, A. B. M. M. (2003).Effects of *Crotalaria* and *Sesbania aculeata* green manures and N fertilizer on soil fertility and the productivity of sugarcane. ***The Journal of Agricultural Science***, *140*(3), 305-309.

Bordoloi, P. (2021). Vermicompost and integrated nutrient management approach for yield enhancement of capsicum (*Capsicum annuum* L.) under hill agro ecosystem of Meghalaya, North East India. ***Journal of Krishi Vigyan***, *10*(1), 309-313.

Borguini, R. G., Bastos, D. H. M., Moita-Neto, J. M., Capasso, F. S., & Torres, E. A. F. D. S. (2013). Antioxidant potential of tomatoes cultivated in organic and conventional systems. ***Brazilian Archives of Biology and Technology***, *56*(4), 521-529.

Britannica, T. (2023). Editors of Encyclopaedia, "Paddy" ***Encyclopaedia Britannica***. An online database, https://www.britannica.com/topic/paddy.

Bustamante, M. A., Suárez-Estrella, F., Torrecillas, C., Paredes, C., Moral, R., & Moreno, J. (2010).Use of chemometrics in the chemical and microbiological characterization of composts from agroindustrial wastes. ***Bioresource Technology***, *101*(11), 4068-4074.

Calapardo, M. J. M., & Bryl, I. M. (2024).Enhancing herbage growth, yield and quality of stevia (*Stevia rebaudiana* Bertoni) using bio-organic nutrients in varied soil media.***Sains Malaysiana***, *53*(3), 533-547.

Canatoy, R. (2018). Effects of vermicompost on the growth and yield of sweet corn in Bukidnon, Philippines. ***Asian Journal of Soil Science and Plant Nutrition***, *3*(2), 1-8.

Caris-Veyrat, C., Amiot, M. J., Tyssandier, V., Grasselly, D., Buret, M., Mikolajczak, M., Guilland, J. C., Demange, C. B., & Borel, P. (2004). Influence of organic versus conventional agricultural practice on the antioxidant microconstituent content of tomatoes and derived purees; consequences on antioxidant plasma status in humans. ***Journal of Agricultural and Food Chemistry***, *52*(21), 6503-6509.

Ceritoglu, M., Sahin, S., & Erman, M. (2018).Effects of vermicompost on plant growth and soil structure. ***Selcuk Journal of Agriculture and Food Sciences***, *32*(3), 607-615.

Chandukishore, T., Samskrathi, D., Srujana, T. L., Rangaswamy, B. E., & Prabhu, A. A. (2023). Influence of plant extract-based vermiwash on plant growth parameters and biocontrol of Thrips (*Scirtothrips dorsalis*) in *Capsicum annum*. ***Journal of Natural Pesticide Research***, *5*(1), 1-8.

Chaturvedi, S., & Pandey, R. (2021). Bioinoculant with vermicompost augments essential oil constituents and antioxidants in *Mentha arvensis* L. ***Journal of Plant Growth Regulation***, *40*(3), 1284-1297.

Chau, N. T. M., & Diem, N. T. T. (2024). Effect of organic substrates on growth, yield and quality of spinach (*Spinacia oleracea* L.). International interdisciplinary conference on green development in tropical regions, in: proceedings of IOP publication conference series. ***Earth and Environmental Science***, *1306*(1), 012016.

Chesti, M. H., Kohli, A., & Sharma, A. K. (2013). Effect of integrated nutrient management on yield of and nutrient uptake by wheat (*Triticum aestivum* L.) and soil properties under intermediate zone of Jammu and Kashmir. ***Journal of the Indian Society of Soil Science***, *61*(1), 1-6.

Choudhary, K., Sharma, S. R., Jat, R., & Didal, V. K. (2017). Effect of organic manures and mineral nutrients on growth, yield attributes and yield of sesame (*Sesamum indicum* L.). ***International Journal of Chemical Studies***, *5*(2), 86-88.

Choudhary, O. P., Josan, A. S., Bajwa, M. S., & Kapur, M. L. (2004). Effect of sustained sodic and saline - sodic irrigation and application of gypsum and farmyard manure on yield and quality of sugarcane under semi-arid conditions. ***Field Crops Research***, *87*(2), 103-116.

Cifuentes, R., de Leon, R., Porres, C., & Rolz, C. (2013). Windrow composting of waste sugar cane and press mud mixtures. ***Sugar Tech***, *15*(4), 406-411.

Dangi, R., Oulkar, D., Dhakephalkar, P., Singh, S. K., Banerjee, K., Naik, D., Tamhankar, S., & Rao, S. (2016). Antimicrobial activity of some *Trigonella* species. ***International Journal of Phytomedicine***, *8*(1), 80-94.

Das, A., & Biswas, P. K. (2020). Effect of Sulphur and biofertilizer in nutrient uptake by sesame and microbial population in red and lateritic soil of West Bengal. ***Agricultural Science Digest***, *40*(3), 226-233.

Das, S. K., Dharan, B. J., Pavitra, P. V., Das, S., Behera, S. P., Veilumuthu, P., & Christopher, J. G. (2022). Investigation on the phenolic content in *Moringa oleifera* and its antimicrobial activity. ***Indian Journal of Agricultural Research***, *56*(3), 255-261.

Dash, P. K., Padhy, S. R., Bhattacharyya, P., Pattanayak, A., Routray, S., Panneerselvam, P., Nayak, A. K., & Pathak, H. (2022). Efficient lignin decomposing microbial consortium to hasten rice - straw composting with moderate GHGs fluxes. ***Waste and Biomass Valorization***, *13*(1), 481-496.

De Araujo, A. S. F., Figueiredo, M. D. V. B., & Monteiro, R. T. R. (2008).Potential of biological nitrogen fixation as indicator of soil pollution. ***Nitrogen Fixation Research Progress***. New York: Nova Science Publishers, 1-13.

de Britto, A. J., Gracelin, D., & Kumar, P. B. J. R. (2011). Antimicrobial activity of a few medicinal plants against gram negative bacteria. ***International Journal of Applied Biology and Pharmaceutical Technology***, *2*(3), 457-461.

De Rezende, F. A., Eric, G. J. D. C., & Ferreira, B. (2012).Composting of coffee husk and cattle manure. ***Revista de Ciências Agro-Ambientais***, *10*(1), 109-119.

Deepak, S., Pawar, A., & Shinde, P. (2014).Study of antioxidant and antimicrobial activities of *Andrographis paniculata*. ***Asian Journal of Plant Science and Research***, *4*(2), 31-41.

Dent, D., & Cocking, E. (2017). Establishing symbiotic nitrogen fixation in cereals and other non-legume crops: the greener nitrogen revolution. ***Agriculture & Food Security***, *6*(1), 1-9.

Deshpande, S. V., Patil, M. J., Daswadkar, S. C., Suralkar, U., & Agarwal, A. (2011). A study on anti-inflammatory activity of the leaf and stem extracts of *Coccinia grandis* L. Voigt. ***International Journal of Drug Research and Technology***, *1*(1), 69-72.

Dhakal, Y., Meena, R. S., De, N., Verma, S. K., & Singh, A. (2015). Growth, yield and nutrient content of mungbean (*Vigna radiata* L.) in response to INM in Eastern Uttar Pradesh, India. ***Bangladesh Journal of Botany***, *44*(3), 479-482

Dharajiya, D., Jasani, H., Khatrani, T., Kapuria, M., Pachchigar, K., & Patel, P. (2016). Evaluation of antibacterial and antifungal activity of fenugreek (*Trigonella foenum-graecum*) extracts. ***International Journal of Pharmacy and Pharmaceutical Sciences***, *8*(4), 212-217.

Dharajiya, D., Patel, P., Patel, M., & Moitra, N. (2014). In vitro antimicrobial activity and qualitative phytochemical analysis of *Withania somnifera* (L.) Dunal extracts. ***International Journal of Pharmaceutical Sciences Review and Research***, *27*(2), 349-354.

Dharani, A., & Sarojini, G. (2014). Composting of coir waste using bacteria (*Pseudomonas* and *streptococci*) and fungi (*Aspergillus* and *Rhizopus*) and their effect on sugar cane plant growth. ***International Journal of Advanced Research in Biological Sciences***, *1*(5), 71-75.

Dizikisa, T., Parlak, K. U., & Yildiz, N. (2022).The effects of vermicompost application on antioxidant enzymes of corn (*Zea mays* L.) grown as a test plant in sugar beet soil samples. ***Fresenius Environmental Bulletin***, *31*(5), 4750-4758.

Doshi, G. M., Zine, S. P., Chaskar, P. K., & Une, H. D. (2014).Solicitation of HPLC and HPTLC techniques for determination of rutin from *Polyalthia longifolia* Thwaites. ***Pharmacognosy Research***, *6*(3), 234-239.

Dua, V. K., Ojha, V. P., Roy, R., Joshi, B. C., Valecha, N., Devi, C. U., Bhatnagar, M. C., Sharma, V. P., & Subbarao, S. K. (2004).Antimalarial activity of some xanthones isolated from the roots of *Andrographis paniculata*. ***Journal of Ethnopharmacology***, *95*(2), 247- 251.

Dumas, Y., Dadomo, M., Di Lucca, G., & Grolier, P. (2003). Effects of environmental factors and agricultural techniques on antioxidant content of tomatoes. ***Journal of the Science of Food and Agriculture***, *83*(5), 369-382.

Duran-Lara, E. F., Valderrama, A., & Marican, A. (2020).Natural organic compounds for application in organic farming. ***Agriculture,*** *10*(2), 1-22.

Dutta, D., & Bandyopadhyay, P. (2009).Performance of chickpea (*Cicer arietinum* L.) to application of phosphorus and bio-fertilizer in laterite soil. ***Archives of Agronomy and Soil Science***, *55*(2), 147-155.

Dwivedi, D., Thanwar, M., & Gharia, A. K. (2015).A phytochemical investigation on *Andrographis paniculata*. ***Journal of Chemical and Pharmaceutical Research***, *7*(10), 822-827.

Dzung, N. A., Dzung, T. T., & Khanh, V. T. P. (2013).Evaluation of coffee husk compost for improving soil fertility and sustainable coffee production in rural central highland of Vietnam. ***Resources and Environment***, *3*(4), 77-82.

El Jawaher, A. (2020). Vermicomposting of organic waste with *Eisenia fetida* increases the content of exchangeable nutrients in soil. ***Pakistan Journal of Biological Sciences***, *23*(4), 501-509.

Elayaraja, D., & Sathiyamurthi, S. (2020). Influence of organic manures and micronutrients fertilization on the soil properties and yield of sesame (*Sesamum indicum* L.) in coastal saline soil. ***Indian Journal of Agricultural Research***, *54*(1), 89-94.

El-Hefny, M., Mohamed, A. A., Abdelkhalek, A., & Salem, M. Z. (2023). Productivity and phytochemicals of *Asclepias curassavica* in response to compost and silver nanoparticles application: HPLC analysis and antibacterial activity of extracts. ***Plants***, *12*(12), 1-22.

Elshaboury, H., Ibrahim, N., & Elsherpiny, M. (2024). Enhancing soybean productivity in saline soil conditions: synergistic effects of organic fertilizer and proline co-application. ***Egyptian Journal of Soil Science***, *64*(2), 385-395.

Eneji, A. E., Honna, T., & Yamamoto, S. (2001). Manuring effect on rice grain yield and extractable trace elements in soils. ***Journal of Plant Nutrition***, *24*(7), 967-977.

Eriksen, J. (2005). Gross sulphur mineralisation–immobilisation turnover in soil amended with plant residues. ***Soil biology and Biochemistry***, *37*(12), 2216-2224.

Fatima, Z., Zia, M., & Chaudhary, M. F. (2007).Interactive effect of *Rhizobium* strains and P on soybean yield, nitrogen fixation and soil fertility. ***Pakistan Journal of Botany***, *39*(1), 255-264.

Feichtinger, F., Erhart, E., & Hartl, W. (2004). Net N-mineralisation related to soil organic matter pools. ***Plant Soil and Environment***, *50*(6), 273-276.

Fersi, M., Mbarki, K., Gargouri, K., Mechichi, T., & Hachicha, R. (2019). Assessment of organic matter biodegradation and physico-chemical parameters variation during co-composting of lignocellulosic wastes with *Trametes trogii* inoculation. ***Environmental Engineering Research***, *24*(4), 670-679.

Florence, M., & Percy, C. (2023). Sustainable enhancement of soil fertility using bioinoculants. ***In:Vermicomposting for Sustainable Food Systems in Africa***, Springer Nature Singapore, 249-260.

Gad, N. (2006). Increasing the efficiency of nitrogen fertilization through cobalt application to pea plant. ***Research Journal of Agriculture and Biological Sciences***, *2*(6), 433-442.

Gan, Y., Johnston, A. M., Knight, J. D., McDonald, C., & Stevenson, C. (2010). Nitrogen dynamics of chickpea: Effects of cultivar choice, N fertilization, *Rhizobium* inoculation and cropping systems. ***Canadian Journal of Plant Science***, *90*(5), 655-666.

Ganguly, R. K., & Chakraborty, S. K. (2019). Assessment of qualitative enrichment of organic paper mill wastes through vermicomposting: humification factor and time of maturity. ***Heliyon***, *5*(5), 1-8.

Gezahegn, D., Seyoum, M., & Dominguez, J. (2012). Vermicomposting as a sustainable practice to manage coffee husk, enset waste (*Enset ventricosum*), Khat waste (*Catha edulis*) and vegetable waste amended with cow dung using an epigeic earthworm *Eisenia andrei* (Bouch'1972). ***International Journal of Pharmatech Research***, *4*(1), 15-24.

Gholami, H., Saharkhiz, M. J., Fard, F. R., Ghani, A., & Nadaf, F. (2018). Humic acid and vermicompost increased bioactive components, antioxidant activity and herb yield of Chicory (*Cichorium intybus* L.). ***Biocatalysis and Agricultural Biotechnology***, *14*(2), 286-292.

Ghosh, A., Das, B. K., Chatterjee, S. K., & Chandra, G. (2008). Antibacterial potentiality and phytochemical analysis of mature leaves of *Polyalthia longifolia* (Magnoliales: Annonaceae). ***The South Pacific Journal of Natural and Applied Sciences***, *26*(1), 68-72.

Gobi, M., & Gunasekaran, P. (2012). Biomanagement of sugar factory pressmud through vermitechnology for the growth and yield of a pulse crop, black gram (*Vigna mungo*). ***Dynamic Soil, Dynamic Plant***, *6*(1), 83-88.

Godlewska, A., & Ciepiela, G. A. (2020). Yield performance and content of selected organic compounds in *Trifolium pratense* treated with various biostimulants against the background of nitrogen fertilisation. ***Legume Research***, *43*(6), 850-855.

Goering H. D., & Van Soest, P. J. (1975). Forage fibre analysis, US Dept of Agriculture. ***Agricultural Research Service Washington***, *379.*

Gomathinayagam, R., Subramanian, G., Persaud, M., Persaud, R., & Velusamy, S. (2021). The studies of effect of bio fertilizers *Rhizobium*, phosphobacteria and root nodule extract (RPB, R+PB and RNE) on the growth and certain biochemical changes in the seedlings of black gram and maize. ***Asian Journal of Applied Science and Technology***, *5*(4), 01-15.

Gopal, M., Gupta, A., Palaniswami, C., Dhanapal, R., & Thomas, G. V. (2010). Coconut leaf vermiwash: a bio-liquid from coconut leaf vermicompost for improving the crop production capacities of soil. ***Current Science***, *98*(9), 1202-1210.

Gopal, M., Gupta, A., Sunil, E., & Thomas, G. V. (2009). Amplification of plant beneficial microbial communities during conversion of coconut leaf substrate to vermicompost by *Eudrilus* sp. ***Current Microbiology***, *59*(1), 15-20.

Gopinath, K. A., Venkatesh, G., Manjunath, M., Jayalakshmi, M., Prasad, T. V., Rajkumar, B., Venugopalan, V. K., Raju, B. M. K., Prabhakar, M., Chary, G. R., & Singh, V. K. (2023). Impact of organic and integrated production systems on yield and seed quality of rainfed crops and on soil properties**.** ***Frontiers in Nutrition***, *10*(1), 1-13.

Green, L. C., Wagner, D. A., Glogowski, J., Skipper, P. L., Wishnok, J. K., & Tannenbaum, S. R. (1982). Analysis of nitrite and (15N) in biological fluids. ***Analytical Biochemistry***, *126*(1), 131-136.

Gul, A., Salam, A., Afridi, M. S., Bangash, N. K., Ali, F., Ali, M. Y., Khan, S., & Mubeeen, R. (2019). Effect of urea, bio-fertilizers and their interaction on the growth, yield and yield attributes of *Cyamopsis tetragonoloba*. ***Indian Journal of Agricultural Research***, *53*(4), 423-428.

Guo, L., Wu, G., Li, C., Liu, W., Yu, X., Cheng, D., & Jiang, G. (2015). Vermicomposting with maize increases agricultural benefits by 304%. ***Agronomy for Sustainable Development***, *35*(3), 1149-1155.

Gupta, N., Shrivastava, N., Singh, P. K., & Bhagyawant, S. S. (2016). Phytochemical evaluation of moth bean (*Vigna aconitifolia* L.) seeds and their divergence. ***Biochemistry Research International***, *2016*(1), 1-6.

Gutema, C., Abdullahi, J., & Tana, T. (2021). Growth and yield of fenugreek (*Trigonella foenum-graecum* L.) varieties as influenced by application of NPS fertilizer at Ginir, south-eastern Ethiopia. ***Agriculture Forestry and Fisheries***, *10*(2), 66-74.

Hama-Ba, F., Kabore, R., Kabore, R., & Dicko, M. H. (2022). Effect of soil type on the nutritional quality of groundnut (*Arachis hypogaea* L.) in Burkina Faso. ***Legume Research***, *45*(12), 1568-1571.

Hamedi, B., Ghasemi Pirbalouti, A., & Rajabzadeh, F. (2022). Responses to morpho-physiological, phytochemical, and nutritional characteristics of damask rose (*Rosa damescena* Mill.) to the applied of organic and chemical fertilizers. ***Communications in Soil Science and Plant Analysis***, *53*(17), 2156-2169.

Hammad, H. M., Khaliq, A., Ashfaq, A., Aslam, M., Malik, A. H., Farhad, W., & Laghari, K. Q. (2011). Influence of different organic manures on wheat productivity. ***International Journal of Agriculture and Biology***, *13*(1), 137-140.

Hand, P., Hayes, W. A., Frankland, J. C., & Satchell, J. E. (1988).Vermicomposting of cow slurry. ***Pedobiologia,*** *31*(3), 199-209.

Hanyabui, E., Frimpong, K. A., Annor-Frempong, F., & Atiah, K. (2024). Effect of pineapple waste biochar and compost application on the growth and yield of pineapple varieties in Ghana. ***Frontiers in Agronomy***, *6*, 1331377.

Haridha, R. S. P., Jeyamangalam, F., & Jenila, R. M. (2020). Effect of organic manures on soil properties and the yield of black gram (*Vigna Mungo* L). ***Strad Research***, *7*(6), 70-79.

Hariharan, T., Vasan, P., & Gopalakrishna Murthy, T. R. (2021). Phytochemical analysis of *Andrographis paniculata* whole plant powder. ***The Pharma Innovation Journal*** *10*(7), 842-845.

Hasan, M., Uddin, M. K., Mohammed, M. T. M., Zuan, A. T. K., & Motmainna, M. (2021). Growth, yield, nodulation and amino acid content of bambara groundnut (*Vigna subterranea*) under inorganic and organic fertilizer application. ***Legume Research***, *44*(3), 322-327.

Hashempoor, J., Asadi-Sanam, S., Mirza, M., & Ghanbari Jahromi, M. (2022). The effect of different fertilizer sources on soil nutritional status and physiological and biochemical parameters of cone flower (*Echinacea purpurea* L.). ***Communications in Soil Science and Plant Analysis***, *53*(10), 1246-1260.

Hassan, A. A., & El-Azeim, A. (2020). Impacts of compost, biofertilizer and some antioxidant treatments on gladiolus (*Gladiolus grandifloras*) a vegetative growth and flowering aspects. ***Scientific Journal of Flowers and Ornamental Plants***, *7*(3), 269-283.

Hati, K. M., Mandal, K. G., Misra, A. K., Ghosh, P. K., & Bandyopadhyay, K. K. (2006). Effect of inorganic fertilizer and farmyard manure on soil physical properties, root distribution, and water - use efficiency of soybean in vertisols of central India. ***Bioresource Technology***, *97*(16), 2182-2188.

Hedge, J. E., & Hofreiter, B. T. (1962). Determination of total carbohydrate by anthrone method***. In: Carbohydrate Chemistry***, (Eds. Whistler, R. L. and Bemiller, J.N) Academic Press, New York, 163-201.

Hosamani, G. B., Chandrashekhar, S. S., Pooja, C. A., & Lakkaboyana, S. K. (2023). Green Chemistry in organic farming. ***Green Chemistry in Agriculture and Food Production***, CRC Press, 68-80.

Hosseinzadeh, S. R., Amiri, H., & Ismaili, A. (2018).Evaluation of photosynthesis, physiological, and biochemical responses of chickpea (*Cicer arietinum* L. cv. Pirouz) under water deficit stress and use of vermicompost fertilizer. ***Journal of Integrative Agriculture***, *17*(11), 2426-2437.

Huerta, E., Vidal, O., Jarquin, A., Geissen, V., & Gomez, R. (2010).Effect of vermicompost on the growth and production of amashito pepper, interactions with earthworms and *rhizobacteria*. ***Compost Science & Utilization***, *18*(4), 282-288.

Humphries, E. (1956). Mineral components and ash analysis, In: Modern methods of plant analysis, (Eds. Paech, K. and Tracey, M.V), ***Springer Verlag, Berlin Gottinger-Heidelberg***, 468-502.

Hussain, S., Sharif, M., Ahmad, W., Khan, F., & Nihar, H. (2018).Soil and plants nutrient status and wheat growth after *Mycorrhiza* inoculation with and without vermicompost. ***Journal of Plant Nutrition***, *41*(12), 1534-1546.

Hutomo, A. P., Ritawati, S., Roidelindho, K., & Utama, P. (2024). The effect of coffee grounds compost and planting media on the growth and yield of kailan plants (*Brassica oleracea* L.). ***Gema Wiralodra***, *15*(1), 167-180.

Ibrahim, M. H., Jaafar, H. Z., Karimi, E., & Ghasemzadeh, A. (2013). Impact of organic and inorganic fertilizers application on the phytochemical and antioxidant activity of Kacip fatimah (*Labisia pumila* Benth). ***Molecules***, *18*(9), 10973-10988.

Intensive Agriculture Report April-June, (2022). Government of India, Ministry of agriculture & farmer's welfare, Department of Agriculture & farmer's welfare, Directorate of extension, 14-17.

Iovino, R., Zullo, R., Rao, M. A., Cassar, L., & Gianfreda, L. (2008). Biodegradation of poly (lactic acid)/starch/coir biocomposites under controlled composting conditions. ***Polymer Degradation and Stability***, *93*(1), 147-157.

Irin, I. J., & Biswas, P. K. (2023). Residual effect of green manure on soil properties in green manure - transplant aman - mustard cropping pattern. ***Indian Journal of Agricultural Research***, *57*(1), 67-72.

Jackson, M. L. (1973). Soil chemical analysis. Prentice Hall of India Pvt. *Ltd.*, New Delhi, India, *498*, 151 – 154.

Jarboui, R., Dhouib, B., & Ammar, E. (2021).Effect of food waste compost (FWC) and its non-aerated fermented extract (NFCE) on seeds germination and plant growth. ***Open Journal of Soil Science***, *11*(2), 122-138.

Jayanthi, L., Sekar, J., Ameer Basha, S., & Parthasarathi, K. (2014). Influence of vermifertilizer on soil quality, yield and quality of chilli, *Capsicum annuum*. ***International Interdisciplinary Research Journal***, *4* (1), 206-218.

Jebara, M., Aouani, M. E., Payre, H., & Drevon, J. J. (2005). Nodule conductance varied among common bean (*Phaseolus vulgaris*) genotypes under phosphorus deficiency. ***Journal of Plant Physiology***, *162*(3), 309-315.

Joshi, D., Yadav, L. R., Ratore, B. S., Srivastava, H., Verma, R. S., Gurjar, B. S., Yadav, M., Sharma, C., & Karol, A. (2023). Growth and yield of urd bean influenced by vermicompost and vermiwash. ***International Journal of Plant & Soil Science***, *35*(18), 1831-1837.

Joshi, R., & Vig, A. P. (2010). Effect of vermicompost on growth, yield and quality of tomato (*Lycopersicum esculentum* L). ***African Journal of Basic & Applied Sciences***, *2*(3), 117-123.

Joshi, R., Singh, J., & Vig, A. P. (2015). Vermicompost as an effective organic fertilizer and biocontrol agent: effect on growth, yield and quality of plants. ***Reviews in Environmental Science and Biotechnology***, *14*(1), 137-159.

Kabashi, N. A., Alam, Z., & Ainuddin, M. (2007). Bio-composting process development by SSF for utilization agro-industrial wastes. ***In : 3rd Kuala Lumpur International Conference on Biomedical Engineering: Biomed, Kuala Lumpur, Malaysia.*** Springer Berlin Heidelberg, 464-468.

Kabbashi, A. N., Alam, M. Z., & Othman, A. (2006). Biocomposting process for utilization agro-industrial wastes. ***In: proceedings of 1st International Conference on Natural Resources Engineering & Technology***, Putrajaya, Malaysia, 24-25th July, 171-181.

Kadalli, G. G., Meena, R. P., & Ramsey, T. (2004). Tips for identifying the maturity and quality of compost: ***Spice India***, Spices Board, Ministry of Commerce & Industry, Government of India.

Kaewwongwal, A., Kongjaimun, A., Somta, P., Chankaew, S., Yimram, T., & Srinives, P. (2015). Genetic diversity of the black gram [*Vigna mungo* (L.) Hepper] gene pool as revealed by SSR markers. ***Breeding Science***, *65*(2), 127-137.

Kalt, W. (2005). Effects of production and processing factors on major fruit and vegetable antioxidants. ***Journal of Food Science***, *70*(1), 11-19.

Kannahi, M., & Ramya, R. (2015). Effect of biofertilizer, vermicompost, biocompost and chemical fertilizer on different morphological and phytochemical parameters of *Lycopersicum esculentum* L. ***World Journal of Pharmacy and Pharmaceutical Sciences,*** *4*(9), 1460-1469.

Kannan, N. (1996), Laboratory Manual in General Microbiology, Palani Paramount Publication, Palani, India.

Kannika, M. K., Yogeshwari, D., & Lakshmi, K. N. (2019). Effect of vermicompost on soil fertility and the nutritional status of *Andrographis paniculata* and *Euphorbia hirta*. ***Journal of Pharmacognosy and Phytochemistry***, *8*(2), 565-569

Karthiya, V., & Vijayalakshmi, A. (2018). Preliminary phytochemical analysis of *Millingtonia hortensis* L. and *Tecoma stans* L. ***International Journal of Recent Scientific Research***, *9*(11B), 29563-29566.

Karthiya, V., & Vijayalakshmi, A. (2023). Groundnut shells and toddy palm shells recycling through vermicomposting technology and its efficacy on growth and yield attributes of cluster bean (*Cyamopsis tetragonoloba* L.) Taub. ***Current Agriculture Research Journal***, *11*(1), 297-305.

Kasthuri, H., Shanthi, K., Sivakumar, S., Rajakumar, S., Son, H., & Song, Y. (2011). Influence of municipal solid waste compost (MSWC) on the growth and yield of green gram (*Vigna radiata* (L.) Wilczek), fenugreek (*Trigonella foenum-graecum* L.) and on soil quality. ***Journal of Environmental Health Science & Engineering***, *8*(3), 280-285.

Kaur, P., Bhardwaj, M., & Babbar, I. (2015).Effect of vermicompost and vermiwash on growth of vegetables. ***Research Journal of Animal, Veterinary and Fishery Sciences***, *3*(4), 9-12.

Khan, A., Khan, R. A., Ali, M., & Shinwari, Z. K. (2023).Impact of plant growth promoting *rhizobacteria* biofertilzers on biochemical attributes, antioxidant activities, nutritional values and productivity of maize. ***Pakistan Journal of Botany***, *55*(6), 2057-2066.

Khan, M. S., Naveed, M., Qadir, M. F., Bashir, M. A., Rafique, M., Siddiqui, M. H., Alamri, S., Brtnicky, M., & Mustafa, A. (2022). Combined effect of animal manures and di-ammonium phosphate (DAP) on growth, physiology, root nodulation and yield of chickpea. ***Agronomy***, *12*(3), 674.

Khatik, P., Massey, J. X., & Meena, S. (2020). Effect of nitrogen scheduling and cultivars on yield attributes and yields of sorghum (*Sorghum bicolor* L.). ***Indian Journal of Agricultural Research***, *54*(5), 641-645.

Khatua, C., Sengupta, S., Balla, V. K., Kundu, B., Chakraborti, A., & Tripathi, S. (2018). Dynamics of organic matter decomposition during vermicomposting of banana stem waste using *Eisenia fetida*. ***Waste Management***, *79*, 287-295.

Kiran, S. (2019).Effects of vermicompost on some morphological, physiological and biochemical parameters of lettuce (*Lactuca sativa* var. crispa) under drought stress. ***Notulae Botanicae Horti Agrobotanici Cluj-Napoca***, *47*(2), 352-358.

Kirnak, H., Gökalp, Z., & Dogan, E. (2017). Soil characteristics of soybean fields as effected by compaction, irrigation and fertilization. ***Legume Research***, *40*(4), 691-697.

Kouki, S., L'taief, B., Al-Qthanin, R. N., & Sifi, B. (2021). Impacts of *Rhizobium* strain ArO_2 on the nodulation, growth, nitrogen (N_2) fixation rate and ion accumulation in *Phaseolus vulgaris* L. under salt stress. ***Legume Research***, *44*(12), 1529-1533.

Koul, B., Yakoob, M., & Shah, M. P. (2022). Agricultural waste management strategies for environmental sustainability. ***Environmental Research***, *206*, 112285.

Krouma, A., & Abdelly, C. (2003). Importance of iron use efficiency of nodules in common bean (*Phaseolus vulgaris* L.) for iron deficiency chlorosis resistance. ***Journal of Plant Nutrition and Soil Science***, *166*(4), 525-528.

Kumar, A., Prakash, C. B., Brar, N. S., & Kumar, B. (2018).Potential of vermicompost for sustainable crop production and soil health improvement in different cropping systems.***International Journal of Current Microbiology and Applied Sciences***, *7*(10), 1042-1055.

Kumar, V., & Prasad, R. K. (2008).Integrated effect of mineral fertilizers and green manure on crop yield and nutrient availability under rice-wheat cropping system in calciorthents. ***Journal of the Indian Society of Soil Science***, *56*(2), 209-214.

Kumaresan, M., Shanmugasundaram, V. S., & Balasubramanian, T. (2003). Bio-composting of organic wastes. ***Agricultural Science Digest***, *23*(1), 67-68.

Kumngen, A., Iewkittayakorn, J., Meehae, U., Suwannarat, S., Anuchan, S., Chotigeat, W., Kunwanlee, P., Kongchouy, N., Leunram, S., & Karrila, S. (2023). Effects of compost from food waste on growth of lettuce (*Lactuca sativa* Var. Crispa L.). ***International Journal of Recycling Organic Waste in Agriculture***, *12*(2), 247-258.

Lahbouki, S., Anli, M., El Gabardi, S., Ait-El-Mokhtar, M., Ben-Laouane, R., Boutasknit, A., Ait-Rahou, Y., Outzourhit, A., Wahbi, S., Douira, A., & Meddich, A. (2022). Evaluation of arbuscular mycorrhizal fungi and vermicompost supplementation on growth, phenolic content and antioxidant activity of prickly pear cactus (*Opuntia ficus-indica*). ***Plant Biosystems-An International Journal Dealing with All Aspects of Plant Biology,*** *156*(4), 882-892.

Lamma, O. A., & Moftah, M. A. (2016).Effect of vermicompost on antioxidant levels in *Andrographis paniculata*. ***International Journal of Applied and Pure Science and Agriculture,*** *2*(3), 1-6.

Lazcano, C., & Domínguez, J. (2011). The use of vermicompost in sustainable agriculture: impact on plant growth and soil fertility. ***Soil nutrients***, Nova Science Publishers, *10*, 1-23.

Lee, J. J., Park, R. D., Kim, Y. W., Shim, J. H., Chae, D. H., Rim, Y. S., Sohn, B. K., Kim, T. H., & Kim, K. Y. (2004). Effect of food waste compost on microbial population, soil enzyme activity and lettuce growth. ***Bioresource Technology***, *93*(1), 21-28.

Libutti, A., Russo, D., Lela, L., Ponticelli, M., Milella, L., & Rivelli, A. R. (2023).Enhancement of yield, phytochemical content and biological activity of a leafy vegetable (*Beta vulgaris* L. var. cycla) by using organic amendments as an alternative to chemical fertilizer. ***Plants***, *12*(3), 569-587.

Lim, S. L., & Wu, T. Y. (2016). Characterization of matured vermicompost derived from valorization of palm oil mill byproduct. ***Journal of Agricultural and Food Chemistry***, *64*(8), 1761-1769.

Lowry, O. H., Rosebrough, N. J., Farr, A. L., & Randall, R.J. (1951). Protein measurement with Folin-phenol reagents. ***Journal of Biological Chemistry***, *193*(1), 265-275.

Maheswarappa, H. P., Thomas, G. V., Gupta, A., Bhat, R., & Palaniswami, C. (2014). Productivity and nutrient status of coconut (*Cocos nucifera*) as influenced by integrated nutrient management with vermicomposted coconut leaves. ***Indian Journal of Agronomy***, *59*(3), 455-459.

Mahmud, M., Abdullah, R., & Yaacob, J. S. (2018).Effect of vermicompost amendment on nutritional status of sandy loam soil, growth performance, and yield of pineapple (*Ananas comosus* var. MD2) under field conditions. ***Agronomy***, *8*(9), 183-199.

Mahmud, M., Ramasamy, S., Othman, R., Abdullah, R., & Yaacob, J. S. (2019).Effect of vermicompost application on bioactive properties and antioxidant potential of MD2 pineapple fruits. ***Agronomy***, *9*(2), 97-108.

Mahmud, M., Abdullah, R., & Yaacob, J. S. (2020).Effect of vermicompost on growth, plant nutrient uptake and bioactivity of ex vitro pineapple (*Ananas comosus* var. MD2). ***Agronomy***, *10*(9), 1333-1355.

Mai, V. C., Le, T. K. D., & Nguyen, T. K. C. (2020).Antioxidative response of *Glycine max* (L.) Merr. cv. Namdan to drought stress. ***Indian Journal of Agricultural Research***, *54*(5), 656-660.

Manivannan, S., Balamurugan, M., Parthasarathi, K., Gunasekaran, G., & Ranganathan, L. S. (2009).Effect of vermicompost on soil fertility and crop productivity-beans (*Phaseolus vulgaris*). ***Journal of Environmental Biology***, *30*(2), 275-281.

Manu, M. K., Kumar, R., & Garg, A. (2017). Performance assessment of improved composting system for food waste with varying aeration and use of microbial inoculum. ***Bioresource Technology***, *234*(1), 167-177.

Masood, J. (2006). Greening your environment - Recycle the waste make your own compost. ***Enviro News of International Society of Environmental Botanists***, *12*(3), 1-3.

Mastouri, F., Hassandokht, M. R., & Dehkaei, M. P. (2005). The effect of application of agricultural waste compost on growing media and greenhouse lettuce yield. In: Proceedings of International symposium on soilless cultivation and hydroponics, Ed: M. Urrestarazu Gavilan, Iran, International Society for Horticultural Science, ***Acta Horticulturae***, *697*, 153-158.

Mawardiana, M., Karnilawati, K., Alhadi, B., & Harmidi, H. (2024).Types of compost and varieties to increase shallot growth and yield in Pidie district. ***In* : *International Conference on Educational Technology and Social Science***, Atlantis Press, 108-113.

Mazumder, P., Khwairakpam, M., & Kalamdhad, A. S. (2023). Assessment of multi-metal contaminant in agricultural soil amended with organic wastes, speciation and translocation - an approach towards sustainable crop production. ***Total Environment Research Themes***, *5*(1), 1-13.

Mbaebie, B. O., Edeoga, H. O., & Afolayan, A. J. (2012). Phytochemical analysis and antioxidants activities of aqueous stem bark extract of *Schotia latifolia* Jacq. ***Asian Pacific Journal of Tropical Biomedicine***, *2*(2), 118-124.

Meda, A., Lamien, C. E., Romito, M., Millogo, J., & Nacoulma, O. G. (2005). Determination of the total phenolic, flavonoid and proline contents in Burkina Fasan honey, as well as their radical scavenging activity. ***Food Chemistry***, *91*(3), 571-577.

Meena, B. L., Fagodiya, R. K., Prajapat, K., Dotaniya, M. L., Kaledhonkar, M. J., Sharma, P. C., Meena, R. S., Miltran, T., & Kumar, S. (2018). Legume green manuring: an option for soil sustainability. ***Legumes for Soil Health and Sustainable Management***, Springer link, Singapore, *9*, 387-408.

Meena, R. S., Ramawatar, K., Meena, V. S., & Ram, K. (2013).Effect of organic and inorganic source of nutrients on yield, nutrient uptake and nutrient status of soil after harvest of greengram. ***An Asian Journal of Soil Science***, *8*(1), 80-83.

Meena, S., Swaroop, N., & Dawson, J. (2016).Effect of integrated nutrient management on physical and chemical properties of soil. ***Agricultural Science Digest***, *36*(1), 56-59.

Mensor C. C., Menezes, F. S., Leitan G. G., Reis, A. S., Dossaltos, T. C., Carbe, C. S., & Leitao, S. G. (2001). Screening of Brazilian plant extracts for antioxidant activity by use of DPPH free radical methods, ***Phytotherapy Research***, *15*(2), 127- 130.

Mohamed, R. M., Mkhalid, I. A., & Barakat, M. A. (2015).Rice husk ash as a renewable source for the production of zeolite NaY and its characterization. ***Arabian Journal of Chemistry,*** *8*(1), 48-53.

Mohd Din, A. R. J., Cheng, K. K., & Sarmidi, M. R. (2017). Assessment of compost extract on yield and phytochemical contents of Pak Choi (*Brassica rapa* cv. chinensis) grown under different fertilizer strategies. ***Communications in Soil Science and Plant Analysis***, *48*(3), 274-284.

Moradi, H., Fahramand, M., Sobhkhizi, A., Adibian, M., Noori, M., Abdollahi, S., & Rigi, K. (2014). Effect of vermicompost on plant growth and its relationship with soil properties. ***International Journal of Farming and Allied Sciences***, *3*(3), 333-338.

Muhammad, D., & Khattak, R. A. (2009). Growth and nutrient concentration of maize in pressmud treated saline-sodic soils. ***Soil and Environment***, *28*(2), 145-155.

Musyoka, S. N., Liti, D. M., Erick, O. O., Meulenbroek, P., & Waidbacher, H. (2020). Using earthworm, *Eisenia fetida*, to bio-convert agro-industrial wastes for aquaculture nutrition.A peer reviewd article. Earthworm compost for fish, ***Bio Resources***, *15*(1), 574-587.

Naeem, M., Iqbal, J., & Bakhsh, M. A. A. (2006).Comparative study of inorganic fertilizers and organic manures on yield and yield components of mungbean (*Vigna radiata* L.). ***Journal of Agriculture and Social Sciences***, *2*(4), 227-229.

Naik, P., Saini, N., & Kumar, A. (2022). Study on efficacy of integrated nutrient management [INM] on physiological parameters in chickpea (*Cicer arietinum* L.). ***International Journal of Progressive Research in Engineering Management and Science***, *2*(10), 1-4.

Nattudurai, G., Vendan, S. E., Ramachandran, P. V., & Lingathurai, S. (2014). Vermicomposting of coirpith with cowdung by *Eudrilus eugeniae* Kinberg and its efficacy on the growth of *Cyamopsis tetragonaloba* (L) Taub. ***Journal of the Saudi Society of Agricultural Sciences***, *13*(1), 23-27.

Nayak, S., Prasanna, R., Pabby, A., Dominic, T. K., & Singh, P. K. (2004).Effect of BGA-*Azolla* biofertilizers on nitrogen fixation and chlorophyll accumulation at different depths in soil cores. ***Biology and Fertility of Soils***, *40*(1), 67-72.

Nduka, B. A., Adewale, D. B., Akanbi, O. S. O., & Adejobi, K. B. (2015). Nursery soil amendments for cashew seedling production: a comparative analysis of coffee husk and NPK. ***Journal of Agricultural Science***, *7*(3), 111-123.

Needelman, B. A. (2013). What are soils. ***Nature Education knowledge***, *4*(3), 2-13

Nohong, B., Baba, S., & Yusuf, M. (2019).The effect of nitrogen fertilization level on growth, yield and nodulation of *Indigofera zollingeriana* at early nursery stage. ***Indian Journal of Agricultural Research***, *53*(1), 100-103.

Nur, F. O., Siti, A. H., & Umi, K. Y. (2013). Comparative evaluation of organic and inorganic fertilizers on total phenolic, total flavonoid, antioxidant activity and cyanogenic glycosides in cassava (*Manihot esculenta*). ***African Journal of Biotechnology***, *12*(18), 2414-2421.

N'Zi, J. C., Koua, A. P., Kahia, J., Kouassi, K. D., N'guetta, A. S. P., & Kouamé, C. (2016). Evaluating nodulation and its effects on some agromorphological parameters of soybean varieties (*Glycine max* L.). ***Asian Journal of Plant Sciences***, *15*(2), 26-34.

Obi, F. O., Ugwuishiwu, B. O., & Nwakaire, J. N. (2016).Agricultural waste concept, generation, utilization and management. ***Nigerian Journal of Technology***, *35*(4), 957-964.

Ogunlela, V. B., Masarirambi, M. T., & Makuza, S. M. (2005).Effect of cattle manure application on pod yield and yield indices of okra (*Abelmoschus esculentus* L. Moench) in semi-arid and subtropical environment**.** ***Journal of Food Agriculture and Environmen****t*, *3*(1), 125-129.

Oliveira, L. S., & Franca, A. S. (2015).An overview of the potential uses for coffee husks.***Coffee in Health and Disease Prevention***, *4*(31), 283-291.

Olle, M. (2016). The effect of vermicompost based growth substrates on tomato growth. ***Journal of Agricultural Science***, *1*(27), 38-41.

Orta-Guzmán, V. N., Lois-Correa, J. A., Domínguez-Crespo, M. A., Pineda-Pineda, J., Torres-Huerta, A. M., Rodríguez-Salazar, A. E., & Licona-Aguilar, Á. I. (2021). Evaluation of sugarcane agroindustrial wastes as substrate in soilless cultivation of tomato (*Solanum lycopersicum* L) effect of substrate composition on yield production. ***Agronomy***, *11*(2), 206-228.

Ott, T., Van Dongen, J. T., Gu, C., Krusell, L., Desbrosses, G., Vigeolas, H., Bock, V., Czechowski, T., Geigenberger, P., & Udvardi, M. K. (2005). Symbiotic leghemoglobins are crucial for nitrogen fixation in legume root nodules but not for general plant growth and development. ***Current Biology***, *15*(6), 531-535.

Owaresat, J. K., Siam, M. A., Dey, D., Jabed, S., Badsha, F., Islam, M. R., & Kabir, M. S. (2023). Factors impacting *Rhizobium*-legume symbiotic nitrogen fixation with the physiological and genetic responses to overcome the adverse conditions: A review. ***Agricultural Reviews***, *44*(1), 22-30.

Oyaizu, M. (1986), Studies on products of browning reaction prepared from glucosamine, ***Japan Journal of Nutrition***, *44*(6), 307-315.

Padminee, D., & Bandyopadhyay, S. K. (2011). Nodulation study in some varieties of French bean crop (*Phaseolus vulgaris* L.). ***Biological Forum,*** *3*(1), 61-66.

Palia, M., Saravanan, S., Prasad, V. M., Upadhyay, R. G., & Kasera, S. (2021). Effec t of different levels of organic and inorganic fertilizers on growth, yield and quality of brinjal (*Solanum melongena* L.). ***Agricultural Science Digest****, 41*(spl), 203-206.

Pandey, A., Tiwari, C., & Singh, S. K. (2022). A study on suitable dose of FYM and vermicompost on soil fertility in green gram [*Phaseolus radiata* L.]. ***The Pharma Innovation Journal***, *11*(9), 1267-1269.

Parthasarathi, K., Balamurugan, M., & Ranganathan, L. S. (2008). Influence of vermicompost on the physico-chemical and biological properties in different types of soil along with yield and quality of the pulse crop - black gram. ***Journal of Environmental Health Science & Engineering***, *5*(1), 51-58.

Patil, D., Patil, A., Vadera, K., & Ansari, A. (2015). Standardization and quality control parameters of aerial parts (Leaves and Stem) of *Trigonella foenum-graecum* L. - An important medicinal plant. ***Journal of Chemical and Pharmaceutical Research***, *7*(3), 163-170.

Patil, S. S., Kasture, M. C., & Dhopavkar, R. V. (2018). Micro-nutrient enriched vermicompost by coconut coir waste. ***International Journal of Current Microbiology and Applied Sciences***, *7*(6), 2352-2361.

Perumal, P. C., Sophia, D., Raj, C. A., Ragavendran, P., Starlin, T., & Gopalakrishnan, V. K. (2012). In vitro antioxidant activities and HPTLC analysis of ethanolic extract of *Cayratia trifolia* (L.). ***Asian Pacific Journal of Tropical Disease***, *2*(2), 952-956.

Petkova, N., Ivanova, L., Filova, G., Ivanov, I., & Denev, P. (2017).Antioxidants and carbohydrate content in infusions and microwave extracts from eight medicinal plants. ***Journal of Applied Pharmaceutical Science***, *7*(10), 055-061.

Podsędek, A. (2007). Natural antioxidants and antioxidant capacity of *Brassica* vegetables: A review. ***LWT-Food Science and Technology***, *40*(1), 1-11.

Polash, S. A., Saha, T., Hossain, M., & Sarker, S. R. (2017). Investigation of the phytochemicals, antioxidant and antimicrobial activity of the *Andrographis paniculata* leaf and stem extracts. ***Advances in Bioscience and Biotechnology***, *8*(5), 149-162.

Pottipati, S., Haq, I., & Kalamdhad, A. S. (2023). Large - scale production of a nutrient - rich soil conditioner by optimized biodegradation of vegetable waste: biodiversity and toxicity assessments. ***Biomass Conversion and Biorefinery***, *14*(16), 19581-19595.

Prakash, M., & Hemalatha, N. (2013). Dynamics of Microorganisms during vermi-stabilization of organic substrates and enhances performance of plant growth promoting *rhizobacteria* on black gram**.** ***International Journal of Current Microbiology and Applied Sciences***, *2*(7), 171-187.

Prandi, B., Ferri, M., Monari, S., Zurlini, C., Cigognini, I., Verstringe, S., Schaller, D., Walter, M., Navarini, L., Tassoni, A., Sforza, S., & Tedeschi, T. (2021). Extraction and chemical characterization of functional phenols and proteins from coffee (*Coffea arabica*) by-products. ***Biomolecules***, *11*(11), 1571-1588.

Prativa, K. C., & Bhattarai, B. P. (2011).Effect of integrated nutrient management on the growth, yield and soil nutrient status in tomato. ***Nepal Journal of Science and Technology***, *12*(1), 23-28.

Quadar, J., Chowdhary, A. B., Dutta, R., Angmo, D., Rashid, F., Singh, S., Singh, J., & Vig, A. P. (2022). Characterization of vermicompost of coconut husk mixed with cattle dung: physicochemical properties, SEM, and FT-IR analysis. ***Environmental Science and Pollution Research***, *29*(58), 87790-87801.

Rahimi, A., Gitari, H., Lyons, G., Heydarzadeh, S., Tunçtürk, M., & Tunçtürk, R. (2023). Effects of vermicompost, compost and animal manure on vegetative growth, physiological and antioxidant activity characteristics of *Thymus vulgaris* L.Under water stress. ***Yuzuncu Yıl University Journal of Agricultural Sciences***, *33*(1), 40-53.

Rahman, R., Bhuiyan, M. K. A., Khan, M. A. A., Hossain, M. M., & Rubayet, M. T. (2024). *Trichoderma*-fortified compost in controlling diseases and increasing yield of tomato.***International Journal of Environment, Agriculture and Biotechnology***, *9*(1), 165-174.

Raina, A. P., Gupta, V., Sivaraj, N., & Dutta, M. (2013).*Andrographis paniculata* (Burm. f.) Wall.ex Nees (kalmegh), a traditional hepatoprotective drug from India. ***Genetic Resources and Crop Evolution***, *60*(30), 1181-1189.

Rajkhowa, D. J., Saikia, M., & Rajkhowa, K. M. (2003).Effect of vermicompost and levels of fertilizer on greengram. ***Legume Research***, *26*(1), 63-65.

Ramya, S. S., Vijayanand, N., & Rathinavel, S. (2015). Foliar application of liquid biofertilizer of brown alga *Stoechospermum marginatum* on growth, biochemical and yield of *Solanum melongena*. ***International Journal of Recycling of Organic Waste in Agriculture***, *4*(3), 167-173.

Ramya, S. S., Vijayanand, N., Ponnerulan, B., Saminathan, E., Veeranan, U., & Kathiresan, D. (2020). Phytochemical screening, hptlc analysis and antidiabetic potential of *Trigonella foenum - graecum* on alloxan induced diabetic rats. ***Plant Archives***, *20*(1) 5315-5322.

Rangaraj, T., Somasundaram, E. M., Amanullah, M., Thirumurugan, V., Ramesh, S., & Ravi, S. (2007).Effect of Agro-industrial wastes on soil properties and yield of irrigated finger millet (*Eleusine coracana* L. Gaertn) in coastal soil. ***Research Journal of Agriculture and Biological Sciences***, *3*(3), 153-156.

Ranjan, J. K., Ahmed, N., Das, B., Pragya, R., & Mishra, B. K. (2013).Green technology for production of baby corn (Zea mays L) under north-west Himalayan conditions. ***International Journal of Chem Tech Research***, *5*(2), 880-885.

Rao, K. J. (2007). Composting of municipal and agricultural wastes. ***In: Proceedings of the International Conference on Sustainable Solid Waste Management***, Chennai, India, 5 - 7th September, 244-249.

Raphael, K., & Velmourougane, K. (2011).Chemical and microbiological changes during vermicomposting of coffee pulp using exotic (*Eudrilus eugeniae*) and native earthworm (*Perionyx ceylanesis*) species. ***Biodegradation***, *22*(3), 497-507.

Rautela, I., Rathore, S., Chauhan, P., Tapliyal, P., & Sharma, D. M. (2019). Vermicompost is boon to enrichment of micronutrient content in soil. ***World Journal of Pharmaceutical Research***, *8*(7), 2309-2318.

Ravindra, K., Seweta, S., Manisha, S., & Asha, S. (2010). Effect of organic amendments on soil mycoflora. ***Asian Journal of Plant Pathology***, *4*(2), 73-81.

Ravindran, K. C., Venkatesan, K., Balasubramanian, T., & Balakrishnan, V. (2007). Effect of halophytic compost along with farmyard manure and phosphobacteria on growth characteristics of *Arachis hypogaea* Linn. ***Science of the Total Environment***, *384* (3), 333-341.

Reghuvaran, A., & Ravindranath, A. D. (2010). Efficacy of biodegraded coir pith for cultivation of medicinal plants. ***Journal of scientific and Industrial Research***, *69*(7), 554-559.

Roberts, P., Jones, D. L., & Edwards-Jones, G. (2007). Yield and vitamin C content of tomatoes grown in vermicomposted wastes. ***Journal of the Science of Food and Agriculture***, *87*(10), 1957-1963.

Roy, R. N., Finck, A., Blair, G. J., & Tandon, H. L. S. (2006). Plant nutrition for food security. A guide for integrated nutrient management. ***FAO Fertilizer and Plant Nutrition Bulletin***, Food and Agricultural Organization of United Nations, Rome, 16, 201-214.

Roy, S. K., Cho, S. W., Kwon, S. J., Yang, J. H., Bae, Y. J., Jung, H. J., Kim, S. J., Chung, K. Y., & Woo, S. H. (2019). Effect of tillage practices and fertilizer management on the growth and nitrogen efficiency in soybean. ***Legume Research***, *42*(2), 222-227.

Ruch, R.J., Cheng, S.J., & Klaunig, J.E. (1989). Prevention of cytotoxicity and inhibition of intracellular communication by antioxidant catechins isolated from Chinese green tea. ***Carcinogenesis***, *10*(6), 1003-1008.

Sabourifard, H., Estakhr, A., Bagheri, M., Hosseini, S. J., & Keshavarz, H. (2023).The quality and quantity response of maize (*Zea mays* L.) yield to planting date and fertilizers management. ***Food Chemistry Advances***, *2*, 100196.

Saha, A., Basak, B. B., Gajbhiye, N. A., Kalariya, K. A., & Manivel, P. (2019). Sustainable fertilization through co-application of biochar and chemical fertilizers improves yield, quality of *Andrographis paniculata* and soil health. ***Industrial Crops and Products***, *140*(14), 1-11.

Sahrawat, A., Sharma, J., & Jawla, S. K. (2022). Evaluation of antioxidant and antifungal activity of the whole part of *Dactyloctenium aegyptium* weed on bengal gram. ***Legume Research***, *45*(12), 1517-1522.

Sajid, M., Rab, A., Wahid, F., Shah, S. N. M., Jan, I., Khan, M. A., Hussain, S. A., Khan, M. A., & Iqbal, Z. (2011). Influence of *rhizobium* inoculation on growth and yield of groundnut cultivars. ***Sarhad Journal of Agriculture***, *27*(4), 573-576.

Sakthivigneswari, G., & Vijayalakshmi, A. (2017). Biocomposting technology and microbial populations of agro industrial waste using *Pleurotus sajor-caju* and earthworm (*Eudrilus eugeniae*). ***International Journal of Pharma and Biosciences,*** *8*(2), 679-685.

Salehi, A., Fallah, S., Zitterl-Eglseer, K., Kaul, H. P., Abbasi Surki, A., & Mehdi, B. (2019). Effect of organic fertilizers on antioxidant activity and bioactive compounds of fenugreek seeds in intercropped systems with buckwheat. ***Agronomy***, *9*(7), 367-381.

Sanjutha, S., Subramanian, S., Rani, C. I., & Maheswari, J. (2008).Integrated nutrient management in *Andrographis paniculata*. ***Research Journal of Agriculture and Biological Sciences***, *4*(2), 141-145.

Saranraj, P., Alrudainy, A. M., Manigandan, M., Kokila, M., & Sivasakthivelan, P. (2022), Combined effect of *Trichoderma resii* and earthworm in reduction of physical characteristics, cellulose, hemicellulose and lignin content in market wastes. ***International Journal of Entomology Research***, *7*(11), 107-109.

Saravanan, M., & Ignacimuthu, S. (2015). Hypocholesterolemic effect of Indian medicinal plants-a review. ***Medicinal Chemistry***, *5*(1), 040-049.

Sarika, D., Singh, J., Prasad, R., Vishan, I., Varma, V. S., & Kalamdhad, A. S. (2014).Study of physico-chemical and biochemical parameters during rotary drum composting of water hyacinth. ***International Journal of Recycling of Organic Waste in Agriculture***, *3*(3), 1-10.

Sarkar, S., Majumder, S., Ghosh, A., Sumedha, S. A. H. A., Acharyya, S., Chakraborty, S., & Bhattacharya, M. (2022). Metabolomic exploration of CTC tea manufacturing waste validates its potentiality as organic fertilizer. ***Turkish Journal of Food and Agriculture Sciences***, *4*(2), 41-48.

Sekhar, D., Kumar, P. P., & Rao, K. T. (2014).Effect of coffee husk compost on growth and yield of paddy. ***Journal of Academia and Industrial Research***, *3*(4), 195-197.

Seleiman, M. F., & Abdelaal, M. S. (2018). Effect of organic, inorganic and bio-fertilization on growth, yield and quality traits of some chickpea (*Cicer arietinum* L.) varieties. ***Egyptian Journal of Agronomy***, *40*(1), 105-117.

Selvamurugan, M., Doraisamy, P., & Maheswari, M. (2013).Biomethanated distillery spentwash and pressmud biocompost as sources of plant nutrients for groundnut (*Arachis hypogaea* L.). ***Journal of Applied and Natural Science***, *5*(2), 328-334.

Sen, B., & Chandra, T. S. (2007). Chemolytic and solid-state spectroscopic evaluation of organic matter transformation during vermicomposting of sugar industry wastes. ***Bioresource Technology***, *98*(8), 1680-1683.

Sen, B., & Chandra, T. S. (2009). Do earthworms affect dynamics of functional response and genetic structure of microbial community in a lab-scale composting system?. ***Bioresource Technology***, *100*(2), 804-811.

Senthil Kumar, D., Satheesh Kumar, P., Rajendran, N. M., Uthaya Kumar, V., & Anbuganapathi, G. (2014).Evaluation of vermicompost maturity using scanning electron microscopy and paper chromatography analysis. ***Journal of Agricultural and Food Chemistry***, *62*(13), 2738-2741.

Shaikh, J. R., & Patil, M. (2020). Qualitative tests for preliminary phytochemical screening: An overview. ***International Journal of Chemical Studies***, *8*(2), 603-608.

Shanker, C., & Ram, G. M. (2023). Effect of organic manures and plant extract on nutritional values and yield of chick pea (*Cicer arietinum*). ***European Chemical Bulletin***, *12*(4), 3017-3033.

Shanmugasundaram, R., Malarkodi, M., & Gokila, B. (2019).Continuous application of fertilizer over four decades on yield, physical and chemical properties of swell-shrink soil under finger millet-maize cropping sequence. ***Indian Journal of Agricultural Research***, *53*(6), 687-692.

Sharma, P. R. (2016). Plant bioassay test for maturity of compost from sugarcane trash and its effects on growth of *Ttriticum aestivum* L and *Trigonella foenum - graecum* L, Ph.D Thesis, Department of Botany, *Chaudhary Charan Singh University, Ghaziabad, U.P.*http://hdl.handle.net/10603/110326.

Sharma, P., Sardana, V., & Kandola, S. S. (2011). Response of groundnut (*Arachis hypogae* L.) to *Rhizobium* inoculation. ***Libyan Agriculture Research Center Journal International,*** *2*(3), 101-104.

Sharma, P., Sharma, S., Singh, J., Singh, A., & Katnoria, J. K. (2023). Characterization of *Tectona grandis* leaf litter compost: an ecological approach for converting leaf litter waste into organic product using composting. ***Biomass Conversion and Biorefinery***, https://doi.org/10.1007/s13399-023-04309-3.

Shekhawat, A.S., Purohit, H.S., Jain, H.K., Meena, R.H. & Meena, R. (2018).Effect of phosphorus and bio-organics on quality and symbiotic efficiency of black gram (*Vigna mungo* L.). ***Journal of Pharmacognosy and Phytochemistry***, *7*(2), 3419-3422.

Shesharao, S., Sathyanarayana, M. L., & Shridhar, N. (2020).Phytochemical analysis of *Trigonella foenum - graecum* and *Coccinia indica* for their different components by HPTLC. ***The Pharma Innovation Journal***, *9*(9), 52-57.

Shi, F., Yu, H., Zhang, N., Wang, S., Li, P., Yu, Q., Liu, J., & Pei, Z. (2021). Microbial succession of lignocellulose degrading bacteria during composting of corn stalk. ***Bioengineered***, *12*(2), 12372-12382.

Shiferaw, B., Bantilan, M. C. S., & Serraj, R. (2004). Harnessing the potential of BNF for poor farmers: technological policy and institutional constraints and research need. ***Symbiotic Nitrogen Fixation; Prospects for Enhanced Application in Tropical Agriculture***. (Ed.): R. Serraj. Oxford & IBH publishing Co. Pvt. Ltd. New Delhi, 3.

Shilev, S., Naydenov, M., Vancheva, V., & Aladjadjiyan, A. (2007). Composting of food and agricultural wastes. ***In :Utilization of by-products and Treatment of Waste in the Food Industry***, Boston, Springer US, 283-301.

Shukurovich, S. S., & Akbarovich, S. R. (2024). The effect of organic fertilizers on plant growth on the amount of nutrients in the soil. ***Genius Repository***, *28*, 12-15.

Siddhuraju, P., Maheshu, V., Loganayaki, N., & Manian, S. (2008). Antioxidant activity and free radical scavenging capacity of dietary phenolic extracts from processed ***Food***, *2*(2), 159-167. indigenous legumes, *Macrotyloma uniflorum* (Lam.) Verdc. and *Dolichos lablab* L.

Sidełko, R., Walendzik, B., Smuga-Kogut, M., Janowska, B., Szymański, K., Głowacka, A., & Leśniańska, A. (2020).Impact of reduced straw content on the sewage sludge composting process. ***Archives of Environmental Protection***, *46*(4), 70 -77.

Silpa, M., & Vijayalakshmi, A., & Raihing, P. (2021). Influence of microorganisms in the conversion of cocoa shell and jack fruit peel waste as biocompost. ***Indian Journal of Applied and Pure Biology***, *2*(1), 392-398.

Silpa, M., & Vijayalakshmi, A. (2022).Efficiency of biocomposted agroindustrial wastes and their response in the growth and yield of *Vigna unguiculata* (L.) Walp. ***Agricultural Science Digest***, *42*(3), 278-283.

Singh, A., & Vijayalakshmi, A. (2013).Effect of composted coirpith, composted pressmud and farmyard manure application on soil enzyme activities and leghaemoglobin content in nodules of green gram (*Vigna radiata* L.). ***International Journal of Current Research***, *5*(10), 3035-3037.

Singh, M. (2021).Organic farming for sustainable agriculture. ***Indian Journal of Organic Farming***, *1*(1), 1-8.

Singh, P. K., Sahu, P., & Shalini, G. P. (2019). Effect of vermicompost developed from municipal solid waste on rhizome yield, photosynthetic pigments and metabolism of mango ginger (*Curcuma amada* Roxb.) grown in highly degraded sodic soil. ***Horticulture International Journal***, *3*(5), 252-259.

Singh, S. M., Gangwar, G. R., Prakash, O., & Rachna, R. (2010). Biocomposting of extracted peppermint plant residue (*Mentha piperita*) using red worm, *Eisenia fetida* and its effect on the growth of *Vigna mungo* (Urad). ***Journal of Applied and Natural Science***, *2*(2), 305-312.

Singh, S., Kumar, R., Meena, R. S., Meena, V. S., & Singh, B. R. (2022). Organic farming: change in productivity of farm products and soil health. ***Vigyan Varta***, *3*(9), 117-125.

Singh, V., Shrivastava, A., Jadon, S., & Bhadauria, S. (2013). Antimicrobial activity and phytochemical analysis of *Withania Somnifera* leaf, stem and root extracts in different solvents on gram positive and gram negative bacteria and fungus. ***International Journal of Indigenous Medicinal Plants***, *46*(4), 1391-1399.

Sinha, S. K., Kumar, A. D., Kumari, A., & Singh, A. K. (2024). The integrated effect of organic manure, biofertilizer and inorganic fertilizer on soil properties, yield and quality in sugarcane plant-ratoon system under calcareous soil of Indo-gangetic plains of India. ***Journal of Scientific Research and Reports,*** *30*(5), 193-206.

Sipai, A.H., Sevak, K., Addangadi, K., & Chaudhary, A.N. (2018). Influence of different modules on yield, nutrient uptake and soil physicochemical properties of mothbean [*Vigna aconitifolia* (Jacq.) Marchel]. ***Journal of Crop and Weed***, *14*(1), 44-49.

Sivasankari, B. (2016). Influence of inorganic fertilizer supplemented organic manure (vermicompost) on the growth and yield of an edible leguminous plant in South India. ***International Journal of Innovative Research in Science, Engineering and Technolog*****y**, *5*(5), 8687-8697.

Sleutel, S., Neve, S. D., Nemeth, T., Toth, T., & Hofmana, H. (2006). Effect of manure and fertilizer application on the distribution of organic carbon in different soil fractions in long-term field experiments. ***European Journal of Agronomy***, *25*(3), 280–288.

Soma, R., Kiranmayee, R., Bhuvaneswari, C., Archana, G., & Mangamoori, L. N. (2010). Phytochemical analysis of *Andrographis paniculata* extract and its antimicrobial activity. ***World Journal of Microbiology & Biotechnology***, *26*(1), 85-91.

Sreeramulu, D., Reddy, C., & Raghunath, M. (2009). Antioxidant activity of commonly consumed cereals, millets, pulses and legumes in India. ***Indian Journal of Biochemistry and Biophysics,*** *46*(1), 112-115.

Srijayam, M., & Manivannan, S. (2015). Microbial diversity and activity during recycling of coffee husk blended with different organic waste using indigenous earthworm *Perionxy ceylanensis*. ***International Journal of Modern Research and Reviews***, *3*(11), 1054-1057.

Srivastava, V., Goel, G., Thakur, V. K., Singh, R. P., de Araujo, A. S. F., & Singh, P. (2020). Analysis and advanced characterization of municipal solid waste vermicompost maturity for a green environment. ***Journal of Environmental Management***, *255*, 109914.

Stanford, D., & English, L. (1949). Use of flame photometer in rapid soil tests of K and Ca. ***Agronomy***, *41*(9), 446-447.

Subbiah, B.V., & Asija, G.L. (1956).A rapid procedure for estimation of available nitrogen in soils. ***Current Science***, *25*(8), 259-260.

Sujatha, S., & Bhat, R. (2012). Impacts of vermicompost and nitrogen, phosphorus, and potassium application on soil fertility status in arecanut grown on a laterite soil. ***Communications in Soil Science and Plant Analysis***, *43*(18), 2400-2412.

Suwarto.,& Asih, R. (2021). Growth of legume cover crops under cassava and its effect on some soil properties. ***Legume Research***, *44*(9), 1077-1081.

Syed, M. H., Yasmeen, A., Hussain, M. S., Subramanian, N. S., & Ramadevi, M. (2013). Preliminary phytochemical screening and HPTLC fingerprinting of leaf extracts of *Pisonea aculeata*. ***Journal of Pharmacognosy and Phytochemistry***, *2*(1), 36-42.

Tagore, G. S., Namdeo, S. L., Sharma, S. K., & Kumar, N. (2013). Effect of *Rhizobium* and phosphate solubilizing bacterial inoculants on symbiotic traits, nodule leghaemoglobin and yield of chickpea genotypes. ***International Journal of Agronomy***, *2013*(1), 1-9.

Taiwo, L. B., & Oso, B. A. (2004). Influence of composting techniques on microbial succession, temperature and pH in a composting municipal solid waste. ***African Journal of Biotechnology,*** *3*(4), 239-243.

Tajini, F., Trabelsi, M., & Drevon, J. J. (2012). Combined inoculation with *Glomus intraradices* and *Rhizobium tropici* CIAT899 increases phosphorus use efficiency for symbiotic nitrogen fixation in common bean (*Phaseolus vulgaris* L.). ***Saudi Journal of Biological Sciences***, *19*(2), 157-163.

Talei, D. (2018). Photosynthesis and antioxidative systems of *Andrographis paniculata* as affected by compost tea rates. ***Journal of Medicinal plants and By-product***, *7*(2), 221-227.

Tarozzi, A., Hrelia, S., Angeloni, C., Morroni, F., Biagi, P., Guardigli, M., Cantelli- Forti, G., & Hrelia, P. (2006).Antioxidant effectiveness of organically and non-organically grown red oranges in cell culture systems. ***European Journal of Nutrition***, *45*(3), 152-158.

Teja, K. S., Sivaram, G. T., Yuvaraj, K. M., Kadiri, L., & Rao, M. P. (2022).Effect of different dates of sowing, organic manures on protein, fiber and alkaloid content in leaves and roots of ashwagandha (*Withania somnifera*). ***The Pharma Innovation Journal***, *11*(9), 522-524.

Thiyageshwari, S., Gayathri, P., Krishnamoorthy, R., Anandham, R., & Paul, D. (2018). Exploration of rice husk compost as an alternate organic manure to enhance the productivity of blackgram in typic haplustalf and typic rhodustalf. ***International Journal of Environmental Research and Public Health***, *15*(2), 358-371.

Toor, R. K., Savage, G. P., & Heeb, A. (2006). Influence of different types of fertilizers on the major antioxidant components of tomatoes. ***Journal of Food Composition and Analysis,*** *19*(1), 20-27.

Uckoo, R. M., Jayaprakasha, G. K., & Patil, B. S. (2015).Phytochemical analysis of organic and conventionally cultivated Meyer lemons (*Citrus meyeri* Tan.) during refrigerated storage. ***Journal of Food Composition and Analysis***, *42*(3), 63-70.

Uma, B., & Malathi, M. (2009).Vermicompost as a soil supplement to improve growth and yield of *Amaranthus* species.***Research Journal of Agriculture and Biological Sciences***, *5*(6), 1054-1060.

Umeh, O. A., Ebunilo, V. C., & Umeh, I. S. (2024). Effects of organic soil amendment on the growth and yield of okra (*Abelmoschus esculentus*) in Ifite Ogwari, Southeastern Nigeria. ***In:e-Proceedings of the Faculty of Agriculture International Conference,*** Nnamdi Azikiwe University, Awka, Nigeria, 12 - 14th March, 74-80.

Updegroff, D.M. (1969), Semi-micro determination of cellulose in biological materials. ***The Annual Review of Biochemistry***, *32*(3), 420-444.

Uthirapandi, V., Subramanian, S. R., Ponnerulan, B., Saminathan, E., Narayanan, V., & Durairaj, K. (2021). Andrographolide production and enhanced antioxidant activity in *Andrographis paniculata* (Burm f.) Nees.promoted by seaweed liquid extracts. ***Brazilian Journal of Botany***, *44*(2), 317-330.

Van Chuong, N. (2023). Response of peanut quality and yield to chicken manure combined with *Rhizobium* inoculation in sandy soil. ***Communications in Science and Technology***, *8*(1), 31-37.

Varghese, S. M., & Prabha, M. L. (2014).Biochemical characterization of vermiwash and its effect on growth of *Capsicum frutescens*. ***Malaya Journal of Biosciences***, *1*(2), 86-91.

Veeresh, S. J., Narayana, J., & da Silva, J. T. (2010). Influence of jeevamrutha (biodynamic formulation) on agro-industrial waste vermicomposting. ***Dynamic Soil, Dynamic Plant****,4(1),* 96-99.

Velmourougane, K., & Raphael, K. (2012).Vermicomposting of coffee processing wastes. ***Dynamic soil, Dynamic Plant***, *6*(1), 110-116.

Verma, S. R., Shivran, A. C., Bhanwaria, R., & Singh, M. (2014). Effect of vermicompost and sulphur on growth, yield and nutrient uptake of fenugreek (*Trigonella foenum-graecum* L.). ***The Bioscan***, *9*(2), 667-670.

Verma, S. R., Shivran, A., Bhanwaria, R., & Singh, M. (2017). Effect of vermicompost and sulphur on growth, yield and nutrient uptake of fenugreek (*Trigonella foenum-graecum* L.). ***Trends in Biosciences***, *10*(20), 3978-3981.

Verrillo, M., Koellensperger, G., Puehringer, M., Cozzolino, V., Spaccini, R., & Rampler, E. (2023).Evaluation of sustainable recycled products to increase the production of nutraceutical and antibacterial molecules in basil plants by a combined metabolomic approach. ***Plants***, *12*(3), 513-537.

Viji, J., & Neelanarayanan, P. (2015). Efficacy of lignocellulolytic fungi on the biodegradation of paddy straw. ***International Journal of Environmental Research***, *9*(1), 225-232.

Visuvanathan, T., Than, L. T. L., Stanslas, J., Chew, S. Y., & Vellasamy, S. (2022). Revisiting *Trigonella foenum-graecum* L. pharmacology and therapeutic potentialities. ***Plants***, *11*(11), 1450.

Voko, M. P., Kulkarni, M. G., Ngoroyemoto, N., Gupta, S., Finnie, J. F., & Van Staden, J. (2022). Vermicompost leachate, seaweed extract and smoke-water alleviate drought stress in cowpea by influencing phytochemicals, compatible solutes and photosynthetic pigments. ***Plant Growth Regulation***, *97*(2), 327-342.

Walkley, A., & Black, C.A. (1934).An examination of the Degtjareff method for determining organic carbon in soils, ***Soil Science***, *37*(1), 29-38.

Wang, D., Shi, Q., Wang, X., Wei, M., Hu, J., Liu, J., & Yang, F. (2010). Influence of cow manure vermicompost on the growth, metabolite contents, and antioxidant activities of Chinese cabbage (*Brassica campestris* ssp. *chinensis*). ***Biology and Fertility of Soils***, *46*(7), 689-696.

Wang, S. Y., & Lin, H. S. (2003). Compost as a soil supplement increases the level of antioxidant compounds and oxygen radical absorbance capacity in strawberries. ***Journal of Agricultural and Food Chemistry***, *51*(23), 6844-6850.

Wang, X. X., Zhao, F., Zhang, G., Zhang, Y., & Yang, L. (2017). Vermicompost improves tomato yield and quality and the biochemical properties of soils with different tomato planting history in a greenhouse study. ***Frontiers in Plant Science***, *8*, 01978.

Wang, J., Han, G., Duan, Y., Han, R., Shen, X., Wang, C., Zhao, L., Nie, M., Du, H., Yuan, X., & Dong, S. (2024). Effects of different organic fertilizer substitutions for chemical nitrogen fertilizer on soil fertility and nitrogen use efficiency of foxtail millet. ***Agronomy***, *14*(4), 866.

Waqas, M., Nizami, A. S., Aburiazaiza, A. S., Barakat, M. A., Rashid, M. I., & Ismail, I. M. I. (2018).Optimizing the process of food waste compost and valorizing its applications:A case study of Saudi Arabia. ***Journal of Cleaner Production***, *176*(1), 426-438.

Wei, H., Tucker, M. P., Baker, J. O., Harris, M., Luo, Y., Xu, Q., E Himmel, M., & Ding, S. Y. (2012).Tracking dynamics of plant biomass composting by changes in substrate structure, microbial community and enzyme activity. ***Biotechnology for Biofuels***, *5*(1), 1-14.

Williams, D. H., & Fleming, I. (1973). Spectroscopic methods in Organic Chemistry, *2nd ed.; McGraw-Hill: New York*, 74−146.

Yadav, J. K., Sharma, M., Yadav, R. N., Yadav, S. K., & Yadav, S. (2017). Effect of different organic manures on growth and yield of chickpea (*Cicer arietinum* L.). ***Journal of Pharmacognosy and Phytochemistry***, *6*(5), 1857-1860.

Yadav, U. C., & Baquer, N. Z. (2014). Pharmacological effects of *Trigonella foenum-graecum* L. in health and disease. ***Pharmaceutical Biology***, *52*(2), 243-254.

Yaduvanshi, N. P. S. (2003). Substitution of inorganic fertilizers by organic manures and the effect on soil fertility in a rice–wheat rotation on reclaimed sodic soil in India. ***The Journal of Agricultural Science***, *140*(2), 161-168.

Yaldiz, G., Arici, Y. K., & Yilmaz, G. (2017). Phytochemical analysis, antioxidant and antibacterial activities of four Lamiaceae species cultivated in barnyard manure. ***Journal of Agricultural Sciences***, *23*(1), 95-108.

Yassen, A. A., Essa, E. M., Marzouk, N. M., & Zaghloul, S. M. (2020). Impact of vermicompost and foliar spray of vermiwash on growth, yield and nutritional status of lettuce plants. ***Plant Archives***, *20*(1), 449-455.

Younis, U., Danish, S., Malik, S. A., Ahmed, N., Munir, T. M., & Rasheed, M. K. (2020). Role of cotton sticks biochar in immobilization of nickel under induced toxicity condition and growth indices of *Trigonella corniculata* L. ***Environmental Science and Pollution Research,*** *27*(2), 1752-1761.

Zahid, L., & Niazi, M. F. K. (2006). Role of ristech material in the reclamation of saline-sodic soils. ***Pakistan Journal of Water Resources***, *10*(1), 43-49.

Zaman, M. M., Chowdhury, M. A. H., Islam, M. R., & Uddin, M. R. (2015). Effects of vermicompost on growth and leaf biomass yield of *stevia* and post harvest fertility status of soil. ***Journal of the Bangladesh Agricultural University***, *13*(2), 169-174.

Zambrano-Moreno, E. L., Chávez-Jáuregui, R. N., Plaza, M. D. L., & Wessel-Beaver, L. (2015). Phenolic content and antioxidant capacity in organically and conventionally grown egg plant (*Solanum melongena*) fruits following thermal processing. ***Food Science and Technology***, *35*(3) 414-420.

Zapałowska, A., & Jarecki, W. (2024).The impact of using different types of compost on the growth and yield of corn. ***Sustainability***, *16*(2), 511.

Zhou, H., Di, L., Hua, X., Deng, T., & Wang, X. (2023a). Bacterial community drives the carbon source degradation during the composting of *Cinnamomum camphora* leaf industrial extracted residues. ***Microbiology Research***, *14*(1), 229-242.

Zhou, H., Di, L., Hua, X., Deng, T., & Wang, X. (2023b). The addition of a small dose of *Cinnamomum camphora* biomass unexpectedly enhanced lignocellulose degradation during the compost of *Stropharia rugosoannulata* cultivation materials. ***Sustainability***, *15*(13), 1-14.

Zou, Y., & Yang, T. (2019). Rice husk, rice husk ash and their applications. ***In: Rice Bran and Rice Bran Oil.*** (American oil Chemists' society), AOCS Press, ***Elsevier***, 1st Eds, 207-246.

Appendices

APPENDICES

APPENDIX – I

ESTIMATION OF LIGNIN

(Goering and Vansoest, 1975)

Principle

Refluxing the sample material with acid detergent solution removes the water soluble and materials other than the fibrous component. The left out material is weighed after filtration, dried, treated with 72% H_2SO_4 and filtered, dried and ashed. The loss of weight on ignition gives the acid detergent lignin.

Reagents

- Acid Detergent Solution
- Dissolve 20 g of acetyl trimethyl ammonium bromide in one litre of 1 N sulphuric acid.
- 72% H_2SO_4 (W/V)
- Acetone
- Round Bottom Flask and Refluxing Set
- Muffle Furnace
- Sintered Glass Crucible – G2

Procedure

A. Acid Detergent Fibre (ADF)

- 1gm of powdered sample and 100ml of acid detergent solution was placed in a round bottom flask and boiled for 5 – 10 minutes. The heat was reduced to avoid foaming as boiling begins. Refluxing was done for 1 hour after the onset of boiling. Boiling was adjusted to slow, even level.
- The container was removed, swirled and filtered the contents through a preweighed sintered glass crucible (G2) by suction and washed with hot water twice.
- Then, washed with acetone and break up the lumps. Acetone washing was repeated until the filtrate was colourless.

Method

- Dried at 100^{o}C for overnight.
- Weighed after cooling in a desiccator.
- ADF content was expressed in percentage i.e., W/S x 100, Where W is the weight of the fibre and S is the weight of the sample.

B. Determination of Acid Detergent Lignin (ADL)

- ADF was transferred to a 100 ml beaker with 25 - 50 ml of 72% sulphuric acid. 1g of asbestos was added to it. It was allowed to stand for 3 hrs with an intermittent stirring with a glass rod.
- The acid was diluted with distilled water and filtered with pre weighed Whatman No. 1 filter paper. The glass rod and the residue were washed several times to get rid of the acid.
- The filter paper was dried at 100^{o}C and weighed after cooling in a desiccator.
- The filter paper was transferred to a preweighed silica crucible and ashed the filter paper with the content in a muffle furnace at 550 ^{o}C for about 3 hrs.
- The crucible was cooled in a desiccator and weighed. The ash content was calculated.
- 1 g asbestos was taken as blank and then added 72% H_2SO_4 and followed the steps from 2 - 5.

Calculation

$$\text{ADL (\%)} = \frac{\dfrac{\text{Weight 72\% } H_2SO_4 \text{ washed fiber}}{\text{(Test – Asbestos blank}} - \dfrac{\text{Ash}}{\text{(Test – Asbestos blank)}}}{\text{Weight of sample}} \times 100$$

APPENDIX – II

ESTIMATION OF CELLULOSE

(Updegroff, 1969)

Principle

Cellulose undergoes acetolysis with acetic/nitric reagent forming acetylated cello dextrins which get dissolved and hydrolyzed to form glucose molecules upon treatment with 67% H_2SO_4. This glucose molecule is dehydrated to form hydroxyl methyl furfural which forms green coloured product with anthrone and the colour intensity is measured at 630 nm.

Reagents

- Acetic/Nitric reagent: 150 ml of 80% acetic acid was mixed with 15 ml of concentrated nitric acid.
- Anthrone reagent: 200 mg of anthrone was dissolved in 100 ml concentrated sulphuric acid and chilled for two hrs before use.
- 67% sulphuric acid.

Procedure

A quantity of 0.1 g of sample was taken in a test tube, to which 3 ml of acetic/nitric reagent was added and mixed well and kept in a water bath for 30 minutes. It was cooled and centrifuged for 15 - 20 minutes after which the supernatant was discarded. The residue was washed with distilled water and 10 ml of 67% H_2SO_4 was added and allowed to stand for 1 hr. 1ml of the solution was taken and diluted to 100ml. From the above diluted solution, 1ml was taken, to which 10ml of anthrone reagent was added and kept in a boiling water bath for 10 minutes. It was then, cooled and the absorbance was measured at 630 nm. A blank was set with anthrone reagent and distilled water. The amount of cellulose present in the sample was calculated using a standard graph corresponding to 40 - 200 µg of cellulose.

APPENDIX - III

ESTIMATION OF ORGANIC CARBON (%)

WET CHROMIC ACID OXIDATION METHOD

(Walkey and Black, 1934)

Principle

Organic carbon present in organic matter is oxidised by chromic acid in the presence of conc. H_2SO_4. Potassium dichromate on reaction of H_2SO_4 provides nascent oxygenwhich combines with carbon and form CO2. The H_2SO_4 enables easy digestion of organic matter by rendering heat of dilution. Only a certain quantity of chromic acid is used for oxidation. The excess chromic acid left unused by the organic matter is determine by back titration with 0.5 N ferrous sulphate or ferrous ammonium sulphate using diphenylamine indicator.

Reagents

- 1 N potassium dichromate: Exactly 49.04 g of $K_2Cr_2O_7$ was dissolve in one litre of distilled water.
- Diphenylamine indicator: 0.5 g diphenylamine was dissolved in 20 ml of water and 100 ml of Conc. H_2SO_4 was added.
- 0.5 N ferrous sulphate or ferrous ammonium sulphate: 139.0 g of ferrous sulphate or 196 g of ferrous ammonium sulphate was dissolved in 800 ml of distilled water. 20 ml of Conc. H_2SO_4 was added and the volume was made up to one litre.
- Conc. H_2SO_4
- Phosphoric acid (Orthophosphoric acid 85%).

Procedure

Exactly 0.5gm of soil (passed through 0.2 mm sieve) was weighed and transferred to 500 ml conical flask. 10ml of 1N $K_2Cr_2O_7$ was added and mixed well by swirling the

flask. Added 20ml of conc. H_2SO_4 mixed by gentle rotation for one minute to ensure complete contact of the reagent with the soil. Allowed the contents to stand for 20-30 minutes. Kept the flask on asbestos sheet to avoid burning of table due to intense heat. Added 200ml of water after 30 minutes.Then added 10 ml of phosphoric acid and 1 ml of diphenylamine indicator.Titrated the solution with 0.5N ferrous ammonium sulphate. As the titration color proceeds the dull green shifted to turbid blue at the end point bright green colour developed. Conducted simultaneously a blank titration (without soil) and the volume of 0.5N ferrous ammonium sulphate consumed was noted.

CALCULATION

Weight of soil taken	= 0.5g
Volume of 1N $K_2Cr_2O_7$	= 10ml
Volume of 0.5N ferrous ammonium sulphate used for blank titration	= X ml (Sample T. V)
Volume of 0.5N ferrous ammonium sulphate used for blank titration	= Y ml (Sample T. V)
Xml of $FeSO_4$ reduces 10ml of 1N $K_2Cr_2O_7$	
Therefore, Yml of FeSO4 reduces Y/X* 10ml	
Hence actual quantity of 1N $K_2Cr_2O_7$ used for oxidation of organic matter	= 10 - (10 x Y/X)
1ml of 1N $K_2Cr_2O_7$	= 0.003g of 'C'
Therefore 10 – (10 x Y/X) ml of 1N $K_2Cr_2O_7$	= 10 - (10 x Y/X) x 0.003
This is present in 0.5g of soil	
Therefore in 100g	= 10 - (10 x Y/X) x 0.003 x 100/0.5
Organic matter (surface soil)	= organic carbon x 1.724
Organic matter (sub surface soil)	= organic carbon x 2.5

APPENDIX - IV

ESTIMATION OF TOTAL NITROGEN (%)

MICROKJELDHAL METHOD

(Humphries, 1956)

Principle

A known weight of the powdered sample was treated with diacid mixture so as to oxidize the organic matter and bring the mineral elements into solution.

Reagents

1. Diacid mixture: 4:1 (w/w) ratio of concentrated sulphuric acid and concentrated perchloric acid.

2. Mixed indicator: 0.5g bromocresol green and 1g of methyl red were dissolved in 100ml of 90% ethyl alcohol.
3. 40% sodium hydroxide solution.
4. 2% boric acid.
5. Concentrated sulphuric acid (0.02 N).

Procedure

1. A quantity of 0.2g of dried, sieved and homogenized sample was taken in a micro kjeldhal digestion flask (50ml capacity) to which 12ml of diacid was added.
2. Complete digestion was ensured by adding one drop of perchloric acid and the contents turns colourless like water.
3. The volume was made upto 100ml with distilled water.
4. 10ml aliquot was pipette out into a Wagnor- Parnas distillation apparatus and 10ml of 2% boric acid with mixed indicator was kept in a beaker at the delivery end of the distillation apparatus.
5. To the distillation apparatus, 10ml of 40% sodium hydroxide was added and steam distilled. The distillate was collected until no more ammonia was evolved.
6. The contents of the beaker were titrated against 0.02 N sulphuricacid until a red colour was appeared.

Total nitrogen content of the sample was determined by the formula.

$$\text{Total nitrogen (\%)} = \frac{0.00028 \times T.V \times 100 \times 100}{10 \times 0.2}$$

Where,

T.V	=	Titre value.
0.00028	=	1ml of 0.02 N sulphuric acid utilized.
10	=	Volume of extract taken for distillation (ml).
0.2	=	Weight of sample (g).
100	=	Total volume (ml).

APPENDIX - V

ESTIMATION OF TOTAL PHOSPHORUS (%)

(Jackson, 1973)

Princple

Phosphorus is precipitated as ammonium phosphomolybdate in nitric acid medium. The precipitate is filtered, washed free of acid, dissolved in a known excess of standard alkali and the excess alkali is determined by back titration with a standard acid using phenolphthalein indicator.

Reagent

- Hydrochloric acid – 1:1
- Nitric acid – 1:1
- Conc. ammonium hydroxide
- Conc. nitric acid
- Solid ammonium nitrate
- Ammonium molybdate solution – 20 percent
- Potassium hydroxide – 0.1619N
- Nitric acid - 0.1619N
- Phenolphthalein

Procedure

- 200 ml of HCl extract of the sample was pipette out into a 400 ml beaker and evaporated to a small volume.
- Then, it was transferred to a silica basin using hot water and evaporated to dryness over a water bath.
- The silica basin was kept in an air oven at 105 to 110 ^{o}C for 3 hours to dehydrate the silica
- This residue was dissolved by adding a small quantity of 1:1 hydrochloric acid and evaporated to dryness over a water bath.
- The residue was again dissolved in nitric acid adding sufficient amount of nitric acid to dissolve the same.
- The insoluble silica was allowed to settle overnight and then filtered through No. 42 filter paper and the residue was washed in the silica basin and on the filter paper with small quantities of 1:4 nitric acid till no yellow colour was left either in the basin or in the filter paper. The filtrate was collected in a 250 ml beaker.
- The extract was made alkaline with conc. ammonium hydroxide.
- To this, 5g of solid ammonium nitrate was added and kept on a thermostat at 65 ^{o}C for 15 minutes.

- The precipitant mixture was prepared by taking 7 ml of conc. nitric acid and 3 ml of distilled water in a 100 ml beaker and 10 ml of 20 percent ammonium molybdate was added to this solution drop by drop with constant stirring.
- 10 ml of this precipitant mixture was added drop by drop to the beaker in the thermostat with constant stirring and kept in the thermostat for another half an hour at 65 ^{o}C and allowed the precipitate to settle well.
- Then, it was filtered through No.40 filter paper by decantation, pouring only the supernatant liquid to the filter paper.
- The precipitate was then washed with cold distilled water till the filtrate runs free of acid.
- The filter paper was then transferred with the precipitate to the same beaker in which precipitation was done and enough water was added to make the filter paper into a pulp.
- Now, 0.1619N KOH was added from the burette, till the yellow precipitate was completely dissolved leaving a colourless solution. Then, another 5 ml of 0.1619N KOH was added to keep the alkali in fair excess quantity.
- A drop of phenolphthalein was added and the excess alkali was titrated against 0.1619N nitric acid. Disappearance of pink colour indicated the end point.

Calculation

Weight of sample taken = W g

Volume of HCl extract prepared = 500 ml

Volume of HCl extract pipette out for analysis = 200 ml

Volume of 0.1619N KOH added in excess = a ml

Volume of 0.1619N HNO_3 used for back titration = b ml

Therefore, actual volume of 0.1619N KOH used to dissolve the precipitate = (a-b)

1 ml of 0.1619N KOH = 0.0005g P_2O_5

(a-b) ml of 0.1619N KOH = 0.0005 x (a-b) x gP_2O_5

This was present in 200 ml of HCl extract

Therefore, in 500 ml = 0.0005 x (a-b) x 500/200

This was present in W g of sample

Therefore, in 100 g = 0.0005 x (a-b) x 500/200 x 100/W

Percentage of P_2O_5 on moisture free basis

= 0.0005 x (a-b) x 500/200 x100/W x 100/(100 – M)

(M – Moisture content of the sample)

APPENDIX - VI
ESTIMATION OF TOTAL POTASSIUM (%)
FLAME PHOTOMETER METHOD
(Jackson, 1973)

Principle

Certain elements when excited in flame, emit radiation. The excitation causes one of the outer electrons of neutral atoms to jump to an outer orbit of higher energy level or the atoms may be excited sufficiently to loose an electron completely. When excited atoms return to lower energy levels, light of characteristics wavelength is emitted. The flame photometer measures this radiation intensity which is proportional to the concentration in a solution.

Preparation

1.907g of KCl was dissolved in 1 litre of distilled water (1000 ppm of K). From this, various standards were prepared ranging from 10 to 100ppm.

Procedure

- The atomizer was fixed in its place and introduced with distilled water.
- The compressor was started and the air pressure was adjusted to 10 psi.
- The gas was opened to light the burner through the window. Flow of gas was adjusted to give a central bluish cone.
- Zero was set with distilled water by using the zero adjustment knob. Then, 100 ppm K solution was introduced and adjusted to read 100 on the scale. Again distilled water was introduced and adjusted to zero. This process was repeated till the metre reading showed zero with distilled water at 100 on the scale with 100 ppm solution without zero adjustment.
- Then, various standard solutions were introduced, the readings were recorded and the standard curve was drawn.
- The filtrate was taken from sesquioxide estimation in a small vial and introduced through the atomizer. The readings were recorded and the percentage of K was calculated by using the standard curve.

Calculation

Weight of sample taken	= W g
Volume of HCl extract prepared	= 500 ml
Volume HCl extract pipette out	
For sesquioxide estimation	=50 ml
Volume of sesquioxide filtrate made up to	= 250 ml
Metre reading	= G

Equivalent ppm from standard curve = A

i.e. 1 ml of the solution contains

A microgram of K = $A/10^6$g of K

Therefore, in 250 ml of the solution = $A/10^6$ x 250

This was present in 50 ml of HCl extract

Therefore, in 500 ml = $A/10^6$ x 250 x 500/50 g

This was present in W g of sample

Therefore, in 100 g = $A/10^6$ x 250 x 500/50 x 100/W g

Percentage of K on moisture free basis

= $A/10^6$ x 250 x 500/50 x 100/W x100/(100 – M)

(M – Moisture content of sample)

APPENDIX- VII

ESTIMATION OF CALCIUM AND MAGNESIUM (%)

VERSANATE METHOD

(Jackson, 1973)

Principle

Calcium and magnesium get complexed by EDTA in the order calcium first followed by magnesium. Calcium is estimated first by using murexide indicator at pH 12 in the presence of sodium hydroxide. Then calcium and magnesium is estimated using Erichrome Black – T at pH 10 in the presence of ammonium chloride and ammonium hydroxide buffer solution.

Reagents

- 0.02 N EDTA
- 10% sodium hydroxide
- Ammonium chloride – ammonium hydroxide buffer solution
- Murexide solution
- Erichrome Black – T indicator

Procedure

Calcium alone

- Pipette out 10 ml of seaqui oxide filterate into a porcelain basin.
- Add 10% sodium hydroxide solution drop by drop to neutralise the activity (red litmus turns blue) and another 5ml excess to maintain the pH at 12.
- Add a pinch (50 mg) of murexide indicator and titrate with 0.02N EDTA till the colour changes from pinkish red to purple or violet.

Calcium and Magnesium

- Pipette out 10 ml of seaqui oxide filterate into a porcelain basin.
- Add ammonium chloride – ammonium hydroxide buffer solution drop by drop to neutralise the acidity (use red litmus paper) and 5 ml excess to maintain the pH at 10.
- Add 2 – 3 drop of Erichrome Black – T indicator solution and titrate with 0.02 N EDTA till the colour changes from purple red to sky blue.

Calculation

Weight of the sample taken = W g

Volume of hydrochloric acid extract prepared = 500 ml

Volume of hydrochloric acid extract pipette out for R_2O_3 estimation = 50 ml

Volume of R_2O_3filterate made upto = 250 ml

Volume of R_2O_3filterate pipetted out for calcium estimation = 10 ml

Volume of 0.02 N EDTA used for calcium and magnesium = a ml

Volume of 0.02 N EDTA used for calcium alone = b ml

Volume of 0.02 N EDTA used formagnesium alone = (a – b) ml

1 ml of 0.02 N EDTA = 0.0004 g calcium

1 ml of 0.02 N EDTA = 0.0004 g magnesium

Percentage of calcium on moisture free basis

$$= 0.0004 \times b \times \frac{250}{10} \times \frac{500}{50} \times \frac{100}{W} \times \frac{100}{(100-M)}$$

Percentage of magnesium on moisture free basis

$$= 0.00024*(a - b) \times \frac{250}{10} \times \frac{500}{50} \times \frac{100}{W} \times \frac{100}{(100-M)}$$

M = Moisture basis

APPENDIX – VIII

ESTIMATION OF PROTEIN (Lowry *et al*., 1951)

Principle

The blue colour developed by the reduction of the phosphomolybdic phospho tungstic components in the Folin - Ciocalteau reagent by the amino acids tyrosine and tryptophan present in the protein plus the colour developed by the biuret reaction of the protein with the alkaline cupric tartrate are measured in the Lowry's method.

Materials

- 2 % sodium carbonate in 0.1 N sodium hydroxide (Reagent A).
- 0.5 % copper sulphate ($CuSO_4$. $5H_2O$) in 1% potassium sodium tartrate (Reagent B).
- Alkaline copper solution: 50 ml of reagent A and 1ml of reagent B were mixed prior to use (Reagent C).
- Folin-Ciocalteau reagent (Reagent D).
- Protein solution (stock standard): Weighed accurately 50mg of bovine serum albumin (fraction V) and dissolved in distilled water and made up to 50 ml in a standard flask.

Working standard

10 ml of the stock solution was diluted to 50 ml with distilled water in a standard flask. 1ml of this solution contains 200 µg protein.

Procedure

Extraction of Protein from Sample

Extraction is carried out with buffers used for the enzyme assay. About 50mg of the sample was taken and ground well with a pestle and mortar in 5-10 ml of the buffer and centrifuged. The supernatant was used for protein estimation.

Estimation of Protein

A quantity of 0.2, 0.4, 0.6, 0.8 and 1ml of aliquots of the working standard were pipetted into a series of test tubes 0.1ml and 0.2ml of the sample extract in two other test tubes. The volume was made up to 1ml in all test tubes. A test tube with 1ml of water served as the blank. 5ml of reagent C was added to each tube including the blank, mixed well and allowed to stand for 10minutes. Then, 0.5ml of reagent D was added, mixed well and incubated at room temperature in the dark for 30 minutes. Blue colour developed was read in a spectrophotometer (UV-vis Spectrophotometer model 108, Systronics, India). A standard graph was drawn and the amount of protein in the sample was calculated

Calculation

Expressed the amount of protein mg/g or 100 g sample.

$$= \frac{\text{mg of protein}}{\text{volume of test standard}} \times \text{concentration of the standard}$$

APPENDIX – IX

ESTIMATION OF CARBOHYDRATE (Hedge and Hofreiter, 1962)

ANTHRONE METHOD

Principle

Carbohydrates are first hydrolysed into simple sugars using dilute hydrochloric acid. In hot acidic medium, glucose is dehydrated to hydroxymethyl furfural. This compound forms a green colour in a dilute solution and a blue color in a concentrated solution. This compound forms a green colored product with an absorption maximum at 630 nm.

Materials

- 2.5 N HCl
- Anthrone reagent: 200 mg anthrone was dissolved in 100 ml of ice cold 95% H_2SO_4 and it was prepared fresh before use.
- Standard glucose: (Stock) 100 mg of glucose was dissolved in 100ml water.
- Working standard – 10ml of stock solution was diluted in 100ml distilled water and stored in a refrigerator after adding a few drops of toluene.

Procedure

100 mg of the sample (leaf) was taken in a boiling tube with 5ml of 2.5 N HCl, hydrolysed by keeping it in a boiling water bath for three hours and cooled to room temperature. Then, it was neutralized with solid sodium carbonate until the effervescence ceased. The volume was made up to 100ml and centrifuged. The supernatant was collected and 0.5 and 1ml aliquots were taken for analysis. From the working standard, the standard was prepared by taking 0, 0.2, 0.4, 0.6, 0.8 and 1ml and '0' served as blank. The volume was made up to 1ml in all the test tubes including the sample test tubes by adding distilled water. Then, 4ml of anthrone reagent was added and heated for eight minutes in a boiling water bath. Then, it was cooled rapidly and the green colour developed was read at 630nm. A standard graph was drawn by plotting concentration of the standard on the x-axis versus absorbance on the y-axis. From the graph, the amount of carbohydrates present in the sample was calculated.

Calculation

$$\text{Amount of carbohydrate present in 100 mg of the sample} = \frac{\text{mg of glucose}}{\text{volume of test sample}} \times 100$$

APPENDIX – X

ESTIMATION OF CHLOROPHYLL (Arnon, 1949)

Principle

Chlorophyll was extracted in 80% acetone. The absorption at 663 nm, 645 nm and 652 nm were read in a spectrophotometer using the absorption coefficients and the amounts of chlorophyll contents were calculated.

Materials

Analytical grade acetone was diluted to 80 % acetone (prechilled)

Procedure

Accurately weighed 1g of finely cut and well mixed representative leaf sample. It was ground to a fine pulp with the addition of 20ml of 80% acetone with a mortar and pestle and was centrifuged as 5,000 rpm for 5 minutes. The supernatant was transferred to a 100ml volumetric flask. The residue was ground with 20 ml of 80% acetone, centrifuged and the supernatant was transferred to the same volumetric flask. This procedure was repeated until the residue was colourless. The mortar and pestle was also washed thoroughly with 80% acetone and the washing was collected in the volumetric flask. The volume was made up to 100 ml with 80% acetone. The absorbance of the solution was read at 645, 663 and 652 nm against the solvent (80% acetone) blank.

Calculation

The amount of chlorophyll present in the extract was calculated in mg chlorophyll g^{-1} tissues by using the following equations.

(i) Chlorophyll 'a' mg g^{-1} tissues = 12.7A (663) – 2.69 A (645) x $\frac{V}{1000\ x\ W}$

(ii) Chlorophyll 'b' mg g^{-1} tissues = 22.9A (645) – 4.68 A (663) x $\frac{V}{1000\ x\ W}$

(iii) Total Chlorophyll mg g^{-1} tissues = 20.2 A (645) – 8.02 A (663) x $\frac{V}{1000\ x\ W}$

Where,

A = absorbance of specific wavelengths

1. = final volume of chlorophyll extract in 80 % acetone.
2. = fresh weight of tissue extract.

APPENDIX – XI

ESTIMATION OF LEGHAEMOGLOBIN CONTENT

(Appleby and Bergersen, 1980)

Principle

Haemoglobin reacts with pyridine in strong alkali to produce hemochrome. The hemochrome is measured at 556 nm.

Reagents

- Diluent buffer: Sodium (0.1 M) / Potassium phosphate buffer (pH 7.4).
- Alkaline pyridine reagent: Dissolved 0.8 g NaOH in 50 ml water and cool. Added 33.8 ml of pyridine (33.2g), dissolved and diluted to 100 ml with water. This produces 4.2 M pyridine in 0.2 M NaOH. Sodium Dithionate: Ground finely and stored in small stopped tubes in dessicator.
- Potassium Hexacyanoferrate.

Procedure

Extraction: Fresh or thawed nodules were mixed with 1-3 volumes of phosphate buffer and macerated in a mixer. It was filtered through two layers of cheese cloth. The nodules debris was discarded.The turbid reddish brown filtrate was clarified by centrifuging at 10,000 rpm for 10-30 minutes diluted suitably.To a suitable volume (2-5 ml) of the extract, an equal volume alkaline pyridine reagent was added and mixed well.The solution becomes greenish-yellow due to the formation of ferric hemochrome.The hemochrome was taken in equal quantity in two tubes. To one portion, few crystals of sodium dithionate was added to reduce the hemochrome and stirred well without aeration. The absorbance was measured at 556 nm after 2-5 minutes against a reagent blank in a spectrophotometer. To the other portion, a few crystals of potassium hexacyanoferrate was added to oxidize the hemochrome and read at 539 nm in a spectrophotometer after 2-5 minutes against a reagent blank.

Calculation

Lb concentration (mM) = A556 – A539 x 2D/23.4 Where, D is the initial dilution.

(The calculation is based upon the equation $E = 23.4 \times 10^3$ mol^{-1} cm^{-1})

APPENDIX – XII

PRELIMINARY PHYTOCHEMICAL SCREENING

(Shaikh and Patil, 2020)

1. Detection of alkaloids

a. Dragendroff's/Kraut's test: Few ml of filtrate + 1-2 mL *Dragendorff's reagents* appearance of reddish-brown precipitate indicative of alkaloids

b. Mayer's/Bertrand's/ Valser's test: Few ml of filtrate + 1-2 drops of *Mayer's reagent* (Along the sides of test tube) appearance of creamy white/yellow precipitate indicative for alkaloids

2. Detection of flavonoids

a. Alkaline reagent test: 1mL extract + 2mL of 2% NaOH solution (+ few drops dil.HCl) appearance of intense yellow color, becomes colorless on addition of diluted acid is suggestive of flavonoids

b. Plant extract + 10% ammonium hydroxide sol appearance of yellow fluorescence.

c. Lead acetate test: 1 ml of plant extract with few drops of 10% lead acetate solution appearance of yellow precipitate indicative of flavonoids.

d. Shinoda's test/Mg - hydrochloride reduction test: Plant extract is dissolved in 5ml alcohol + Fragments of magnesium ribbon + few drops of conc. HCl appearance of pink to crimson colored solution indicative of flavonoids.

3. Detection of Sterols

a. Libermann - Burchard's test: 50 g extra is dissolved in 2ml acetic anhydride + 1-2 drops of con. H_2SO_4 (along the side of test tube).The appearance of array of color change is indicative of sterols.

4. Detection of Terpenoids

Libermann – Burchard's test: 2ml of chloroform + 5 ml plant extract, (evaporated on water bath) + 3ml conc. H_2SO_4 (boiled on water bath) appearance of grey color solution suggestive of Terpenoids.

5. Detection of Anthroquinones

Bomtrager's test: 10ml of 10% ammonia solution + few ml of filtrate (shaken vigorously for 30 seconds) appearance of pink, violet, or red colored solution indicative of Anthroquinones.

6. Detection of Anthocyanins

HCl test: 2ml plant extract + 2ml of 2N HCl (+ few ml of ammonia) appearencence of pink red sol. which turns blue violet after addition of ammonia indicative of anthocyanins.

7. Detection of Proteins

a. Biuret test: 2ml of filtrate + 1 drop of 2% copersulphate sol. + 1ml of 95% of ethanol + KOH pellets appearance of pink colored solution indicates presence of proteins.(in ehanolic layer)

b. Ninhydrin test: 2ml of filtrate + 2 drops of Ninhydrin solution (10mg ninhydrin + 200 ml acetone) appearance of purple colored solution indicates the presence of proteins, (amino acids).

c. Xanthoproteic test: Plant extract + few drops of conc. Nitric acid appearance of yellow colored solution suggestive of proteins.

8. Detection of Phenolic compounds

a. Ferric chloride test: Extract aqueous solution + few drops 5% ferric chloride solution result in forming dark green/ bluish black color and indicates the presence of Phenolic compounds.

b. Lead acetate test: Plant extract is dissolved in 5ml distilled water + 3ml of 10% lead acetate solution appearance of white precipitate the presence of Phenolic compounds.

c. Ellagic Acid Test: plant extract aqueous solution + 5% glacial acetic acid + 5% sodium nitrite solution appearance of solution turns muddy/ Niger brown precipitate the presence of Phenolic compounds.

9. Detection of Quinones

a. Alcoholic KOH test: 1ml of plant extract + few ml of alcoholic potassium hydroxide **z**: 1ml of filtrate + 1.5 ml of glacial acetic acid + 1 drop of 5% ferric chloride + con. H_2SO_4 (along the side of test tube) formation of a blue colored solution suggestive of cardiac glycosides (in acetic acid layer)

b. Bromine water test: Plant extract + few ml of bromine water appearance of yellow precipitate suggestive of cardiac glycosides.

c. Baljet's test: 2 ml of extract + a drop of Baljet'sreagent appearance of yellow orangecolor indicates the presence of cardiac glycosides.

15. Detection of Glycosides

a. Modified Bontrager's test: Plant extract + ferric chloride solution + boil for 5min + cooled + equal volume of benzene layer is separated + Ammonia solution formation of rose - pink to blood red colored solution indicate the presence of glycosides.

b. Aqueous NaOH test: Alcoholic extract + dissolved in 1 ml of water + few drops of aqueous NaOH solution forms a yellow color.

16. Detection of Lignin: Labat test: Extract solution + Gallic acid forms olive green color.

17. Detection of Coumarins: NaOH test: Plant extract + 10 % NaOH + Chloroform form a yellow color.

18. Detection of volatile oils

Fluorescence test: 10ml of extract, filtered till saturation, exposed to UV light. Appearance of bright pinkish fluorescence indicates the presence of volatile oils.

19. Detection of carotenoids

Carr-Price reaction: 10ml of extract evaporated to dryness + 2-3 drops of saturated solution of antimony tri chloride in chloroform appearance of blue - green color eventually changing to red indicate the presence of carotenoids.

APPENDIX – XIII

ANTIOXIDANT ACTIVITY

DPPH RADICAL SCAVENGING ACTIVITY

(Mensor *et al.*, 2001)

Principle

DPPH radical reacts with an antioxidant compound that can donate hydrogen, and gets reduced. DPPH, when acted upon by an antioxidant, is converted into diphenylpicryl hydrazine. This can be identified by the conversion of purple to light yellow colour.

Reagents

- DPPH - 2, 2-diphenyl-2-picryl hydrazyl hydrate (0.3mM in methanol)
- Methanol

Procedure

The extracts (20 µl) were added to 0.5ml of methanolic solution of DPPH and 0.48 ml of methanol. The mixture was allowed to react at room temperature for 30 minutes. Methanol served as the blank and DPPH in methanol, without the extracts, served as the positive control. After 30 minutes of incubation, the discolouration of the purple colour was measured at 518 nm in a spectrophotometer. The radical scavenging activity was calculated as follows

$$\text{Scavenging activity \%} = \frac{\text{Control} - \text{Sample}}{\text{Control}} \times 100$$

APPENDIX – XIV

HYDROGEN PEROXIDE SCAVENGING ACTIVITY

(Ruch *et al*., 1989)

Principle

The UV absorption of hydrogen peroxide can be easily measured at 230 nm. On scavenging of hydrogen peroxide by the plant extract, the absorption decrease at this wavelength. This property is utilized to quantify their H_2O_2 scavenging ability.

Reagents

- Phosphate buffer (0.1M, pH 7.4)
- H_2SO_4 (40mM) in phosphate buffer

Procedure

A solution of H_2O_2 (40 mM) was prepared in phosphate buffer. Plant extracts at the concentration of 5µl were added to H_2O_2 solution (0.6 ml) and the final volume was made up to 3ml. The absorbance of the reaction mixture was recorded at 230 nm in a spectrophotometer. A blank solution containing phosphate buffer, without H_2O_2 was prepared. The extent of H_2O_2 scavenging of the plant extracts was calculated as

$$\text{\% scavenging of hydrogen peroxide} = \frac{(A0 - A1) \times 100}{A0}$$

A0 - Absorbance of control; A1 - Absorbance in the presence of plant extracts

APPENDIX – XV

NITRIC OXIDE RADICAL SCAVENGING ACTIVITY

(Green *et al.*, 1982)

Principle

At physiological pH, sodium nitroprusside generates nitric oxide which interacts with O2 to produce nitrite ions, which is measured at 546 nm.

Reagent

1. Sodium nitroprusside (100 mM)
2. pH buffers saline (PBS) pH 7.4
3. Griess reagents

Procedure

Sodium nitroprusside (2 ml), phosphate buffered saline (0.5ml) and plant extract (0.5µl) were mixed and incubated at 25°C for 30 minutes. Griess reagent (0.5 ml) was added and allowed to stand for another 30 minutes. The pink colourchromophore was developed and the absorbance was read at 546 nm.

APPENDIX – XVI

REDUCING POWER ASSAY

(Oyaizu, 1986)

Principle

Substances, which have reduction potential, react with potassium ferricyanide (Fe_3^+) to form potassium ferrocyanide (Fe_2^+), which then reacts with ferric chloride to form ferric ferrous complex that has an absorption maximum at 700 nm.

Potassium ferricyanide + Ferric chloride ⟶ Potassium ferrocyanide + Ferrous chloride

Reagents

1. Potassium ferricyanide (1%)
2. Phosphate buffer (0.2 M, pH 6.6),
3. Trichloro acetic acid (10%)
4. Ferric chloride (0.1%)
5. Ascorbic acid (1%)

Procedure

0.5 ml of the plant extracts were mixed with phosphate buffer (2.5 ml) and potassium ferricyanide (2.5 ml). This mixture was kept at 50ºC in water bath for 20 minutes. After cooling, 2.5 ml of 10% trichloro acetic acid was added and centrifuged at 3000 rpm for 10 minutes whenever necessary. The upper layer of solution (2.5 ml) was mixed with distilled water (2.5 ml) and a freshly prepared ferric chloride solution (0.5 ml). The absorbance was measured at 700 nm.

APPENDIX – XVII
ASSESSMENT OF ANTIBACTERIAL ACTIVITY
(WELL DIFFUSION METHOD)
(Bauer *et al*., 1996)

Procedure

Inoculum Preparation

Growth Method

The growth method is performed as follows

1. At least three to five well-isolated colonies of the same morphological type are selected from an agar plate culture. The top of each colony is touched with a loop, and the growth is transferred into a tube containing 4 to 5 ml of a suitable broth medium, such as Nutrient broth.
2. The broth culture is incubated at 35°C until it achieves or exceeds the turbidity (usually 2 to 6 hours)
3. The turbidity of the actively growing broth culture is adjusted with sterile saline or broth to obtain turbidity. This results in a suspension containing approximately 1 to 2 x 10^8 CFU/ml for *Escherichia coli, Vibrio cholera* and *Staphylococcus aureus*.

Inoculation of Test Plates

1. Optimally, within 15 minutes after adjusting the turbidity of the inoculum suspension, a sterile cotton swab is dipped into the adjusted suspension. The swab should be rotated several times and pressed firmly on the inside wall of the tube above the fluid level. This will remove excess inoculum from the swab.
2. The dried surface of a Nutrient agar plate is inoculated by streaking the swab over the entire sterile agar surface. This procedure is repeated by streaking two more times, rotating the plate approximately 60° each time to ensure an even distribution of inoculum. As a final step, the rim of the agar is swabbed.
3. The lid may be left jar for 3 to 5 minutes, but no more than 15 minutes, to allow for any excess surface moisture to be absorbed before applying the drug.
4. The media was punctured by making a well of 6 mm in diameter and filled with 30 µl of a sample. Further the petriplates were placed inversely for complete diffusion and inhibition zones were examined by measuring the diameter (mm) formed around the well after 24 hrs incubation at 37°C. The zones were measured by using standard (Hi-Media) scale.

APPENDIX – XVIII
ESTIMATION OF AVAILABLE NITROGEN IN SOIL
ALKALINE PERMANGANATE METHOD
(Subbiah and Asijia, 1956)

Principle

A known weight of soil is mixed with excess of alkaline permanganate and distilled organic matter present in soil is oxidised by the nascent oxygen liberated by $KMnO_4$ in the presence of NaOH and thus ammonia is released. This released ammonia is absorbed in a known volume of boric acid (2%) containing double indicator and converted to ammonium borate. This ammonium borate is titrated against standard H_2SO_4.

Reagents

- 0.32% $KMnO_4$ solution (3.2 g of $KMnO_4$ dissolved in one litre of distilled water).
- 2.5% NaOH solution (25 g of NaOH dissolved in one litre of distilled water).
- 2% boric acid (20 g of boric acid dissolved in one litre of distilled water).
- N/50 H_2SO_4 (30 ml of Conc. H_2SO_4 is diluted to one litre with distilled water and standardized by titration with N/10 Na_2CO_3. This gives N/10 H_2SO_4. From this N/50 H_2SO_4 is prepared by dilution.
- Double indicator bromocresol green (0.5 g) and methyl red (0.1 g) dissolved in 100 ml and ethyl alcohol.

Procedure

Weighed 20 g of soil and tranferred into a distillation flask.Added 30 ml of distilled water to moist the soil and 1 ml of liquid paraffin.Added few pieces of glass beads to avoid frothing.Added 100 ml of freshly prepared 0.32% $KMnO_4$ and 100 ml 2.5% NaOH to the soil in the distillation flask. A 100 ml beaker containing approximately 20 ml of 2% boric acid with double indicator was kept below the delivery end of the condensor in the distillation set. Distilled the contents and the liberated ammonia was collected in boric acid. Distillation continued until the release of ammonia. Titrate the ammonia collected in boric acid with N/50 H_2SO_4.

Calculation

Weight of the soil taken = 20g

Volume of N/50 H_2SO_4 = Xml (titer value)

1 ml of N/10 H_2SO_4 = 0.0014 gN

Therefore 1 ml of N/50 H_2SO_4 = 0.00028gN

X ml of N/50 H_2SO_4 = 0.00028*XgN

This is present in 20 gm of soil

Therefore N present in Kg/Ha = $0.00028\ (X/20)*10^6$

APPENDIX - XIX
ESTIMATION OF AVAILABLE PHOSPHORUS IN SOIL
CALORIMETRY METHOD
(BRAY 1 METHOD – Jackson, 1973)

Principle

The combination of HCl and NH_4F extracts acid soluble forms of phosphorus such as mono calcium phosphate. The flouride ion has the special property of complexing $Al^{+++}$and Fe^{+++} in acid solution with consequent release of phosphorus held in the soil by these ions. The phosphorus so released into the soil solution in estimated colorimetrically as available phosphorus.

Reagents

- NH_4F solution (1N): 37g of NH_4F was dissolved in 1 litre of distilled water.
- HCl (0.05N): 20.2 ml conc. HCl diluted 500 ml with distilled 500 ml with distill water.
- Bray No. 1 extractant [0.03 NH_4F and 0.02 N HCl]: 15 ml of 1N NH_4F and 25 ml of 0.5N HCl are mixed and the volume was upto 500 ml with distilled water.
- Ascorbic acid.

Procedure

Weighed 5g of soil and transfer to a 100 ml polythene shaking bottle. Added 50 ml of Bray 1 extractant. Shake the contents in a reciprocatory mechanical shaker for one minutes. Filtered the contents through whatman No. 40 filter paper.Simultaneously conducted a blank. Pipetted out 5 ml of filterate into 25 ml volumetric flask. Added 4 ml of reagent B as in Olsen's method and made up the volume to 25 ml. The intensity of the colour developed was measured in a photoelectric calorimeter using filter (660 nm).

Calculation

Weight of soil taken	= 5g
Volumn of $NaHCO_3$	= 50 ml
Volume of extractant solution used for	
Phosphorus estimation (aliqreo)	= 5 ml
calorimeter reading	= T
Concentration of phosphorus read from	
standard graph for the reading T	= X ppm
	= X mg/ml

$= X/10^6$ g/ml

Therefore in 25 ml of solution $= X/10^6 \times 25g$

This is present in 50 ml of the extractant solution and 5 g of soil

Therefore available P_2O_5 in kg/ha $= X \times 25 \times 50 \times 2 \times 10^6$

$10^6 \times 5 \times 5$

APPENDIX – XX
ESTIMATION OF AVAILABLE POTASSIUM IN SOIL
FLAME PHOTOMETRY METHOD
(Stanford and English, 1949)

Principle

- The potassium ions in the exchange site are replaced with NH_4^+ and K^+ is released.
- The concentration of K ions in the solution is then determined using flame photometer.

Reagents

1 N Ammonium acetate (Neutral in pH): Dissolved 77 g of AR grade ammonium acetate in 1000 ml distilled water. pH adjusted to 7.0.

Procedure

Transferred 5g of soil into a polythene shaking bottle.Added 25 ml of 1 N ammonium acetate and contents shaked in a mechanical reciprocating shaker for 5 minutes. Contents filtered through whatman No. 40 filter paper. Filterates were fed into the flame photometer and the readings recorded. Using standard curve available potassium content was calculated.

Calculation

Weight of the soil taken = 5 g

Volume of the extractant used = 25 ml

Flame photometer reading = T

Concentration of K in the standard curve = X ppm

= X mg/ml

$= X/10^6$ g/ml

Therefore, in 25 ml solution $= X/10^6 \times 25g$

This is present in 5gm of soil

Therefore, available K in soil in kg/ha $= X/10^6 \times 25 \times 2 \times 10^6/5$

Annexures

भारत सरकार
GOVERNMENT OF INDIA
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
भारतीय वनस्पति सर्वेक्षण / BOTANICAL SURVEY OF INDIA
दक्कन क्षेत्रीय केंद्र / DECCAN REGIONAL CENTRE
हैदराबाद / HYDERABAD - 500 001
तेलंगाना / TELANGANA

संख्या/No.: BSI/DRC/2022-23/ Identification/ 653 दिनांक/Date: 03/01/2023

सेवा मे/To

Miss. S. Hema
Ph.D. Scholar
Department of Botany,
St. Joseph's College for Women,
Visakapatnam, Andhra Pradesh-530004.

विषय: पौधों की पहचान के संबंध में।
Subject: Identification of plant materials regarding.

प्रिय कुमारी एस. हेमा,/Dear Ms. S. Hema

आपके पत्र दिनांक 29.12.2012 के संदर्भ में आपके द्वारा भेजी गई पौधों के नमूनों की पहचान **ट्रिगोनेला फोनम-ग्रेकम** एल. (फैबेसी) के रूप में की गई है। पहचान के बाद, पौधे का नमूना इसके साथ वापस कर दिया है।

With reference to your letter dated 29.12.2022, the plant material sent by you has been identified by the concerned expert as **Trigonella foenum-graecum** L. belongs to the family Fabaceae. After identification, the plant material is returned herewith.

धन्यवाद /Thanking you,

भवदीया/ Yours faithfully

एल. रासिंगम
03/01/23

(एल.रासिंगम/ L. Rasingam)
वैज्ञानिक-'ई' एवम् का.अ./Scientist – 'E'& HoO

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भारत सरकार
GOVERNMENT OF INDIA
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MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
भारतीय वनस्पति सर्वेक्षण / BOTANICAL SURVEY OF INDIA
दक्कन क्षेत्रीय केंद्र / DECCAN REGIONAL CENTRE
हैदराबाद / HYDERABAD - 500 001
तेलंगाना / TELANGANA

सत्यमेव जयते

भारतीय वनस्पति सर्वेक्षण
BOTANICAL SURVEY OF INDIA

संख्या/No.: BSI/DRC/2022-23/ Identification/ 580 दिनांक/Date: **23/11/2022**

सेवा मे/To

Miss. S. Hema
Ph.D. Scholar
Department of Botany,
St. Joseph's College for Women,
Visakapatnam, Andhra Pradesh-530004.

विषय: पौधों की पहचान के संबंध में।
Subject: Identification of plant materials regarding.

प्रिय कुमारी एस. हेमा,/Dear Ms. S. Hema

आपके पत्र दिनांक 14.11.2012 के संदर्भ में आपके द्वारा भेजी गई पौधों के नमूनों की पहचान संबंधित विशेषज्ञ द्वारा इस प्रकार की गई है:

With reference to your letter dated 14 November 2022, the plant materials sent by you have been identified by the concerned expert as follows:

Filed No.1. **Vigna aconitifolia** (Jacq.) Maréchal belongs to the family Fabaceae,

Filed No.2. **Vigna mungo** (L.) Hepper belongs to the family Fabaceae,

Filed No.3. **Andrographis paniculata** (Burm.f.) Nees belongs to the family Acanthaceae.

पहचान के बाद, पौधे का नमूना इसके साथ वापस कर दिया है।/ After identification, the plant material is returned herewith.

धन्यवाद /Thanking you,

Yours faithfully

एल. रासिंगम
23/11/22

एल.रासिंगम/ L. Rasingam
वैज्ञानिक-'ई' एवम् का.अ./Scientist – 'E'& HoO

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Publications

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University Estd. u/s 3 of UGC Act 1956, Category 'A' by MHRD
Re-accredited with A++ Grade by NAAC. CGPA 3.65/4, Category I by UGC
Coimbatore - 641 043, Tamil Nadu, India

Appendix L2

(Item No 5 of Check List) Details of Research Publications

S.No	Article	Journal	Other Details Vol/No/Page No/ Year	Published in UGC-CARE / Scopus Indexed/ Web of Science
1	The Effect of Paddy and Coffee Husk as the Organic Manure on the Vegetative and Yield Parameters of Moth Bean [*Vigna aconitifolia* (Jacq) Marechal].	Agricultural Science Digest	Vol: 44(2), 260-264 2024.	Scopus Indexed
2	Impact of Paddy and Coffee Husk as the Bio Compost and its Effect on the Growth and Yield of Black Gram [*Vigna mungo* (L.) Hepper].	Agricultural Science Digest	Vol: 44(1), 184-188 2024.	Scopus Indexed

*Proof of list of Journals from Internet to be attached along with copies of reprints.

Scholar : S. Keerthana

Supervisor & HoD : Dr. Vijayalakshmi 7/5/24

Checked By:

7/5/2024

HoD /Dean of Respective School

The scholar Sr. Hema, S (Reg. No. 17PHBOP001) has published her article in the following journal:

1. Agricultural Science Digest - indexed and active in Scopus from 2019 to present.

This may be considered.

07.05.2024.

RESEARCH ARTICLE Agricultural Science Digest, Volume 44 Issue 2: 260-264 (April 2024)

The Effect of Paddy and Coffee Husk as the Organic Manure on the Vegetative and Yield Parameters of Moth Bean [*Vigna aconitifolia* (Jacq) Marechal]

S. Hema[1], A. Vijayalakshmi[1], Pinky Raihing[1]

10.18805/ag.D-5578

ABSTRACT

Background: Amidst of emerging world with the new technologies we are in the dangerous condition regarding the disposal of agro industrial wastes which creates a serious problem. Organic manures can prevent and can enhance the productivity in the plants as well as can reduce the environmental issues.

Methods: The study was conducted in the month of September to November 2019 at St. Joseph's College Campus, Visakhapatnam, A.P. with the bio composting process of paddy and coffee husk along with *Pleurotus eous, Pleurotus florida, Trichoderma asperelloides* and *Eisenia fetida*, with 6 treatments. The plants were analyzed for root length, shoot length, number of leaves, number of nodules, fresh weight and dry weight of the plant on 20, 40 and 60 DAS and the yield parameters were analyzed on 90th day of the plant.

Result: The results showed a great increase in the treatment 6 (Pre decomposed coffee husk, consortium of *Pleurotus eous, P. florida, Trichoderma asperelloides* and *Eisenia fetida*) in root length (8.5, 12.9 and 16.1 cm) shoot length (15.2, 30.3 and 43.2 cm) number of leaves (11, 18 and 49) number of nodules (12, 20 and 9) fresh weight (4.83, 8.98 and 15.47 g) and dry weight (1.11, 3.56 and 4.37 g) when compared with the other treatments and control. The yield parameters also showed significant results in number of pods (27), length of the pod (5.7 cm), number of seeds/pod (6), weight of the seeds/pod (2.89 g), fresh weight of the pod (1.653 g) and dry weight of the pod (0.986 g).

Key words: *Eisenia fetida*, Mothbean, Organic manure, *Pleurotus eous, Pleurotus florida, Trichoderma asperelloides.*

INTRODUCTION

Over the past century the attention is given to the agricultural science specially as a response to the excess growth of the global population, particularly the issues like food, crop and security and the technological advances resulting the many emerging issues and challenges to the future generations and among them the important challenge is the disposal of agro industrial wastes which is also a great hazard with its unorganized deposition which can cause environmental issues like pollution, landfills, eutrophication, economic loses, health risks and also climate changes by releasing harmful greenhouse gases (Khuriyati and Kumalasari, 2015).

Every year nearly 20 million tons of paddy is produced, which results in generating nearly 24 million tons of paddy straw and husk. If these are burnt then 4.4 million tons of paddyash is produced, which could be used in brick industry, steel and cement (Giddel and Jivani, 2007).

In India there are different commercial crops one of the important among them is coffee and it is the export crop which alone fetches a considerable and desirable foreign exchange to various countries. In India the southern states of Karnataka (71%), Kerala (21%) and Tamil Nadu (5%) overall produce 8,200 tons (Velmourougane *et al*., 2010). According to the statistical data coffee productivity in India from financial year 2013 to 2020 by state shows Karnataka has taken the 1st place in producing the coffee and it is followed by Kerala, Tamil Nadu, Andhra Pradesh and Odissa. The coffee plantations, coffee pulp and seed husk are formal to be more hazardous and major solid water which are gained during its processing about 1 ton of husk is generated during its dry processing since this is lingo cellulosic waste and it as hazardous (Aranda and Barois, 2000).

Use of paddy husk and coffee husk which is fibrous in nature and also they are fatal to cattle feeding and filling up of the land with these wastes is more hazardous to the environment and is wrong way of disposing of the waste. Moth bean is one of the most drought resistant crop grows in semi arid and arid regions of Gujarat, Karnataka, Rajasthan, Maharashtra and Haryana and its yield is much

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How to cite this article: Hema, S., Vijayalakshmi, A. and Raihing, P. (2024). The Effect of Paddy and Coffee Husk as the Organic Manure on the Vegetative and Yield Parameters of Moth Bean [*Vigna aconitifolia* (Jacq) Marechal]. Agricultural Science Digest. 44(2): 260-264. doi: 10.18805/ag.D-5578.

Submitted: 24-02-2022 **Accepted:** 20-06-2022 **Online:** 15-07-2022

less as compared to other legume crops, hence it is necessary to enhance the production specially by applying organic manure, biofertilizer and micronutrients in various combinations as the need is increasing to reduce the usage of chemical fertilizer and increase the use of organic fertilizer to improve the physico-chemical as well as the soil fertility the supply of the nutrients in the plant (Sipai *et al.,* 2018).

MATERIALS AND METHODS

Pot culture study of moth bean

The experimental pot was filled with 7 kgs of red sandy loam soil and control also was maintained. The seeds of *Vigna aconitifolia* (Jacq) Marechal were obtained from Jaipur Rajasthan Agriculture institute. Viable seeds were used for pot culture studies with 3 replications of each treatment and it was conducted during September-November 2019 at St. Joseph's college campus, Visakhapatnam, A.P. at the latitude 17.719185 and longitude 83.286938.

The treatments are as follows:

C - Control.

T_1- Pre decomposed paddy husk, *Pleurotus eous* and *Eisenia fetida* (5 t/ha).

T_2- Pre decomposed paddy husk, *Pleurotus florida* and *Eisenia fetida* (5 t/ha).

T_3- Pre decomposed paddy husk, consortium of *Pleurotus eous, Pleurotus florida,Trichoderma asperelloides* and *Eisenia fetida* (5 t/ha).

T_4- Pre decomposed coffee husk, *Pleurotus eous* and *Eisenia fetida* (5t/ha).

T_5- Pre decomposed coffee husk, *Pleurotus florida* and *Eisenia fetida* (5 t/ha).

T_6- Pre decomposed coffee husk, Consortium of *Pleurotus eous, P. florida,Trichoderma asperelloides* and *Eisenia fetida* (5 t/ha).

Vegetative parameters such as shoot length, root length, number of leaves, number of nodules, fresh weight and dry weight on 20, 40 and 60 days after sowing (DAS) and on 90th day yield parameters of the plant such as number of pods/plant, length of the pod, number of seeds/pod, weight of the seeds/pod, pod fresh weight and pod dry weight were evaluated and the inference was subjected to statistical analysis of one way and two way ANOVA with the software Sigma stat 3.1.

RESULTS AND DISCUSSION

The effect of paddy and coffee husk as the organic manure on the vegetative parameters of moth bean [*Vigna aconitifolia* (Jacq) marechal]

The present study shows the influence of the agro industrial wastes paddy and coffee husks and its effect on the

Table 1: Effect of paddy and coffee husk as organic manure on the vegetative parameters of moth bean on 20, 40 and 60 DAS.

Treatments	Root length (cm)			Shoot length (cm)		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	3.9	9.7	12.4	9.2	19.5	27.2
T1	5.5	10.5	13.2	13.1	22.1	33.4
T2	6.2	11.3	14.1	11.9	24.4	32.9
T3	7.1	12.2	15.8	14.9	29.2	41
T4	4.7	11.4	14.6	14.3	20.9	34.1
T5	5.8	11.9	15	13.7	23.9	40.2
T6	8.5	12.9	16.1	15.2	30.3	43.2
SEd		0.34365			0.39561	
CD (p<0.05)		0.69368**			0.79856**	

**Significant at (p<0.05); DAS - Days after sowing.

Table 2: Vegetative parameters of moth bean with the influence of paddy and coffee husk as the organic manure.

Treatments	Number of leaves (cm)			Number of nodules		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	7	11	21	5	10	3
T1	8	13	26	7	13	5
T2	8	12	24	8	16	6
T3	9	16	45	10	19	8
T4	7	13	25	8	15	5
T5	8	12	27	9	14	7
T6	11	18	49	12	20	9
SEd		0.40053			0.44186	
CD (p<0.05)		0.80849**			0.89191**	

**Significant at (p<0.05); DAS - Days after sowing.

vegetative growth and yield parameters of moth bean (*Vigna aconitifolia*(Jacq) Marechal) the results are as shown in Table (1-4).

Root length was observed during 20, 40 and 60 DAS and it is found to be high in treatment 6 (Pre decomposed Coffee husk, consortium of *Pleurotus eous, P.florida, Trichoderma asperelloides* and *Eisenia fetida* (8.5,12.9 and 16.1 cm) among all the treatments and it is followed by the treatment 3 (Pre decomposed paddy husk, consortium of *Pleurotus eous, P. florida,Trichoderma asperelloides* and *Eisenia fetida.*) (7.1, 12.2 and 15.8 cm) when compared to control (3.9, 9.7 and 12.4 cm).

Significantly the increased growth of the Shoot length also observed in Treatment 6 (15.2, 30.3 and 43.2 cm) followed by treatment 3 (14.9, 29.2 and 41.0 cm) compared to control (9.2, 19.5 and 27.2 cm). A marvelous improvement in number of leaves was observed in treatment 6 (11, 18 and 49) (Table 2) when compared to treatment 3 (9, 16 and 45) and control (7, 11 and 21).

Number of nodules as it is showed in Table 2 there was increase in 20 DAS to 40 DAS later there is decreasing trend found at 60 DAS and the highest number of nodules obtained in treatment 6 (12, 20 and 9) followed by treatment 3 (10, 19 and 8) compared to control (5, 10 and 3).

Fresh weight and dry weight

According to Table 3 the maximum fresh weight (4.83,8.98 and 15.47 g) and dry weight (1.11, 3.56 and 4.37 g) of test crop was found in treatment 6 and it is followed by treatment 3 (4.11,7.99 and 14.97 g) (0.99, 3.32 and 4.19 g) compared to the control (2.97,6.02 and 10.79 g), (0.45,2.14 and 3.09 g). The present study is in par with the results of Raihing and Vijayalakshmi, (2021) where the effect of fruit and vegetable vermicompost on lablab (*Lablab purpureus* (L) Sweet) showed the highest shoot length in T8 Treatment (113.7, 124.5 and 135 cm) on 15, 35 and 55 days after sowing (DAS).

Manivannan *et al.* (2009) found in *Phaseolus vulgaris*, when applied with vermicompost and NPK gave good results in growth parameters such as root length (22.5 cm) shoot length (69.1 cm) and number of nodules (39).

According to Harireddy and Joy Dawson, (2021) during harvest time the vermicompost application (6 t/ha) with *Rhizobium* and *Azospirillum* has resulted in the maximum growth of plant height (40.20 cm) comparatively it is superior to the other treatments. The influencing factors are always for the growth of the plant height and it is of the nutrients which are from the organic manures and biofertilizers work as the available nutrients for the best growth of the plant height (Darshanth and Singh, 2014).

Table 3: The effect of paddy and coffee husk as the organic manure on the vegetative parameters of moth bean on 20, 40 and 60 DAS.

Treatments	Fresh weight (g)			Dry weight (g)		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	2.97	6.02	10.79	0.45	2.14	3.09
T1	3.54	6.85	11.34	0.54	2.32	3.74
T2	3.74	7.61	12.53	0.69	2.65	4.1
T3	4.11	7.99	14.97	0.99	3.32	4.19
T4	3.71	6.76	12.25	0.53	2.5	4
T5	3.93	7.01	13.41	0.73	2.42	4.03
T6	4.83	8.98	15.47	1.11	3.56	4.37
SEd		0.39463			0.36884	
CD (p<0.05)		0.79659**			0.74453****	

Significant at (p<0.05); DAS- Days after sowing.

Table 4: Influence of paddy and coffee husk as the organic manure on the yield parameters of the moth bean at 90 DAS.

Treatments	Number of pods /plant	Length of the pod (cm)	Number of seeds /pod	weight of the seeds/pod (g)	Pod fresh weight (g)	Pod dry weight (g)
C	15	3.4	4.0	2.01	0.986	0.521
T1	17	4.3	5.0	2.16	1.312	0.663
T2	18	4.1	4.0	2.42	1.283	0.843
T3	23	5.0	5.0	2.68	1.541	0.946
T4	16	3.8	5.0	2.33	1.041	0.713
T5	19	4.2	4.0	2.12	1.033	0.638
T6	27	5.7	6.0	2.89	1.653	0.986
SEd	0.1764	0.6355	0.2588	0.1633	0.1383	0.0319
CD (p<0.05)	0.3843	1.3631	0.5552	0.3503	0.2966	0.0685

** Significant at (p<0.05); DAS- Days after sowing.

Highest number of leaves (13.66) were found in leafy vegetables with the treatment of dead sheep compost in comparison with control (8.66) (Al-Sabbagh *et al.,* 2020). Similar results were observed by Kavya *et al*. (2021) that on applying RDF + Fe 0.5% + Zn 0.5% + Mn 0.5% recorded maximum height of the plant (42.42) at 60 DAS in *Vigna radiata* L.

Influence of paddy and coffee husk as the organic manure on the yield parameters of the moth bean [*Vigna aconitifolia* (Jacq) Marechal] at 90 DAS

The yield concept always based on the quantitative idea of the fertilizer is based on yield and nutritional requirement of the crop and the nutrient of the soil available with that of the applied fertilizer (Regar and Singh 2014; Sakarvadia *et al*., 2021).

The remarkable number of pods/plant, length of pod, number of seeds/pod, weight of the seeds/pod, pod fresh weight and pod dry weight found in the treatment 6 when it is compared to the control and all the other treatments, the Treatment 6 is followed by 3rd Treatment in its increase. The maximum number of pods/plant (27) number of seeds/pod (6) length of the pod (5.7 cm), weight of the seeds/pod (2.89 g), pod fresh weight (1.653 g) and pod dry weight (0.986 g) was found high among all the treatments and the minimum results were found in control as it is shown in Table 4 similar findings were found with the work of Ruheentaj and Sarawad, (2020) with the application of vermicompost on the growth of *Vigna aconitifolia* (Jacq) Marechal recorded highest yield (625.0 kg/ha) and significant results also found with the application of vermicompost and FYM in the increase of pod numbers (61.47/plant), pod length (8.67 cm) seed weight (1.96 g) it also coincides with that of findings of Sadashivanagowda *et al*. (2017) with incorporation of vermicompost in black gram yield is noticed to be highest. According to Sipai *et al.* (2018) with the incorporation of prophenophenol 50% EC at 0.05% and *Helicoverpa* in the module 4 showed great results in the growth of the moth bean yield seeds (1316 kg/ha) when compared with all the other modules.

Similar results were observed by Silpa and Vijayalakshmi, (2021) with the inclusion of Jackfruit peel vermicompost resulted in the highest yield of *Vigna unguiculata* (L) Walp in the treatment 8 such as number of pods (21), length of the pod (16.50 cm), weight of the seeds (1.68 g), pod fresh weight (5.711 g) and dry weight (2.398 g). The results of this particular study also is similar to that of Hasan *et al.* (2021) with the application of N and P fertilizer on Groundnut plants and found that the plant height (20.65) increased along with the number of pods 74.28% in treatment 15. Changkija and Gohain, (2018) obtained the significant results in increasing the grain weight (12.07 g) of soy bean with the application of poultry manure in treatment 6. Similar to these results Zebire and Gelgelo, (2019) reported that there was increase in the yield (74.2 g) of haricot bean with application of P fertilizer.

CONCLUSION

The present study clearly reveals the significant effect of paddy and coffee husk compost as organic manure on Moth bean and the significant values proved that it is effective bio compost specially the Treatment 6 which showed the maximum increase in the vegetative growth as well as yield parameters of the test plant. In conclusion we suggest that the biocomposting of agro industrial waste is the effective tool to protect the environment by lessening the harmful effects of the waste, as well as to increase the crop production and it can be suggested to the farmers to use the bio compost as the organic manure for better income as well as better results in the crop.

ACKNOWLEDGEMENT

We would like to thank the Management of St. Joseph's College for Women (A), Visakhapatnam for providing the facilities to conduct the study.

Conflict of interest

I declare that authors have no conflict of interest regarding this article.

REFERENCES

Al-Sabbagh, T., Tareq, M., Craig, A.M. and Sugumaran, K. (2020). Influence of dead sheep compost material using aerobic technique on the growth of leafy vegetables in Kuwait under greenhouse conditions. Journal of Agriculture and Horticulture Research. 3(2): 31-37.

Aranda, E. and Barois, I. (2000). Coffee pulp vermicomposting treatment. In Coffee Biotechnology and Quality. Springer, Dordrecht. pp: 489-506.

Changkija, S. and Gohain,T. (2018). Effect of organic nutrient sources on productivity of soybean [*Glycine max* (L.) Merri]. Agricultural Science Digest. 38(1): 36-39. doi: 10.18805/ag.D-4678.

Dashrath, S. and Singh, R.P. (2014). Effect of integrated nutrient management on growth, physiological parameters and productivity of lentil (*Lens culinaris* Medik.). International Journal of Agricultural Sciences. 10(1): 175-178.

Giddel, M.R. and Jivani, A.P. (2007). Waste to Wealth, Potential of Rice Husk in India a Literature Review. In International Conference on Cleaner Technologies and Environmental Management PEC, Pondicherry, India. 2: 4-6.

Hasan, M., Uddin, M.K., Mohamed, M.T.M., Zuan, A.T.K., Motmainna, M. and Haque, A.N.A. (2021). Effect of nitrogen and phosphorus fertilizers on growth, yield, nodulation and nutritional composition of bambara groundnut [*Vigna subterranea* (L.) Verdc.]. Legume Research. 44(12): 1437-1442. doi: 10.18805/LR-617.

Harireddy, Y. and Dawson, J. (2021). Effect of biofertilizers and levels of vermicompost on growth and yield of cowpea (*Vigna unguiculata* L.). The Pharma Innovation Journal. 10(6): 985-988.

Kavya, P., Singh, S., Hinduja, N., Tiwari D. and Sruthi, S. (2021). Effect of foliar application of micronutrients on growth and yield of greengram (*Vigna radiata* L.). Legume Research. 44(12): 1460-1464. doi: 10.18805/LR-4445.

Khuriyati, N. and Kumalasari, D. (2015). Cleaner production strategy for improving environmental performance of small-scale cracker industry. Agriculture and Agricultural Science Procedia. 3: 102-107.

Manivannan, S., Balamurugan, M., Parthasarathi, K., Gunasekaran, G. and Ranganathan, L.S. (2009). Effect of vermicompost on soil fertility and crop productivity-beans (*Phaseolus vulgaris*). Journal of Environmental Biology. 30(2): 275-281.

Regar, K.L. and Singh, Y.V. (2014). Fertilizer recommendation based on soil testing for the targeted yield of rice in eastern plain zone of Utter Pradesh. The Bioscan. 9(2): 531-534.

Raihing, P. and Vijayalakshmi, A. (2021). Effect of vermicomposted vegetable and fruit wastes on the vegetative and yield parameters of lablab [*Lablab purpureus* (L.) sweet]. Agricultural Science Digest. doi: 10.18805/ag. D-5476.

Ruheentaj, V.G.Y. and Sarawad, I.M. (2020). Effect of integrated nutrient management on yield and uptake of nutrients by mothbean (*Vigna acontifolia*) in northern dry zone of Karnataka. Journal of Pharmacognosy and Phytochemistry. 9(5): 379-383.

Sadashivangowda, S.N.O., Alagundagi, S.C., Nadagouda, B.T., Bagali, A.N. and Nadagouda, B.T. (2017). Influence of spacing and organics on growth, yield and quality of arid legume moth bean [*Vigna aconitifolia* (Jacq.) Marechal]. Research in Environment and Life Science. 10(6): 546-549.

Sakarvadia, H.L.,Vekaria, L.C., Ponkia, H.P., Jadeja, A.S. and Parakhia, D.V. (2021). Soil test based fertilizers application for targeted yield of soybean (*Glycine max* L.) in Saurashtra region of Gujarat. Agricultural Science Digest. 41(3): 464-467. doi: 10.18805/ag.D-5214.

Silpa, M. and Vijayalakshmi, A. (2021). Efficiency of biocomposted agroindustrial wastes and their response in the growth and yield of *Vigna unguiculata* (L.) Walp. Agricultural Science Digest. doi: 10.18805/ag.D-5321.

Sipai, A.H., Sevak, K., Addangadi, K. and Chaudhary, A.N. (2018). Influence of different modules on yield, nutrient uptake and soil physicochemical properties of mothbean [*Vigna aconitifolia* (Jacq.) Marchel. Journal of Crop and Weed. 14(1): 44-49.

Velmourougane, K., Bhat, R. and Gopinandhan, T.N. (2010). Impact of drying surface and raking frequencies on mold incidence, ochratoxin A contamination and cup quality during preparation of Arabica and Robusta cherries at the farm level. Foodborne Pathogens and Disease.7(11): 1435-1440.

Zebire, D.A. and Gelgelo, S. (2019). Effect of phosphorus fertilizer levels on growth and yield of haricot bean (*Phaseolus vulgaris*. L.) in South Ommo Zone, Ethiopia. Agricultural Science Digest-A Research Journal. 39(1): 55-58. doi: 10.18805/ag.A-294.

SHORT COMMUNICATION Agricultural Science Digest, Volume 44 Issue 1: 184-188 (February 2024)

Impact of Paddy and Coffee Husk as the Bio Compost and its Effect on the Growth and Yield of Black Gram [*Vigna mungo* (L.) Hepper]

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10.18805/ag.D-5623

ABSTRACT

The recent developments of urban areas change the climate in the ecosystem and decreasing the arable land became the pressurized problems for all the producers of the present world. Moreover organic agriculture optimizes the application of biocomposts to improve soil fertility and productivity while minimizing the environmental implications and also it is necessary for sustainable agriculture. The study was conducted at St Josephs College for Women (A), Visakhapatnam Andhra Pradesh. Agro-industrial wastes of Paddy and Coffee husk were collected and were used for the biocomposting process using *Pleurotus eous, P. florida, Trichoderma asperelloides* and *Eisenia fetida.* The vermicompost was used for the growth of black gram with 6 treatments. The plant was analyzed for root length, shoot length, number of leaves, number of nodules, fresh weight and dry weight at different stages (20, 40 and 60 DAS). On 90th day the yield parameters like number of pods/plant, number of seeds/plant, length of the pod, weight of the seeds/pod, fresh weight and dry weight of the pod were analyzed. The experimental study results revealed that the treatment 6 (Pre decomposed Coffee husk, Consortium of *Pleurotus eous, P. florida, Trichoderma asperelloides* and *Eisenia fetida*) has shown a significant increase in root length (7.9,12.2 and 16.5 cm), shoot length (11.8, 25.8 and 30.7 cm), number of leaves(19.0,37.0 and 41.0) number of nodules (10.0,30.0 and 17.0), fresh weight (2.77,7.37 and 15.39 g) and dry weight (0.52,3.67 and 5.73 g) of the plant on 20 DAS, 40 DAS and 60 DAS and the yield parameters also showed the increase in number of pods/plant (39), number of seeds/plant (5), length of the pod (5.6 cm), weight of the seeds /pod (2.384 g), fresh weight of the pod (2.95 g) and dry weight (1.195 g) on 90th Day of black gram when in comparison with the control. It is to conclude that treatment 6 can be a better manure to enhance the growth and yield of plants and also it can be a great help for the farmers.

Key words: Black gram, *Eisenia fetida,* Paddy and Coffee husk, *Pleurotus eous, Pleurotus florida*, *Trichoderma asperelloides.*

The recent developments of the urban areas climate changes in the ecosystem and decreasing of the arable land became the pressurized problems for all the producers of the present world. Ghasemi Ghehsareh *et al.* (2020). Moreover organic agriculture optimizes the application of boicomposts to improve soil fertility and productivity while minimizing the environmental implications and also it is necessary for sustainable agriculture (Masunga *et al*., 2016; Askari *et al.,* 2020). Conversion of agricultural wastes into biocomposts will reduce the pressure of chemical fertilizers and also take the important role in conditioning the nutrients in the soil as the main source of nutrient for agricultural soil. According to Sakthivigneswari and Vijayalakshmi, (2016) the best way to save the soil is to convert the organic residues to vermicomposts and it can be used as an efficient fertilizer, it contains all the necessary enzymes, vitamins and substances that are used for the plant growth. The commonly used earthworm species for the vermicompost process are *Eisenia fetida, Eudrilus euginea* (Blouin *et al.,* 2019; Gupta *et al*., 2020; Ceritoglu *et al.,* 2021). Black gram is the important pulse crop which grows throughout India for it is the major source of protein hence a lot of efforts are being put to enhance the crop (Gomathinayagam *et al*., 2021). Among the entire legumes black gram is an important crop which is grown in India. And it contains 24% of protein, 60% of carbohydrate and 1.3% of fat. It is commonly called as 'urd' or 'urd bean' through its ability it fixes the atmospheric nitrogen and improves the soil fertility with its root nodules (Shekhawat *et al.,* 2018). The main aim of this present study is to evaluate the effect of paddy and coffee husk vermicompost on the growth at 20, 40 and 60 days after sowing (DAS) and yield parameters (90th Day) of black gram (*Vigna mungo* L.).

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How to cite this article: Hema, S., Vijayalakshmi, A. and Silpa, M. (2024). Impact of Paddy and Coffee Husk as the Bio Compost and its Effect on the Growth and Yield of Black Gram [*Vigna mungo* (L.) Hepper]. Agricultural Science Digest. 44(1): 184-188. doi: 10.18805/ag.D-5623.

Submitted: 28-06-2022 **Accepted:** 30-09-2022 **Online:** 15-10-2022

The pot culture experimental study was conducted from June to August 2019 at St. Joseph's College for Women (A), Visakhapatnam and Andhra Pradesh situated at (17°43′07″N, 83°17′13″E).

Collection of Agro-industrial wastes

The paddy and coffee husks were collected from nearby villages in Visakhapatnam District of Andhra Pradesh. The wastes which were collected for the study were sun-dried and preserved for further study. The collected raw samples were used for the pre-decomposition with the incorporation of *Pleurotu seous, Pleurotus florida* spawn and *Trichoderma asperelloides*, it is done in six pits each with the measurement of 1.5 feet in length and 4 square feet width, the composts were given the following names C1, C2, C3, C4, C5 and C6. After 30 days of the pre-decomposition process, the samples were filled in plastic trays of 50×20×20 cm for the further process of vermicompost. 15 exotic earthworms *Eisenia fetida* were added to the respective trays and left for 60 days for the composting process. This whole process was done from January to March 2019.

Collection of seeds

The viable seeds of black gram were collected from Tamil Nadu Agricultural University, Coimbatore. The viable seeds were used for the pot culture experiments.

The experimental pot cultures with the treatments

The pot culture experiments were carried out with 6 treatments respectively, all the pots were filled with the paddy and coffee husk vermicompost and 7 kg of red sandy loamy soil was used. Viable seeds were sown in each pot nearly 5 plants were maintained for the study in all the treatments triplicates were maintained. The following treatments are used for the study.

Statistical analysis

The obtained results on 20, 40 and 60 DAS for vegetative parameters and the yield parameters on 90 DAS were analyzed statistically using One-way and Two -way ANOVA (Sigma stat 3.1).

C	Control
T_1	Pre decomposed paddy husk, *Pleurotus eous* and *Eisenia fetida* (5 t/ha).
T_2	Pre decomposed paddy husk, *Pleurotus florida* and *Eisenia fetida* (5 t/ha).
T_3	Pre decomposed paddy husk, Consortium of *Pleurotus eous, Pleurotus florida, Trichoderma asperelloides* and *Eisenia fetida* (5 t/ha).
T_4	Pre decomposed Coffee husk,*Pleurotus eous* and *Eisenia fetida* (5 t/ha).
T_5	Pre decomposed Coffee husk, *Pleurotus florida* and *Eisenia fetida* (5 t/ha).
T_6	Pre decomposed Coffee husk, Consortium of *Pleurotus eous, P. florida,Trichoderma asperelloides* and *Eisenia fetida* (5 t/ha).

Impact of paddy and coffee husk as the biocompost and its effect on the vegetative parameters of *Vigna mungo* (L.) Hepper.

Treatment 6 (Pre decomposed Coffee husk, Consortium of *Pleurotus eous, P. florida, Trichoderma asperelloides* and *Eisenia fetida*) showed the maximum growth in vegetative parameters of *Vigna mungo* as it is shown in Tables (1 and 2). Root length was observed to be increasing from 20 Days after sowing (DAS) to 60 DAS in treatment 6 (7.9,12.2 and 16.5 cm) followed by treatment 3 (6.1,11.3and15.6 cm) as it is compared to control (3.1,7.3 and 11.6 cm). Shoot length increased gradually in the treatment 6 (11.8, 25.8 and 30.7 cm) followed by the treatment 3 (11.1, 25.2 and 29.1 cm) compared to the control (8.2, 18.6 and 24.9 cm). Similar results were correlated with Raihing and Vijayalakshmi, (2022) in black gram with the application of vegetable and fruit waste, shoot length was found to be more in treatment-8 (56.9, 62.1 and 71.5 cm) and root length in treatment 8 (14.5,17.2 and 18.5 cm).

Number of leaves showed a great increase on 20 to 60 DAS as shown in Table 1 remarkable increase was found in treatment 6 (19.0, 37.0 and 41.0) in comparison with the other treatments and it is followed by treatment 3 (17.0, 32.0 and 39.0) and the control (10.0, 20.0 and 29.0) showed the minimum number of leaves. Similar results were also reported by Palla *et al*., 2021) the maximum number of leaves was found to be more at 90 DAS (7.70) in brinjal when it is applied with different inorganic and organic fertilizers.

Number of nodules showed an increase in 40 DAS was found to be decreasing in its number at 60 DAS and treatment 6 (10.0, 30.0 and 17.0) showed a remarkable increase among all the other treatments and the control (4.0, 11.0 and 9.0). Similar results were found in the observations of Sentirenla Changkija and Gohain, (2018) the maximum number of nodules (14.33) were found in soybean with the application of poultry manure 6 t ha + *Rhizobium* @ 20 g Kg^{-1} seed+Phosphatica @20 g Kg^{-1} (T_6).

As is shown in Table 2 maximum fresh weight was found in treatment 6 (2.77, 7.37 and 15.39 g) followed by treatment 3 (1.99,6.16 and 15.20 g) and the minimum fresh weight was found in control (1.10,4.01 and 10.97 g) and remarkable dry weight was recorded in treatment 6 (0.52,3.67 and 5.73 g) and it is nearly followed by treatment 3 (0.49,3.07 and 5.06 g) and the least dry weight was recorded in control (0.19, 2.01 and 3.07 g). Similar results were in par with the work of Silpa and Vijayalakshmi, (2022) in *Vigna unguiculata* the incorporation of bio compost raw jack fruit peel+*Pleurotus florida* + *Eudrilus euginiae* in treatment 8 showed the good results in the fresh weight (5.491 g, 9.811 g and 32.516 g) and dry weight (0.855 g, 1.489 g and 3.020 g) of the plant.

As shown in Table 3 the yield parameters of black gram recorded the highest results in the treatment 6 (Pre decomposed coffee husk, consortium of *Pleurotus eous, P. florida, Trichoderma asperelloides* and *Eisenia fetida*) and it is closely followed by the treatment 3 (Pre decomposed

Table 1: Impact of paddy and coffee husk as the biocompost and its effect on the vegetative parameters of *Vigna mungo* (L.) Hepper.

Treatments	Root length (cm)			Shoot length (cm)			Number of leaves			Number of nodules		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	3.1	7.3	11.6	8.2	18.6	24.9	10.0	20.0	29.0	4.0	11.0	9.0
T_1	4.7	9.7	13.9	10.5	21.1	27.2	12.0	23.0	34.0	6.0	19.0	13.0
T_2	4.2	9.5	13.4	10.2	20.8	27.8	11.0	24.0	32.0	7.0	17.0	11.0
T_3	6.1	11.3	15.6	11.1	25.2	29.1	17.0	32.0	39.0	9.0	25.0	15.0
T_4	4.3	8.6	12.7	10.9	19.1	27.5	13.0	22.0	30.0	5.0	18.0	10.0
T_5	5.2	9.9	12.5	9.9	19.7	26.9	14.0	25.0	31.0	8.0	20.0	12.0
T_6	7.9	12.2	16.5	11.8	25.8	30.7	19.0	37.0	41.0	10.0	30.0	17.0
SEd		0.01858			0.17871			0.44129			0.20840	
CD (p<0.05)		0.03754**			0.36119**			0.89191**			0.42119**	

**Significant at (p<0.05) DAS-Days after sowing.

C- Control, T_1- Raw paddy husk pre decomposed by *Pleurotus eous+Eisenia fetida* (5 t/ha), T_2- Raw paddy husk pre decomposed by *Pleurotus florida* + *Eisenia fetida* (5 t/ha),T_3- Raw paddy husk pre decomposed by consortium of *Pleurotus eous, Pleurotus florida, Trichoderma asperelloides* + *Eisenia fetida* (5t/ha), T_4- Raw Coffee husk pre decomposed by *Pleurotus eous* + *Eisenia fetida* (5 t/ha), T_5- Raw coffee husk pre decomposed by *Pleurotus florida* + *Eisenia fetida* (5 t/ha), T_6- Raw coffee husk pre decomposed by Consortium of *Pleurotus eous, P. florida, Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Table 2: Impact of paddy and coffee husk as the biocompost and its effect on the fresh weight and dry weight of *Vigna mungo* (L.) Hepper.

Treatments	Fresh weight (g)			Dry weight (g)		
	20 DAS	40 DAS	60 DAS	20 DAS	40 DAS	60 DAS
C	1.10	4.01	10.97	0.19	2.01	3.07
T_1	1.52	5.06	12.14	0.24	2.34	4.03
T_2	1.51	5.17	12.09	0.28	2.15	4.21
T_3	1.99	6.16	15.20	0.49	3.07	5.06
T_4	1.66	5.39	12.13	0.20	2.09	4.01
T_5	1.71	6.01	13.19	0.29	2.31	4.02
T_6	2.77	7.37	15.39	0.52	3.67	5.73
SEd		0.19346			0.07555	
CD (p<0.05)		0.39101**			0.15250**	

**Significant at (p<0.05); DAS-Days after sowing.

C- Control, T_1- Raw paddy husk pre decomposed by *Pleurotus eous* + *Eisenia fetida* (5 t/ha), T_2- Raw paddy husk pre decomposed by *Pleurotus florida* + *Eisenia fetida* (5 t/ha),T_3- Raw paddy husk pre decomposed by consortium of *Pleurotus eous, Pleurotus florida,Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha), T_4- Raw coffee husk pre decomposed by *Pleurotus eous* + *Eisenia fetida* (5t/ha), T_5- Raw coffee husk pre decomposed by *Pleurotus florida* + *Eisenia fetida* (5 t/ha), T_6- Raw coffee husk pre decomposed by Consortium of *Pleurotus eous, P. florida, Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

paddy husk, consortium of *Pleurotus eous, Pleurotus florida*, *Trichoderma asperelloides* and *Eisenia fetida*) when compared to the control and all the other treatments. Treatment 6 (39) showed the maximum number of pods/ plant and it is followed by the treatment 3 (37) and the minimum number showed by control (29) as well as the length of the pod was also recorded to be high in treatment 6 (5.6 cm) followed by treatment 3 (5.1 cm) and the lowest is found in control (3.5 cm). The length of the pod was found to be high in the work of Raihing and Vijayalakshmi, (2021) in treatment 8 (13.00 cm) with the application of fruit waste, cow dung, *P. eous*,*Trichoderma asperelloides* and *Eudrilus eugeniae* (5 t/ha).

The maximum number of seeds in treatment 6and treatment 3 was found to have the similar results (5) and the control (3) showed the lowest results, similar results were found in soybean with the application of poultry manure 6 t ha +*Rhizobium* @ 20 g Kg^{-1} seed Phosphatica @20 g Kg^{-1} (T6) in the maximum number of seeds/pod (2.83) (Changkija and Gohain, (2018). The maximum increase is found in the weight of the seeds/pod in treatment 6 (2.384 g) followed by treatment 3 (2.012 g) when it is compared to other treatments and the control (1.012 g), as well as pod fresh weight and dry weight also showed the highest increase in treatment 6 (2.95 and 1.195 g) followed by treatment 3 (2.87 and 1.102 g) the lowest was found in control (1.22 and 0.670 g).

Table 3: Impact of paddy and coffee husk as the biocompost and its effect on the yield parameters of *Vigna mungo* (L.) hepper at 90 DAS.

Treatments	Number of pods/plant	Length of the pod (cm)	Number of seeds/pod	weight of the seeds/pod (g)	Pod fresh weight (g)	Pod dry weight (g)
C	29	3.5	3	1.012	1.22	0.670
T_1	36	4.0	4	1.885	1.61	0.831
T_2	34	3.9	4	1.911	1.77	0.901
T_3	37	5.1	5	2.012	2.87	1.102
T_4	35	4.3	5	1.117	1.75	0.811
T_5	36	4.7	4	1.224	1.67	0.728
T_6	39	5.6	5	2.384	2.95	1.195
SEd	0.0440	0.3171	0.1688	0.2535	0.1936	0.0402
CD (p<0.05)	0.0943**	0.6802**	0.3622**	0.5438**	0.4153**	0.0863**

**Significant at (p<0.05) DAS-Days after sowing.

C-Control, T_1- Raw paddy husk pre decomposed by *Pleurotus eous* + *Eisenia fetida* (5 t/ha), T_2- Raw paddy husk pre decomposed by *Pleurotus florida* + *Eisenia fetida* (5 t/ha),T_3- Raw paddy husk pre decomposed by consortium of *Pleurotus eous, Pleurotus florida,Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha), T_4 - Raw Coffee husk pre decomposed by *Pleurotus eous* + *Eisenia fetida* (5 t/ha), T_5- Raw coffee husk pre decomposed by *Pleurotus florida* + *Eisenia fetida* (5 t/ha), T_6 - Raw Coffee husk pre decomposed by Consortium of *Pleurotus eous, P. florida, Trichoderma asperelloides* + *Eisenia fetida* (5 t/ha).

Similar results are correlated with Kumar *et al*. (2021) who found the increase in the yield of pea crops 40 to 61% and capsicum crop 14-48% with the application of biomass with matkakhad, rock phosphate, gypsum, patent Kali and lime @ 1% and with the inclusion of *Tricoderma, Rhizobium, Azatobacter* along with PSB. Veeral and Kalaimathi, (2021) observed similar results in groundnut plants an increase in the plant height (29.9 cm) in the treatment 7 (Press mud @ 12.5 t/ha+50% RDF and *Rhizobia* @ 2 kg ha) and the number of pods/plant (27.4). Significant results were found in cluster bean with the application of chemical fertilizer with *rhizobium* (2.5 g). Treatment 16 showed the highest number of pods (221.2) (Gul *et al.,* 2019). The maximum number of pods/plant (45.94) were found in soya beans with the application of 90 P_2O_5 level (kg/ha) (Edwin Luikham *et al*., 2018).

CONCLUSION

The application of Agro-industrial wastes Paddy and Coffee husk biocompost on black gram and its influence on the growth and yield parameters of black gram was proved with maximum results in treatment 6 (T6). The study concludes that it can be a substitute for the chemicals and it can be used as promising, sustainable, safe and eco-friendly manure to have the best growth, yield and productivity of plants.

ACKNOWLEDGEMENT

We would like to thank the management of St.Joseph's College for Women (A), Visakhapatnam andhra Pradesh for providing the facility to carry out the study.

Conflict of interest

I declare that Authors have no conflict of interest regarding this article.

REFERENCES

Askari, A., Khanmirzaei, A. and Rezaei, S. (2020). Vermicompost enrichment using organic wastes: Nitrogen content and mineralization. International Journal of Recycling Organic Waste in Agriculture. 9(2): 151-160.

Blouin, M., Barrere, J., Meyer, N., Lartigue, S., Barot, S. and Mathieu, J. (2019). Vermicompost significantly affects plant growth: A meta-analysis. Agronomy for Sustainable Development. 39(4): 1-15.

Ceritoglu, M., Erman, M., Ceritoglu, F. and Bektas, H. (2021). The response of grain legumes to vermicompost at germination and seedling stages. Legume Research. 44(8): 936-941. doi: 10.18805/LR-610.

Changkija, S. and Gohain, T. (2018). Effect of organic nutrient sources on productivity of soybean [*Glycine max* (L.) Merril] Agricultural Science Digest. 38(1): 36-39. doi: 10.18805/ag.D-4678.

Ghasemi G.M., Ghanbari, M. and Reezi, S. (2020). The effects of different potted mixtures on the growth and development of miniature roses (Rosa 'Orange Meillandina'). International Journal of Recycling Organic Waste in Agriculture. 9(4): 399-409.

Gomathinayagam, R., Subramanian, G., Persaud, M., Persaud, R. and Velusamy, S. (2021). The studies of effect of bio fertilizers *rhizobium*, phosphobacteria and root nodule extract (R.PB, R+PB and RNE) on the growth and certain biochemical changes in the seedlings of black gram and maize. Asian Journal of Applied Science and Technology. 5(4): 01-15.

Gul, A., Salam, A., Afridi, M.S., Bangash, N.K., Ali, F., Ali, M.Y. and Mubeeen, R. (2019). Effect of urea, bio-fertilizers and their interaction on the growth, yield and yield attributes of *Cyamopsistetra gonoloba*. Indian Journal of Agricultural Research. 53(4): 423-428. doi: 10.18805/IJARe.A-395.

Gupta, S.C., Trivedia, B.K. and Singh, P. (2020). Effect of diverse nutrient application on symbiotic traits, yield attributes, nutrient uptake, microbial population, dehydrogenase activity and productivity of chickpea (*Cicer arietinum* L.) in black soils. Legume Research. 43(6): 844-849. doi: 10.18805/LR-4051.

Kumar, R., Chadha, S., Upadhyay, R.G., Sharma, G.D. and Kanwar, S. (2021). Evaluation of different enriched composts under protected organic farming in capsicum pea based cropping system. Legume Research. 44(8): 929-935. doi: 10.18805/LR-4300.

Luikham, E., Kumar, K. and Anal, P.S.M. (2018). Influence of phosphorus on yield and quality of promising varieties of soybean [*Glycine max* (L.) Merril] under rainfed condition. Agricultural Science Digest. 38(1): 65-67. doi: 10.18805/ag.A-4109.

Masunga, R.H., Uzokwe, V.N., Mlay, P.D., Odeh, I., Singh, A., Buchan, D. and De Neve S. (2016). Nitrogen mineralization dynamics of different valuable organic amendments commonly used in agriculture. Applied Soil. Ecol. 101: 185-193.

Palia, M., Saravanan, S., Prasad, V.M., Upadhyay, R.G. and Kasera, S. (2021). Effect of different levels of organic and inorganic fertilizers on growth, yield and guality of brinjal (*Solanum melongena* L.). Agricultural Science Digest. 41 (Special Issue): 203-206. doi: 10.18805/ag.D-5157.

Raihing, P. and Vijayalakshmi, A. (2021). Effect of vermicomposted vegetable and fruit wastes on the vegetative and yield parameters of lablab [*Lablab purpureus* (L.) sweet]. Agricultural Science Digest. doi: 10.18805/ag.D-5476.

Raihing, P. and Vijayalakshmi, A. (2022). Influence of vegetable and fruit wastes vermicompost on the growth and yield of black gram (*Vigna mungo* L.). Agricultural Science Digest. 42(3): 322-326. doi: 10.18805/ag.D-5492.

Sakthivigneswari, G. and Vijayalakshmi, A. (2016). Effect of different bio composting techniques on physico chemical changes in Corncob. South Indian Journal of Biological Sciences. 2(1): 61 65.

Shekhawat, A.S., Purohit, H.S., Jain, H.K., Meena, R.H. and Meena, R. (2018). Effect of phosphorus and bio-organics on quality and symbiotic efficiency of black gram (*Vigna mungo* L.). Journal of Pharmacognosy and Phytochemistry. 7(2): 3419-3422.

Silpa, M. and Vijayalakshmi, A. (2022). Impact of cocoa shell and jack fruit peel waste biocompost influence on the growth and yield attributes of *Vigna unguiculata* subsp. *sesquipedalis* (L.). Agricultural Science Digest. doi: 10.18805/ag.D-5488.

Veeral, D.K. and Kalaimathi, P. (2021). Improving physiological and yield traits of groundnut (*Arachis hypogaea* L.) by using various sources of organic wastes and bio fertilizers, *Rhizobia*. Indian Journal of Agricultural Research. 55(4): 473-477. doi: 10.18805/IJARe.A-5255.