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Design and Development of Manure Spreader - A Review

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Abstract— Organic manure plays important role to yield productivity of soil. It is good quality source of nitrogen phosphorus and excellent source of calcium and potash. The evenly spreading of manure on farm field is extremely important to achieve better effect. In India traditionally manure has distributed with help of fork and other mechanical device which is very tedious and slow process. The study of existing literature of manure spreader shows there are mainly two types of spreader viz. animal drawn spreader and tractor operated spreader. Performance of available spreader on different parameter has been studied which shows tractor operated spreader gives better result. Study also focus on their limitations of design and source of power supply. There is scope of develop tractor operated spreader attachment which will driven by rear wheel of trailer. By dismantling the attachment we can use trailer for transportation.

Keywords – *Manure, Trailer, Spreader.*

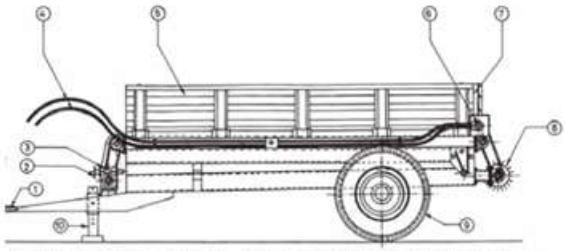
Introduction-Crops need nutrients to grow and develop and they draw these nutrients from the soil. If this withdrawal is not compensated for, the crop yield goes down progressively. This withdrawal is completed through fertilizers and manures to maintain the productivity of the soil and to achieve higher yields. Soil fertilization is carried out by means of organic matter in the form of farmyard manure, liquid manure faces, plants or straw and mineral matters. The manure has to be handled in bulk. So, the problem faced during application of manure differs from that of other fertilizer not only with respect to the rate to be applied per hectare, but also with respect to non-uniformity of the size of the particles. The overall goal for any field receiving manure should be how many gallons or tons of manure should be applied to a known area and to apply the manure as uniformly as possible Organic manure is considered as the eco-friendly bio-fertilizer for the highly polluted modern era. Today's farmer needs machinery which can spread the manure effectively with lest cost with consumes low power.

History-The first successful automated manure spreader was designed by Joseph Kemp in 1875. Manure spreaders began as ground-driven units which could be pulled by a horse or team of horses. At the time of his invention he was living in Waterloo, Canada but thereafter he moved to Newark Valley, NY and formed the J.S. Kemp Manufacturing Co. to manufacture and market his current and subsequent designs. In 1903 he expanded the company to Waterloo, Iowa before selling the design to International Harvester in 1906.

Review of Literature- T P.R Sapkale et.al (2010) [1] test the performance of tractor operated manure spreader. A manure spreader was attached to the 45 HP tractors through the hitch point and test was conducted. The 540+rpm PTO speed was used to operate the rotary blades of manure spreader. The distribution pattern of farm yard manure was uniformly spread over the area and little variation was found. This was due to clods in to manure. It showed that there was saving of 94 per cent in time as compared to traditional method. The field capacity of the manure spreader was also worked out in terms of area coverage per hour. The actual average swath width of manure spreader was found 7.6 m but the effective swath was taken as 7.4 m by considering the overlap uniformity of application and spread pattern. The manure spreader was operated in two different fields. The theoretical field capacity of a tractor operated manure spreader was found to be 1.950 and 2.06 and average actual field capacity of the tractor operated manure spreader was found to be 1.395 and 1.473 at forward speed of 2.438 km/h. The average field efficiency of the tractor operated manure spreader was found to be 71.55 per cent. The field application rate of farm yard manure was observed to be 5.435 and 5.89 t per ha. The cost economics of the manure was analyzed. The cost of spreading with the tractor operated manure spreader was Rs. 247 per ha. The saving in cost and time were 72 and 94 per cent, respectively as compared to conventional method of manual broadcasting.

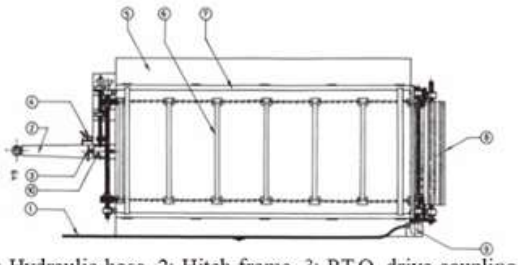
B. Suthakar et.al (2008) [2], evaluate the field performance of a tractor PTO operated manure spreading attachment to a two wheel trailer and compare it with the traditional method of spreading manure. The machine mainly consists of a manure tub to load the manure, an endless chain conveyor for conveying the manure towards the rear end of the trailer and a hydraulically operated spreader drum to shear off manure. The machine was tested at Research Farms of the Tamil Nadu Agricultural University and at the farmer's fields. It possesses the linear relationship for the forward speed and chain conveyor speed with the application rate. But, the speed of the spreader drum did not influence the application rate of the manure. The desired application rate of the manure (12.202 tonnes/ha) was observed for the forward speed of 2.31 km/hr and the chain conveyor speed of 1.51 m/min with the effective width of 1.20 m and

a time saving of 50-60 % when compared to the conventional method. The spread pattern obtained was a flat top profile, which is acceptable for uniform spreading. It can also be used as a trailer by just shifting a door whenever the trailer is required for transportation.



1: Hitch frame, 2: P.T.O. drive coupling, 3: Reduction gear box, 4: Hydraulic hose, 5: Manure tub, 6: Hydraulic motor, 7: Adjustable door, 8: Spreader drum, 9: Pneumatic tyre, 10: Parking stand

Figure 1.Front view of manure spreader



1: Hydraulic hose, 2: Hitch frame, 3: P.T.O. drive coupling, 4: Parking stand, 5: Tractor trailer, 6: Chain conveyor, 7: Manure tub, 8: Spreader, 9: Hydraulic motor, 10: Reduction gear box

Figure 2.Top view of manure spreader

The desired application rate of the manure can be obtained by selecting the suitable combination of the forward speed of operation, chain conveyor speed and the spreader speed. The application rate for the selected combination levels of the variables should meet optimum requirement of manure to be applied over field, which should be around 12 tonnes/ ha. The results of the investigation are summarized and the values are furnished in the It may be seen from the table that the combination of the forward speed of 2.31 km/hr, chain conveyor speed of 1.51 m/min and the any of the speed of spreader drum equals the (12.202 tonnes/ha) optimum requirement of the manure to be applied over the field. Based on analysis of results the following conclusions were made.

The application rate decreased with increase in forward speed of tractor. Minimum (8.13tonnes/ha) and maximum (18.40 tonnes/ha) application rate were observed for the forward speedof 4.00 km/hr and 1.88 km/hr, respectively. The application rate increased with decease in chain conveyor speed. The maximum application rate (13.80 tonnes/ha) was observed for the chain conveyor speed of 1.51 m/min followed by 1.88 m/min (12.437 tonnes/ ha) and 11.219 tonnes/ha), respectively. There was a linear relationship for the forward speed and chain conveyor speed with the application rate manure

Chain conveyor speed, m/min	Spreader speed, m/min	Application rate of manure (tones/ha) at selected levels of forward speed		
		1.88 km/min	2.31 km/min	4.00 km/min
2.26 m/min	25.12 m/min	16.16	10.39	6.93
	37.68 m/min	16.40	9.94	7.22
	47.10 m/min	16.92	10.08	7.06
1.88 m/min	25.12 m/min	18.85	10.59	8.43
	37.68 m/min	17.96	10.86	7.87
	47.10 m/min	18.47	10.74	8.09
1.51 m/min	25.12 m/min	20.11	12.22	9.22
	37.68 m/min	20.41	12.62	8.87
	47.10 m/min	20.25	12.02	9.46

Table 1- Application rate of manure for different combinations

The speed of the spreader drum did not influence the application rate of the manure over the field.

The spread pattern obtained was a flat top profile, which is acceptable form from the point of achieving uniform spreading. The desired application rate of manure (12.202 tonnes/ha) was observed for the forward speed of 2.31 km/hr and the chain conveyor speed of 1.51 m/min. The effective width of the manure for the all the treatments was 1.20 m.

There w as a 50-60 % of time saving with the manure spreading attachment two-wheel trailer when compared to conventional method of manure application. The manure spreading attachment to two-wheel trailer can also be used as a trailer by just Shifting a door whenever the trailer is required for transportation.

R. C. Singh and C. D. Singh (2014) [3] develop animal drawn spreader existing bullock carts which used for transport of manure to the field .it is modified for FYM spreading operation. Keeping all facts in mind an animal drawn FYM spreader is developed for uniform spreading of manure and eliminates the human drudgery involved in spreading of manure in the field. The developed farmyard manure spreader of 480 kg capacity and gave manure application rate of 5 to 10 t/ha for the manure delivery rate of 0.38 to 0.74 kg/s at the operational speed of 2.4 km/h, respectively.

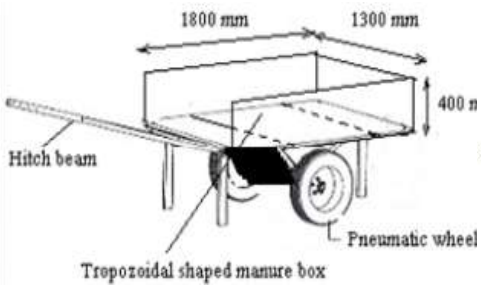


Figure 3-.Schematic view of developed manure spreader

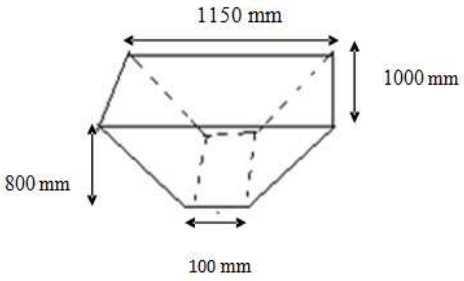


Figure 4.Trapezoidal shaped manure box.

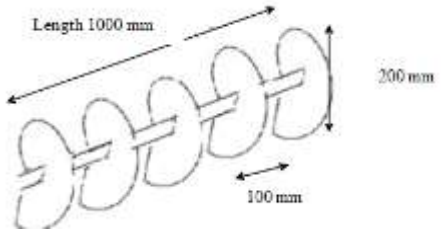


Figure 5. Details of spiral auger used for manure spreading. Spiral auger- disc size: Thickness = 2 mm; Pipe outside dia = 48 mm

Manure delivery rate (kg/min)	Speed, (m/s)	Swath, (m)	Application rate (t/ha)	Field capacity (ha/h)	Field efficiency (%)
23.8	0.68	1.1	5.30	0.19	84
22.4	0.67	1.1	5.06	0.20	83
22.9	0.66	1.1	5.25	0.18	83
Avg. 23.0	0.67	1.1	5.18	019	83

Moisture content = 20% (db).

Table 2 – Field performance on different opening width

Conclusion-Very least work has been done on design of manure spreader. The existing tractor drawn Manure spreader run on hydraulic power. It requires hydraulic motor and gear box. Attachment of spreader gets the power from PTO shaft of tractor. This spreader is heavy and difficult to maintenance. The performance of this spreader on farm field gives effective spreading with low cost and reduction of time, while animal drawn spreader require separate cart which is used only for carrying manure. It require spiral auger which is complex to manufacturing. It is intricate to get evenly spread pattern. The animal drawn spreader is economically efficient but it consume more time as compared to tractor drawn spreader. Review also underlines the need of manure spreader which is easy to operate and design. The Manure tub can be used for transportation after dismantling the spreader.

REFERENCES:

1] *P*.R Sapkale, S.B Mahalle and T.B Bastewad*, "Performance evaluation of tractor operated manure spreader",* International Journal of Agricultural Engineering, Vol. 3 No. 1 (April, 2010): 167-170.

[2] B. Suthakar, K. Kathirvel, R. Manian and D. Manohar Jesudas," Development and Performance Evaluation of Manure Spreading Attachment to Two Wheel Trailer", *agriculture mechanization in Asia, Africa and Latin America , vol. 39 May 2008.*

[3] R.C Singh and C.D Singh "Design and development of animal drawn farmyard manure spreader",*African journal of agricultural reaserch,Vol.9, October 2014.*

[4] Padmavati Manchikanti and Mahashweta sengupta,"Agricultural machinery in india: IPR perspective" ,*Journal of intellectual property right, vol 16,pp 163-169,March 2011*