WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

MODELLING AND ANALYSIS OF COMPOST SPREADER

P. Seema Rani [a], Sambaraju Vivek Teja [b], Madyala Rahul [c], Palvi Srijan Sai [d], Lavudiya Umesh [e]

[a] Asst. Professor, Department of ME, JB Institute of Engineering & Technology, Moinabad, Hyderabad -75, Telangana.
[b, c, d, e] UG- Scholars, Department of ME, JB Institute of Engineering & Technology, Moinabad, Hyderabad, Telangana.
[b]Second affiliation, Address, City and Postcode, Country

A B S T R A C T :

Compost is a mixture of materials employed as a fertiliser for plants and to improve the physical, chemical, and biological properties of soil. It is frequently generated by the decomposition of plant and food waste, the recycling of organic materials, and the use of manure. The resulting mixture is rich in phytochemicals and beneficial organisms, such as bacteria, protozoa, nematodes, and fungi. Compost improves soil fertility in gardens, landscaping, horticulture, urban agriculture, and organic farming, hence reducing dependence on commercial chemical fertilisers. Compost offers benefits including nutrient provision for crops as fertiliser, functioning as a soil conditioner, augmenting the humus or humic acid content of the soil, and introducing beneficial bacteria that assist in pathogen suppression and reduce soil-borne diseases. Compost is used to the fields to improve agricultural productivity. The manual application of compost necessitates considerable time and labour. Minimising the effort and time required for compost distribution will advantage farmers. We plan to create and analyse a motorised compost spreader, which includes a frame, storage bin, spreader wheel, motor, motor support, wheels, shaft, and battery, among other elements. This technology substantially reduces physical effort in compost distribution and functions in a fraction of the time needed for conventional methods. The project involves the investigation of compost and its distribution method, the materials employed, the manufacturing procedure, the modelling of components, assembly, evaluation, and the creation of a workbook.

Keywords: Compost Spreader, Fertilizer, Modelling, Analysis

INTRODUCTION

The motorised compost spreader is a unique, economical, and durable device that improves soil fertility by the consistent application of compost in agricultural fields. It requires diminished manual effort, hence lowering labour expenses. The ongoing project, "Motorised Compost Spreader," consists of a chassis for transporting compost to the specified site and aiding the spreading operation, a storage bin for containing the requisite amount of compost, a spreader wheel for distributing the compost, a motor to operate the spreader wheel, a motor support, wheels, a shaft, and a battery to energise the motor.

DC Motor: A DC motor is an electrical apparatus that employs direct current (DC) to produce mechanical power. The primary configurations rely on magnetic forces produced by currents in the coils. Nearly all types of DC motors feature an internal device, either electromechanical or electronic, that periodically changes the direction of current inside a segment of the motor. DC motors were the first type of motors widely employed, as they could be powered by existing direct-current lighting power distribution systems. The velocity of a DC motor can be controlled throughout a wide range by altering the supply voltage or varying the current intensity in its field windings. Compact DC motors are employed in tools, toys, and appliances. The universal motor, a lightweight brushed motor employed in portable power tools and appliances, operates on both direct current and alternating current. Large DC motors are currently employed in the propulsion of electric vehicles, elevators, hoists, and drives for steel rolling mills. The advent of power electronics has facilitated the replacement of DC motors with AC motors in several applications.

Battery: A battery is an electric power source consisting of one or more electrochemical cells with external connections for supplying electrical devices. During battery discharge, the positive terminal acts as the cathode while the negative terminal operates as the anode. The terminal identified as negative functions as the source of electrons. When a battery is connected to an external electric load, negatively charged electrons flow across the circuit and reach the positive terminal, thereby commencing a redox reaction by attracting positively charged ions, or cations. Thus, it converts high-energy reactants into lower-energy products, with the free-energy difference provided to the external circuit as electrical energy. Historically, the term "battery" referred solely to a device made up of multiple cells; however, its application has expanded to include devices with a single cell.

Wheel: A wheel is a circular rotating element engineered to rotate on an axle bearing. The wheel is a crucial element of the wheel and axle, which constitutes one of the six simple machines. Wheels, in conjunction with axles, facilitate the seamless movement of large items, enhancing transportation while supporting weight or performing functions in machines. Wheels fulfil various roles, such as those of a ship's wheel, steering wheel, potter's wheel, and flywheel. Common occurrences are seen in transportation applications. A wheel reduces friction by facilitating motion through rolling, in conjunction with axles. For wheels to revolve, a moment must be applied to the wheel around its axis, either via gravity or through the application of an

external force or torque.

Centrifugal force: Centrifugal force is a theoretical force in Newtonian physics, often known as a "inertial" or "pseudo" force, that appears to act on all objects when viewed from a spinning frame of reference. It appears to be directed radially outward from the axis of rotation of the frame. The magnitude of the centrifugal force F exerted on an object of mass m at a distance r from the axis of a rotating reference frame with angular velocity ω. This fictitious force is commonly employed in rotating systems, such as centrifuges, centrifugal pumps, centrifugal governors, and centrifugal clutches, as well as in centrifugal railways, planetary orbits, and banked curves, when analysed from a non-inertial reference frame, such as a rotating coordinate system.

LITERATURE SURVEY

2.1 Mr. Harshal Aher Abhishek Adhav, Anurag Salunke, Nikhil Avhad: A Review on the Design and Fabrication of a Manure Spreader Precisely spreading fertiliser to allow farmers to expect enough acknowledgement for compost additives will soon be essential. Cow compost is vital for the cultivation of residential land. A vigourous interaction is necessary to do this. Natural faeces is an eco-friendly bio-manure utilised for improving soil quality. The judicious application of fertiliser for land usage is crucial for mitigating soil contamination, safeguarding surface water, and reducing the loss of ammonia and other nutrients during composting. Natural agriculture approaches are suitable and relevant for specific land types in certain locations of India. The utilisation of labour for the exploitation of natural resources is inefficient because of high labour costs. As a result, it garners considerable attention in numerous global regions. This minimises expenses while safeguarding the environment and the well-being of farmers. The time has come to execute a more advanced strategy. The streetcar was employed to convey cargo and was connected to the farm truck. The rotor attached to the streetcar obtains power from the PTO shaft of an agricultural vehicle. The general connection and belt pulley transfer power from the farm vehicle's PTO to the spreading rotor. We utilise an inclined side wall on the trolley in lieu of a conveyor system. The trolley possesses a load capacity of 400 kg of cow manure and is frequently utilised for transporting diverse loads as required.

2.2 Dr. P. Sathiamurthi, A. S. Anaamalaai, M. R. Ahamed Buhari, A. Anburaja, M. Ajmal Thahasin, and associates investigated that fertiliser is produced from bovine manure, plant waste, and other organic substances. Land, surface water, and groundwater can be conserved through the judicious application of fertiliser. The harvest yield can be improved with the careful use of compost in appropriate amounts. A significant quantity of organic waste appropriate for fertiliser application is consistently supplied in India, and the use of this solid waste has emerged as a prominent strategy for its eco-friendly disposal. The bulk of contemporary spreaders leverage power takeoff from work trucks, while others employ a ground-driven system to operate the transport mechanism and distributors. The wheel's revolution functions as a driving mechanism or power source in a ground-driven component. The conveyance is utilised to enable the distribution of fertiliser along the back sharp edges. This paper delineates the normal operational protocols for fertiliser spreaders.

2.3 Sengottaian K., Mohanrajhu N., Palani S., Jayabalan C., et al. Examined that faeces functions as a natural fertiliser. Agriculturists finalise the decomposition of botanical and zoological refuse to generate compost. The result of this decomposition is a product abundant in organic matter, known as compost. Compost possesses a low concentration of nutrients. Provided all variables remain unchanged, the incorporation of humus enhances soil fertility. This functions based on the intrinsic properties of the soil, promoting superior moisture retention and increased aeration. Furthermore, as compost consists solely of natural components, it does not contribute to any sort of pollution. It minimises farm waste by digesting rubbish to generate fertiliser. Composts are either natural or manufactured materials integrated into soil to supply vital nutrients for plants. They may originate from either natural or inorganic sources. They function by augmenting plants and yields, incorporating supplements, with the objective of achieving a development rate that exceeds that achieved through traditional approaches. The scientifically engineered composts additionally serve as insecticides, safeguarding plants from pests and insects. Composts possess considerable economic significance for agriculturists. They promote plant growth and are economically viable. Fertilisers also augment agricultural output. Farmers, historically and still, apply compost in horticultural areas manually. The area is extremely challenging to navigate because of the significant buildup of refuse. Moreover, it is an unhygienic procedure that could negatively impact the health of farmers and result in illness in cases of significant injuries. The findings from this study suggest that the use of compost by urban and suburban families may present risks to public health and environmental safety. There is a clear need
for additional informational resources for animal guardians to improve management strategies.

2.4 Mr. G.D. Yadav, Dr. M.S. Pawar, and his colleagues examined the substantial importance of organic manure in improving soil productivity. It is a superior supplier of nitrogen, phosphorus, calcium, and potash. The consistent application of manure on agricultural fields is essential for good outcomes. In India, manure has conventionally been applied using a fork and other mechanical clamps, a method that is arduous and time-intensive. The review of contemporary literature on manure spreaders identifies two main categories: animal-drawn spreaders and tractor-operated spreaders. The evaluation of current spreaders across multiple parameters reveals that tractor-operated spreaders produce superior outcomes. The research additionally investigates the constraints of design and the origins of power supply. A tractor-operated spreader attachment can potentially be constructed, driven by the rear wheel of the trailer.

MODELLING

3.1 PART MODELLING

Chassis: Four circles with a diameter of 25mm have been created, arranged 320mm apart horizontally and 125mm apart vertically, as depicted in figure (3.1.1). A profile has been constructed with dimensions of 340mm horizontally, 1200mm at a 30-degree angle, and 150mm horizontally, as depicted in figure (3.1.2). We utilised the rib command, designating a circle as the profile and the profile as the central curve, as depicted in figure (3.1.3). We utilised the circle command to generate a circle with a diameter of 23mm on the longitudinal pipes of the constructed structure, as depicted

in figure (3.1.4). We have outlined profile lines for the slotting command at the specified distances illustrated in figure (3.1.5). We employed the slot command, choosing a circle as the profile and designating it as the central curve, as depicted in figure (3.1.6). The circle command was utilised to represent circles for vertical pipes, as shown in figure (3.1.7). We utilised the pad command to generate a three-dimensional depiction of the vertical pipes, as demonstrated in figure (3.1.8). We utilised a command line to generate squares measuring 20mm in width, spaced 300mm apart, as depicted in figure (3.1.9).

We have imported and assembled wheels as shown in figure (3.1.33).

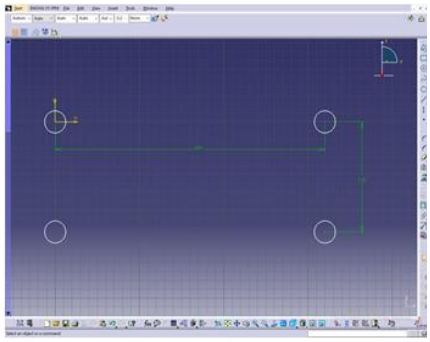


Fig (3.1.1) structure pipe sketch

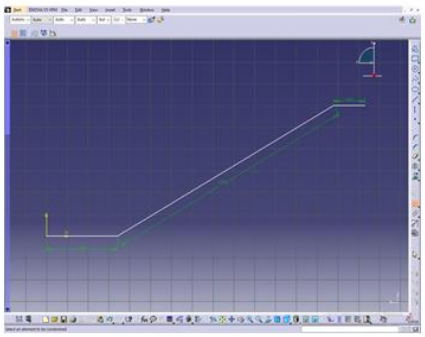


Fig (3.1.2) profile sketch for structure

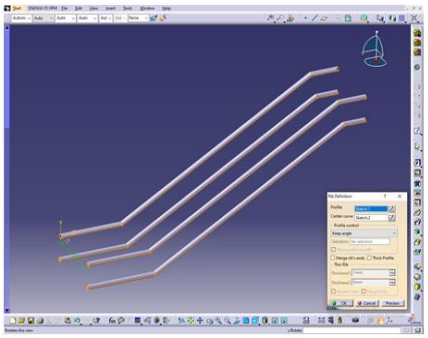


Fig (3.1.3) rib command for structure

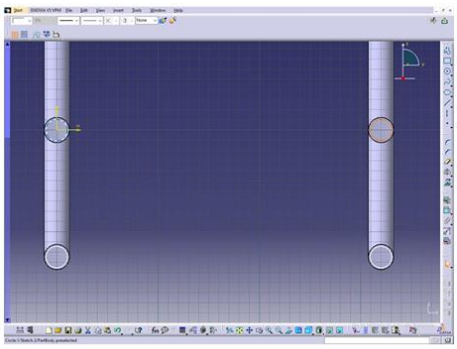


Fig (3.1.4) circles for slot sketch

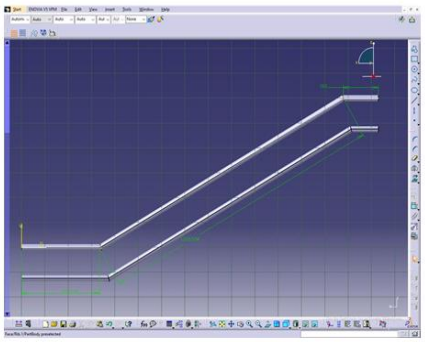


Fig (3.1.5) profile lines sketch

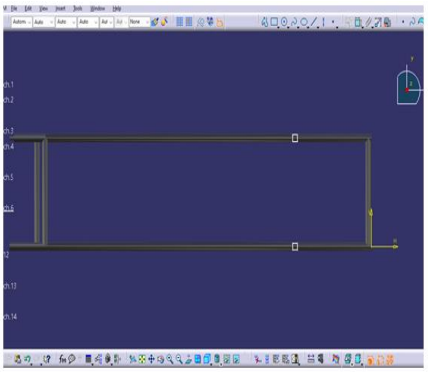
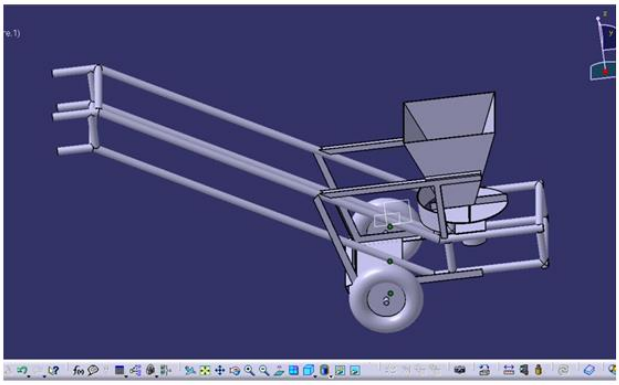


Fig (3.1.9) square command

Equations and formulae should be typed

After the importing of all components, the final assembly is as shown in the below figure.



4. FABRICATION

4.1 PARTS PREPARATION

The fabrication process of the compost spreader frame involved several precise steps, starting with the cutting and preparation of circular pipes. A 25mm diameter, 2mm thick circular pipe was selected as the primary structural material. Initially, the pipe was marked at 1700mm from its edge using measuring tools, followed by a cutting operation using a Dewalt cutting machine. To ensure smooth edges and remove cutting chips, an angle grinder

was used. Further, the pipe was marked at 340mm from its edge, and a slot was carefully cut using an angle grinder. This slot allowed the pipe to be bent at the 340mm length, following the required profile. The bent pipe was then welded using an arc welding machine to secure its position, and a hammer was used to remove flux from the welded area. The same procedure was repeated to obtain four identical frames for the compost spreader.

For the frame assembly, another 25mm diameter, 2mm thick circular pipe was marked at 320mm from its edge and cut using the Dewalt cutting machine. After grinding to remove sharp edges, the side frames were joined using an arc welding machine. Initially, the bottom edges of the side frames were welded to form the base structure, followed by welding the top edges. To improve structural integrity, additional 100mm length circular pipes were welded between the frames. Welding was applied on all sides of the structure to enhance strength and durability.

To further reinforce the structure, two angle supports were prepared. These angles measured 40mm in width, 2mm in thickness, and 400mm in length. One angle was welded to the bottom of the structure as per the design requirements, while another was attached to the bearing support. For additional strength, an extra angle was welded to reinforce the bearing support, ensuring stability.

The wheel assembly process involved fabricating a wheel hub with an inner diameter of 20mm, along with an 8mm diameter tap. The wheel hub was welded to the wheel plate using an arc welding machine, ensuring a secure fit. After welding, the surface was grinded using a paper plate to remove weld flux and smoothen the finish. The wheels were then fixed to the structure using a bolt and nut arrangement, ensuring proper alignment and functionality.

Finally, the battery support plate was welded onto the structure using arc welding. All necessary electrical wiring was installed and securely connected to the frame to complete the motorized system. By following this detailed fabrication process, a strong, durable, and efficient compost spreader was successfully assembled, significantly reducing manual effort and improving agricultural efficiency.

4.2 PARTS ASSEMBLY

We have assembled and painted the project to prevent is from corrosion.

Fig (4.2.1) project

5. RESULTS

Clamp was assigned to the scraper support square pipe, as illustrated in Figure 6.1. A force of 200 N (equivalent to a total mass of 20 kg, including the compost and other components) was applied to the chassis from the top in the direction of gravity, as shown in Figure 6.2.

The Von Mises stress diagram was generated to analyze the structural response. The maximum Von Mises stress recorded was 1.49×10^6 N/m² (1.49 MPa), which is significantly lower than the yield stress of mild steel (240 MPa). This indicates that the selected material thickness is sufficient to withstand the applied force without failure.

Additionally, a transitional displacement diagram was obtained, as shown in Figure 6.4. The maximum transitional displacement observed was 0.00374 mm, which is negligible compared to the overall length of the chassis. This confirms that the structure remains stable under the given load conditions, ensuring durability and reliability in practical applications.

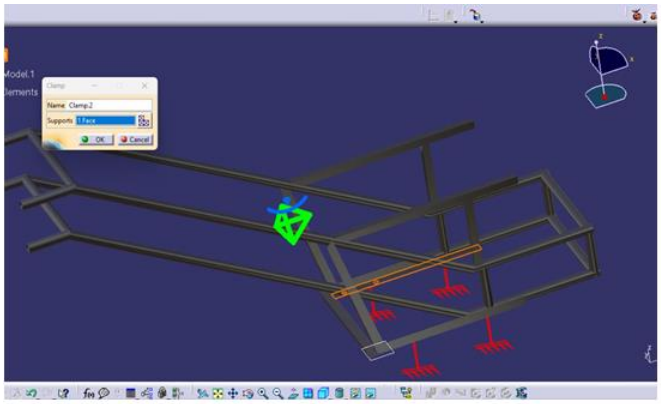


Fig (6.1) Assigning Clamp

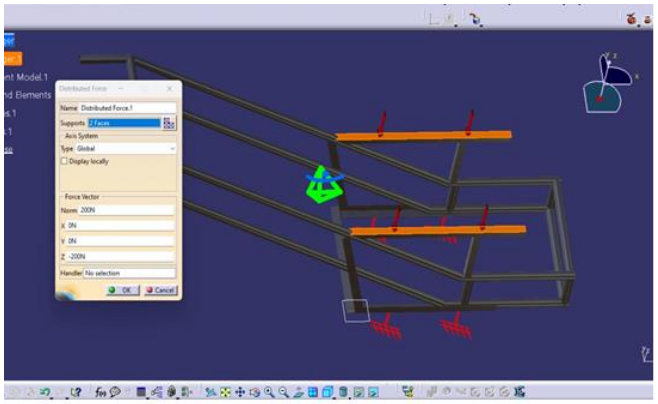


Fig (6.2) Force application

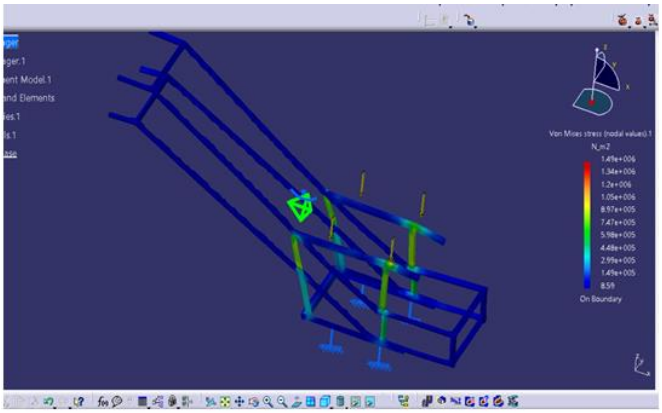


Fig (2.3) Vonmises Stress Diagram

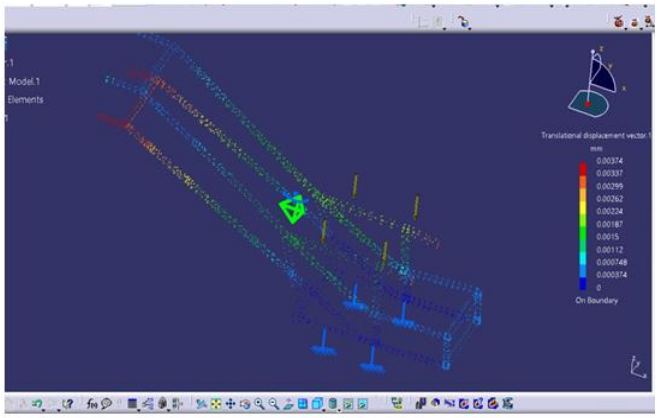


Fig (6.4) Transitional displacement diagram

- he fabricated compost spreader is able to through the dry compost to a distance ranging from 0 to 10ft.
- Spead of compost spreading is also very high when compared to manual compost spreading process.
- Usage of this machine will reduce manual effort to greater extent .
- The motorised compost spreader is able to spread the compost Evenly
- The fabricated compost spreader is able to through the dry compost to a distance ranging from 0 to 10ft.
- Spead of compost spreading is also very high when compared to manual compost spreading process.
- Usage of this machine will reduce manual effort to greater extent .
- The motorised compost spreader is able to spread the compost Evenly

CONCLUSION

As per the analysis (von-mises stress diagram and transitional displacement diagram) the selected material and thickness of the materials are sufficient. Hence, we can proceed for the fabrication of the model. The main aim of the motorised compost spreader is to cut back the manual efforts of farmers in spreading compost on farm field in most efficient and effective way. Process of compost spreading using motorised compost spreader, we will reduce labour effort, cost and also obtained more uniformly in spreading of compost over field. The fabricated compost spreader is able to through the dry compost to a distance ranging from 0 to 10ft. Spead of compost spreading is also very high when compared to manual compost spreading process. Usage of this machine will reduce manual effort to greater extent.

Acknowledgements

This work is not an individual contribution till its completion. We take this opportunity to thank all for bringing it close to the conclusion. First of all, we would like to thank our guide Mrs. P. Seema Rani for continuously assessing our work providing great guidance by timely suggestions and discussion at every stage of this work. Thanks to, Dr. Anoop Kumar Shukla, Head of department of mechanical engineering for providing all facilities without which this seminar work would not have been possible. We sincerely thank to Mrs. P. Seema Rani for her guidance. I would like to express gratitude towards my parents & other faculty members of J.B. Institute of Engineering & Technology for their kind cooperation and encouragement which helped me in completion of this project. My thanks and appreciations also go to my co-peers in assisting with different aspects of the project and people who willingly helped me out with their best of abilities.

REFERENCES

1. International Journal of scientific & Technology research volume 9, issue 03, march 2020 ISSN2277-8616
2. International Journal of Innovation technology and Exploring Engineering ISSN:2278-3075, volume9, issue - 1, march2019.
3. NACHI support bearing table with set screw cylindrical bore.
4. Dr.P.Sathiamurthi, international journal of scientific & technology research volume 9, issue 03, march 2020 issn2277-8616.
5. A Review Paper on Design and Fabrication of Manure Spreader, Mr. Harshal Aher1 Abhishek Adhav2, Anurag Salunke3, Nikhil Avhad4, p-ISSN: 2395-0072, May 2022.
6. Howard A. The waste products of agriculture: Their utilization as humus. Journal of Royal Society of Arts. 1933;11, 13, 15, 25, 34, 36, 37, 38.
7. Biswas DR, Ghosh AK. Manures, biofertilizers and fertilizers. In: Soil Science, an Introduction. Indian Society of Soil Science. New Delhi: National Agricultural Science Centre Complex. ISBN: 81-903797-7-1. p.436.
8. Acharya CN. Preparation of Compost Manure from Town Wastes. Calcutta: Indian Council of Agricultural, Research, Ministry of Agriculture; 1950. Bulletin No. 60.
9. Scott JC.Health and Agriculture in China. London: Faber; 1952. 280 p.
10. van Vuren JPJ.Soil Fertility and Sewage; 1949.
11. University of California, Sanitary Engineering Laboratory. Reclamation of Municipal Refuse by Composting. Burkeley, California (Technical Bulletin No. 9); 1953.
12. Imhoff K, Fair GM.Sewage treatment. In: Composting. New York: World Health Organization; 1956. pp.14, 16
13. Gotaas HB.Raw material: Quantity and composting. In: Composting. World Health Organization; 1956. pp.35, 40
14. Millar CE, Turk LM.Fundamentals of soil science. In: Composting. 2nd ed. NewYork: World Health Organization; 1956. p.36.
15. Waksman SA.Soil microbiology. In: Composting. New York: World Health Organization; 1952, 1956. p36
16. Jenkins SH. Organic manures. In: Composting. Harpenden, England: World Health Organization; 1935, 1956. p.37
17. Narayanasamy G, Arora BR, Biswas DR, Khanna SS. Fertilizers, manures and biofertilizers. In: Goswami NN, Rattan RK, Dev G, Narayanasamy G, Das DK, Sanyal SK, etal., editors. Fundamentals of Soil Science. New Delhi: Indian Society of Soil Science; 2009. pp.579-622.
18. Biswas DR, Ghosh AK.Manures, biofertilizers and fertilizers. In: Rattan RK, Katyal JC, Dwivadi BS, Sarkar AK, Bhattacharyya T, Kukal JCTSS, editors. Soil Science: An Introduction. New Delhi: Indian Society of Soil Science; 2009. pp.424-461.
19. Das PC.Manures. In: Manures and Fertilizers. Ludhiyana, India: Kalyani Publishers. p.40.
20. Palaniappan SP. Green manuring: Nutrient potentials and management (chapter 4). In: Tandon HLS, editor. Fertilizers, Organic Manures, Recyclable Wastes and Biofertilizers. New Delhi: FDCO; 1994, 1994. pp.52-71
21. Ignatieff V and Page HJ (1958). Efficient Use of Fertilizers. F.A.O. Agricultural Studies No 43 (second edition)