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Research Paper

Design and Development of Single Flight Horizontal Screw Conveyor Metering Mechanism for Disposing Vermicompost Manure into Subsurface of Soil

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ABSTRACT

Research was conducted to design a single-flight horizontal screw conveyor metering mechanism for disposed of vermicompost manure into the subsurface of soil. All the components of the screw conveyor were constructed from locally available materials for the mixing of vermicompost manure properly and delivered into the delivery pipe of size 70 mm through which it dropped into the furrow made by the furrow opener of tractor drawn subsurface manure applicator already design in Farm Machinery and Power Engineering Department of G.B. Pant University of Agriculture and Technology Pantnagar Uttarakhand. The design was made by computing the hopper volume, shaft diameter, screw geometry, and the discharge capacity of the conveyor respectively. Vermicompost spreading from one location to another in the field is difficult task due to non-uniformly distribution of it into the field during the broadcasting method. Hence a horizontal screw conveyor mechanism was designed which could mixed the vermicompost properly and then disposed it in correct ratio So a screw flight of pitch 90 mm and a thickness of screw of 3 mm was welded over the solid shaft. The length of the shaft was 1800 mm with a pitch angle of 29^0. Three different screw flight outer diameters viz. 96, 106 and 116 mm were selected and tested in the workshop for performance evaluation screw mechanism at four different moisture contents namely.13,21, 31 and 43% respectively. For this purpose, a three-phase variable speed electric motor was connected to the applicator by a telescopic universal joint shaft of length 916.6 mm inclined at 8^0 from the horizontal. The screw conveyor mechanism was rotated at different rotational speeds namely 14,21,28,35 and 42 rpm. Therefore, the result pertained that for handling of vermicompost manure at a discharge rate of 10 t ha^{-1} (recommended dose), the screw conveyor flight of outer diameter 116 mm, vermicompost moisture of 43 % (d.b) and the tractor forward speed was normally maintained between 2.0 to 3.0 km h^{-1} were recommended respectively.

HIGHLIGHTS

- Vermicompost is considered a high rich organic nitrogen manure which improves soil fertility.
- The study aimed that to design such a metering mechanism which could disposed manure below the soil surface so that ammonia volatilization can be reduced and the effect of global warming can also be decreased.
- The study revealed that ammonia emission from the field can be reduced by placing the vermicompost manure below the soil surface.

Keywords: Capacity, design, screw conveyor, screw flight, vermicompost

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Vermicomost which is an important and valuable source of plant nutrients increases the root nodulation, microbial activity in the rhizosphere, soil organic carbon, crop growth and yield attributes and valuable source of plant nutrients. The selection of conveying method depends upon the nature of application and on the type of material being conveyed. The organic manure may be granular, powder, amorphous or any combination of these. Conveying is accomplished by a combination of mechanical, inertial, pneumatic, and gravity forces. Screw conveyors are popular devices for conveying farm products. It is very effective conveying devices for free flowing or relatively free flowing bulk solids, giving good throughput control and providing best solutions to deliver manure into the field because of their simple structure, high efficiency, low cost and maintenance requirement. Screw conveyors vary in size from 75 to 400 mm in diameter and from less than 1m to more than 30 m in length (Athanasiov *et al.* 2006). A screw conveyor consists of trapezoidal shape hopper in which it was revolved. Manure is pushed along the bottom of the delivery orifice by the helix shape designed of screw flight. The performance of screw conveyor, as characterized by its capacity, volumetric efficiency, and power requirements, is affected by the conveyor geometry and size, the properties of the material being conveyed, and the conveyor operating parameters such as the screw rotational speed, screw clearance and conveying angle (Srivastava *et al*. 2006). In recent years, a number of studies have been conducted by researchers to decide the performance properties of screw conveyors. Konig and Riemann (1960) found out that the influence of inlet screw diameter on screw conveyor capacity and reported a near linear increase in capacity with increased inlet screw diameter upto a maximum point. After reaching to that point, capacity was decreased. Burkhardt (1967) tested the effects of pitch, radial clearance hoppers filling level on the performance of screw feeders. (Carleton *et al.* 1969) discussed the performance of screw conveyors and screw feeders based on experiments on the effects of screw feeders based on experiments on the effects of screw geometry, speed, fill level and material properties. (Bloome *et al.* 1976) indicated that capacity of a screw conveyor is affected by its diameter, intake length, conveying angle, rotational speed, and moisture content of grain. (Nicolai *et al*. 2006) analyzed large portable screw conveyors performance specifications. They determined the capacity, volumetric efficiency, and power requirements for 200 mm and 250 mm to 1100 rpm at inclination angles of 13°, 20°, and 30° for conveying corn crop. **(**Balami *et al*. 2013) developed and tested an animal feed mixing machine having a vertical conveyor with a diameter and pitch size of 145 mm and 100 mm respectively and found that it mixing efficiency of 95.31% attainable in 20 minutes.

MATERIALS AND METHODS

Design consideration

Factors considered in the design of the machine were cost, availability of the materials, rigidity and vibration stability, durability and strength of the metallic material selected to ensure corrosion and wear resistance, portability of the machine and necessary physical properties of vermicompost was also be considered while designed of screw conveyor.

Assumption consideration

The screw conveyor was designed on the basis of following assumptions (Henderson and Perry, 1966).

(a) Horizontal conveyor of material would occur.

(b) The pitch of screw (p) should be slightly less or equal to its diameter for the best performance and considered to be 90 mm.

(c) It should be capable of handling 5 to 20 tonne of vermicompost material per hectare.

Description of the machine

The vermicompost applicator was designed and calibrated in the laboratory to determine the application rate of manure delivered per hectare. The machine was lifted up to 150 mm height above the ground surface with the help of hydraulic jack such that the ground wheel freely rotated. The machine was tested according to IS 6813 of rotational under different filling levels of hopper namely half and full fill and at different levels of moisture content of vermicompost viz. 13, 21, 31 and 43% (d.b) respectively and five forward speeds viz. (14, 21, 28, 35 and 42 rpm) of the machine were taken into consideration. All the physical properties i.e. moisture content, bulk density, angle of repose and chemical properties of manure were measured in laboratory. The application rate of vermicompost was measured at three different moisture states for three forward speeds of tractor 2, 4 and 6 km h^{-1}. The machine was driven by an electric motor connected with machine with a by a telescopic torque tube of length 916 mm and at inclination of 8^0 as shown in (Fig. 1).

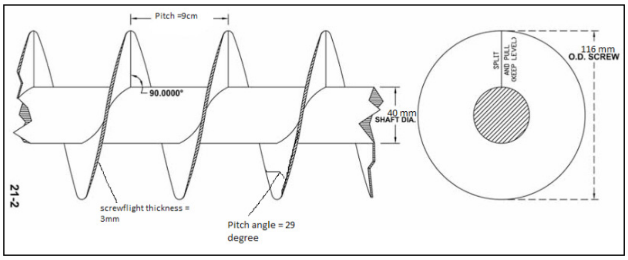

Fig. 1: Screw flight designed over the shaft

One end of tube was connected to the motor and other end was connected to the screw conveyor shaft by a sprocket which was welded at one end of torque tube. The motor was rotated for five fixed different rotational speeds viz., 14, 21, 28, 35 and 42 rpm. To measure the amount of manure delivered, the polyethylene bags were attached at the bottom of the manure delivery pipe as shown in (Fig. 2). The outcome vermicompost weight was measured with help of electronic balance. The experiment was repeated three times at each rotational speed of the shaft and the average delivered amount was calculated. In (Fig. 3) the performance of screw conveyor was also tested on the flat soil surface over the plastic polyethylene sheet of size 20 m × 4m at three different forward speeds of tractor viz 2, 4 and 6 km h^{-1} and different opening of orifice for observing the distribution pattern of materials. The material was collected at 500 mm distance interval up to 25 m distances and then weighted it on electronic balance to determine the actual manure application rate.

Principle of operation

Due to economic consideration, the machine was designed to deliver a vermicompost manure with average capacity ranging from 1 to 10 t h^{-1} with the help of tractor operator. The manure to be filled into the hopper manually, the materials are then moved through the driven shaft via chain and sprocket power transmission system by the rotational of the conveyor and discharge of materials at the lower bottom of hopper through the outlet orifice pipe. An adequate clearance was kept between the conveyor screw flight and the bottom of hopper was considered in the design to neglect clogging of driven shaft. For effective operation, the materials to be conveyed are expected to be at safe moisture level to prevent clogging which usually reduce the performance of the transmission unit.

DESIGN CALCULATIONS

Determination of thickness of seed hopper sheet

The thickness of hopper sheet (t) was designed considering the maximum bending moment (BM_{max}) in the wall by the Rankine's equation 1 as (1904

Fig. 2: Laboratory calibration of screw conveyor mechanism

Fig. 3: Field performance test of screw convey or mechanism

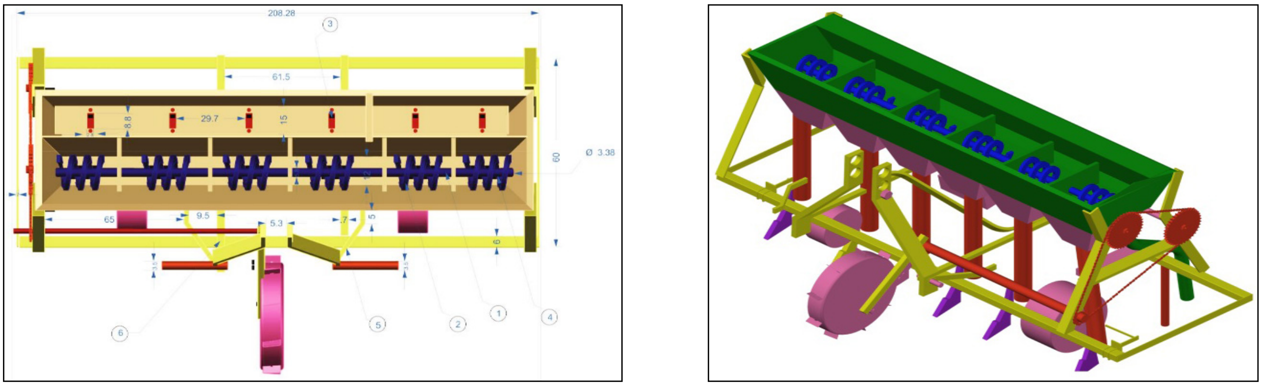

Fig. 4: Top view and perspective view tractor operated manure and seed applicator

(1-Horizontal screw conveyor metering mechanism and shaft, 2-Helical single threaded screw flight, 3-Fluted roller top opening, 4-Rectangular orifice, 5-Side plate to support hitch system)

kg-mm). Sheet thickness was found as 1.77 mm. However, for safer design and ease of availability, 3 mm thick MS sheet was selected.

$$MB_{\max} = \frac{\rho h_3^2 b_2^2 \cos\theta}{8} \quad \ldots(1)$$

$$\sigma_{\max\, allow} = \frac{BM_{\max} I}{y} \quad \ldots(2)$$

where, ϱ is bulk density of the vermicompost manure (605 kg m^{-3}); h_3 is maximum height of hopper, (370 mm); b_2 is maximum width of hopper, (510 mm); BM_{max} is bending moment, (kg.m); θ is angle of repose of vermicompost (45°); $\sigma_{max\ allow}$ is maximum allowable shear stress (9.8 kg mm^{-2}); I is moment of inertia, (mm^4) and y is distance of the outer stress fiber from the neutral axis, (t/2 mm).

Volume of the hopper

The volume of vermicompost hopper was determined by the equation 3 given below:

$$\rho = \frac{W}{V_v} \quad \ldots(3)$$

where, ϱ is bulk density of vermicompost (605 kg m^{-3}); W is weight of vermicompost (50 kg) and V_v is volume of vermicompost (m^3).

$$605 = \frac{50}{V_v}$$

$$V_v = 0.09 \text{ m}^3 = 90000 \text{ cm}^3$$

Design of screw conveyor metering device

The pitch and thickness of screw conveyor flight were decided on the basis of type of manure to be delivered. Therefore, a single flight screw of 3 mm thickness and 90 mm pitch was welded over the solid shaft of 38 mm diameter with a pitch angle of 29°. Therefore, a screw flight of 116 mm major diameter was welded over the solid shaft.

Outer diameter of screw (D) was calculated by the equation 4:

$$h = 0.6403\, p = 50.76 \text{ mm} \quad \ldots(3)$$

Therefore, the height of screw flight was kept top and bottom of the shaft was 2h.

$$[2 \times 50.76 = 115.2 \text{ mm}]$$

Thus, outer diameter of screw flight was considered to be 116 mm that was less than the bottom width of vermicompost hopper to free it a jammed problem of screw.

Screw flight development

$$\text{Pitch diameter } (D_p) = D - \frac{3}{4}h = 11.6 = 70.28 \text{ mm} \quad \ldots(5)$$

$$\text{Root diameter } (D_r) = D - 2 \times 0.6495\, p = 0.9 \text{ mm} \quad \ldots(6)$$

Bulk density of vermicompost, $\rho_v = 605$ kg m^{-3}

Diameter of solid shaft

A solid transmission shaft was selected for transmitted the power to the metering mechanism of manure hopper. The shaft was subjected to both bending and torsion moment. The load acting on the shaft was considered to bending or torsional load. The following assumption (Khurmi and Gupta, 2004) to be considered for designing of shaft is given below:

(i) The design of the shaft was based on the determination of its diameter, so as to ensure satisfactory strength and rigidity when the shaft is transmitting power operation and under loading condition.

(ii) It should be enough strength to sustain loads.

(iii) Deflection produced due to external power devices (like sprockets, chain) is minimum and within tolerable limit.

(iv) The load acting on the shaft is uniformly distributed load and the maximum bending moment will be act at the center of the shaft.

$$d \geq \sqrt[3]{\frac{32T_e n}{\pi\sigma_y}} \geq \sqrt[3]{\frac{32\times 226.20}{3.14\times 56\times 10^6}} \qquad \ldots(7)$$

where, d is the diameter of solid shaft; T_e is the equivalent torque; n is factor of safety (n=1.5) and σ_y is the yield stress of material

$d = 40$ mm

Therefore 40 mm diameter shaft was selected to transmit the power to the manure metering device.

Calculation of inside and outside circumference of washer

$$Length\ (l) = \sqrt{(\pi d)^2 + P^2} \qquad \ldots(8)$$

where l is the circumference of inner circle; d is the diameter of shaft; p is pitch of screw flight; L is the circumference of outer circle and D is the outer diameter of screw flight

$$l = \sqrt{(3.14\times 40)^2 + 90^2}$$

$$l = 149.46\ mm$$

$$L = \sqrt{(\pi D)2 + P^2} = \sqrt{(3.14\times 116)^2 + 90^2}$$

$$L = 375.19\ mm$$

Inner and outer diameter of washer

Inner and outer diameter was calculated as using the equation 9 and 10 is given below:

$$d' = \frac{D-d}{\frac{L}{l}-1} \qquad \ldots(9)$$

where d' is inner diameter of washer and D' is outer diameter of the washer:

$$d' = \frac{116-40}{\frac{375.19}{149.46}-1} = \frac{76}{1.510} = 51 \text{ mm}$$

$$D' = (D - d) + d' \qquad \ldots(10)$$

$D' = (D - d) + d' = (116 - 38) + 51.00 = 129.0$ mm

Degree of cut making in washer

The degree of arc cut made in washer was found from the equation 11 and as shown in (Fig. 5).

$$d'(<) = \frac{1}{\left(\frac{\pi d'}{360}\right)} \qquad \ldots(11)$$

Table 1: Dimension of horizontal screw conveyor

Parts	**Dimension (mm)**
Thickness of screw	3 mm
Pitch	90 mm
Diameter of solid shaft	40 mm
Pitch angle	29°

$$d'(<) = \frac{1}{\left(\frac{\pi d'}{360}\right)} = \frac{149.46}{\frac{3.14\times 51.65}{360}} = 331.76° \qquad \ldots(12)$$

$d'(<) = 331.76°$

$\theta = 360° - 331.76° = 28.23°$

Hence, 28.23° (29°) degree cut was made in washer .

Conveying capacity of screw conveyor

The conveying capacity screw conveyor was determined by using the equation 13 given below.

$$C_s = 47.2\left(D_s^2 - d_s^2\right) \times p \times n \quad \text{...(13)}$$

where, C_s is conveying capacity of screw conveyor ($m^3 h^{-1}$); D_s is diameter of screw (m); d_s is diameter of shaft (m); p is pitch of screw conveyor (m) and n is speed of conveyor (rpm).

Bending Stress of shaft

The bending stress of the shaft was calculated by using equation (14):

$$\sigma_{bm} = \frac{MY}{I} = \frac{M.\frac{d}{2}}{\frac{\pi}{64}d^4} \quad \text{...(14)}$$

where, σ_{bm} is bending stress ($N\ m^{-2}$); M is magnitude of the bending moment at the section (N- m); d is shaft diameter (40 mm); Q is weight of material (27.77 kg m^{-1}); l is length of the shaft (1800 mm); w is weight of vermicompost material per meter length; and I is moment of inertia of the cross section with respect to its neutral axis.

For uniformly distributed load (UDL)

If the reactions at the ends of the shaft are R_1 and R_2 as shown in (Fig. 7).

$$R_1 + R_2 = w.l \quad \text{...(15)}$$

$w.l$ = 27.77 kg m^{-1} × 9.8×1.8 = 489.86 N

$$R_1 = R_2 = \frac{489.86}{2} = 244.93 \text{ N}$$

To obtained bending moment M for equation

$$M = \frac{wl^2}{8} \quad \text{...(16)}$$

$$M = \frac{wl^2}{8} = \frac{27.77 \times 9.8 \times 1.8^2}{8} = 110.22N$$

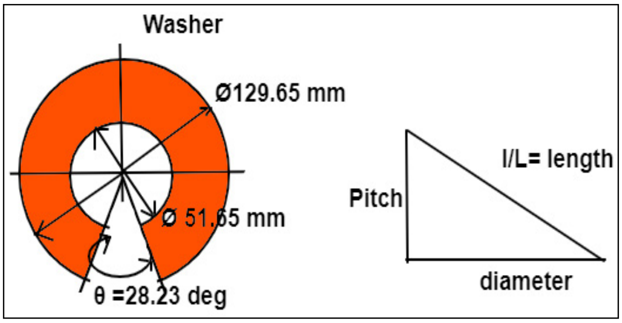

Fig. 5: Design of washer size to be select for developed screw flight

Fig. 6: Design of washer web for screw flight

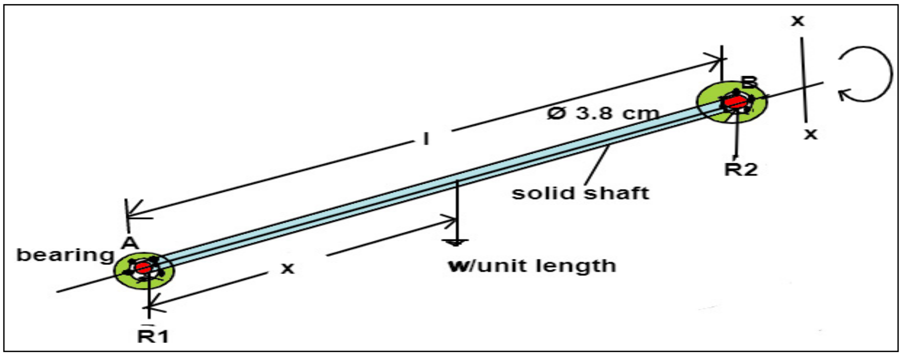

Fig. 7: Load distribution on the shaft

Table 2: Application rate of screw conveyor per hectares at different screwflight diameter under different moisture contents of vermicompost

Screw-flight diameter, mm	Moisture content, %	Application rate ($t\ ha^{-1}$) at different size of screw flight				
		(2)	(3)	(4)	(5)	(6)
		Revolution per minute of screw conveyor				
		[14]	[21]	**[28]**	**[35]**	**[42]**
116	13	7.860	7.62	7.38	7.104	6.828
	21	9.300	9.040	8.784	8.451	8.118
	31	9.420	9.170	8.922	8.571	8.220
	43	10.800	10.55	10.23	9.828	9.426
	Average	9.340	9.090	8.82	8.48	8.148
106	13	6.15	6.08	6.018	5.781	5.544
	21	7.32	7.23	7.158	6.876	6.594
	31	7.45	7.35	7.242	6.957	6.672
	43	8.49	8.4	8.304	7.977	7.65
	Average	7.352	7.265	7.1805	6.897	6.615
96	13	4.896	4.839	4.782	4.596	4.41
	21	5.82	5.754	4.688	4.466	5.244
	31	5.892	5.826	4.76	5.532	4.304
	43	4.756	3.681	5.606	4.345	4.084
		5.341	**5.025**	**4.959**	4.734	4.510

Stress produced due to bending, the flexure formula:

$$\sigma_{bm} = \frac{MY}{I} = \frac{M.\frac{d}{2}}{\frac{\pi}{64}d^4}$$

$$\sigma_{bm} = \frac{110.21 \times \frac{0.038}{2}}{\frac{\pi}{64}\left(0.038^4\right)}$$

$= 20.46 \times 10^6\ N\ m^{-2}$

Shear stress acting of solid shaft

For solid shaft the shear stress is calculated as given below by using equation 17:

$$\tau = \frac{Tr}{J} \qquad \ldots(17)$$

where, τ is shear stress ($N\ m^{-2}$) (allowable strength of shaft, 56 MPa); *J* is polar moment of inertia (m^4); *r* is radial distance from the center of the shaft to the point of interest and *p* is pitch of screw conveyor (9 mm).

$$t = \frac{Tr}{\frac{\pi}{32}d^4} = \frac{T \times 0.058}{\frac{\pi}{32}0.038^4}$$

$56 \times 10^6 = T \times 283474.46$

$T = 197.54\ N\ m$

According to maximum shear stress theory, the equivalent torque is:

$$T_{eq} = \sqrt{M^2 + T^2} = \sqrt{110.21^2 + 197.54^2} = 226.20 \text{ N m}$$

Power required by the shaft

The power requirement by the shaft was determined for capacity of the material to be delivered by the screw conveyor. Therefore, the maximum power required at 42 rpm of the shaft to deliver the manure was determined by the equation 18.

$$P = Q \times g \times (l_v . k_a \pm H) . k_o \quad \dots(18)$$

where, P is power W; Q is capacity of conveyor kg s^{-1}; k_a is coefficient of friction for material (range = 2.2-2.7); k_o is overloading coefficient (range = 1.05-1.2); l_v is length of the conveyor 1800 mm; H is perpendicular height, 787 mm from ground and g is acceleration due to gravity 9.8 m s^{-2};

$P = 0.360 \times 9.81 \times (1.8 \times 2.7 + 0.787) \times 1.2 = 23.9$ W

$P = 0.087 \times 9.81 \times (1.8 \times 2.7 + 0.787) \times 1.2 = 5.78$ W

Therefore, for safety factor the driving power P is taken as 24 W.

Driving force of the conveyor

If the screw conveyor must function, the angular moment is expected to be directly proportional to the angular force which should be greater than the required driving force.

Actual angular force required:

$$F_w = \frac{2M_w}{D\tan(\alpha + \beta)} \quad \dots(19)$$

where, F_w is driving force of the conveyor (N); M_w is angular moment (N.m); D is diameter of screw (mm); α is pitch angle (deg); β is frictional angle for the whole screw; F is coefficient of friction (range = 0.09–0.395) and n' is number of screw rotation and is taken according to the conveyor material for dense material n = 0.8-1.5

Therefore,

$\beta = \tan^{-1} 0.395 = 21.55°$

Angular moment for the shaft

$$M_w = \frac{q_m}{2n'\pi} = \frac{2.538}{2 \times 3.14 \times 1.5} = 0.269 \text{ N.m}$$

$$q_m = \frac{Q_s}{V} = \frac{0.360}{\pi Dn} = \frac{0.360}{\pi \times 0.116 \times 42} = 1.41\ kg\ m^{-1}$$

Actual $q_m = 1.41 \times 1.8 = 2.538$ kg

Actual angular force required

$$F_\alpha = \frac{2M_w}{D\tan(\alpha + \beta)} = \frac{2 \times 0.269}{0.116 \times \tan[29° + 21.55°]} = 3.817\ N$$

Magnitude of the force required for driving force was determined by:

$$F_d = q_m (l_v \pm H) . f. g \quad \dots(20)$$

where, F_d is driving force (N); q_m is weight of the materials to be transported (kg m^{-1}); l_v is length of conveyor, (m); H is height of conveyor from ground, (m); f is coefficient of friction and g is acceleration due to gravity, 9.81(m s^{-2})

$F_d = 1.41 \times (1.8 + 0.787) \times 0.39 \times 9.8 = 13.94$ N

$F_d > F_a$

The driving force required to drive the screw conveyor must be greater than the angular force

RESULTS AND DISCUSSION

Result from the experiment was revealed that the screw flight of diameter 116 mm was designed and suitable for discharge a vermicompost manure at recommended rate from 6.8 to 10 t ha^{-1} as shown in (Fig. 7a & 7b) and presented in (Table 3) but it was observed that some little bit amount of vermicompost manure was left below clearance space between the screw conveyor and the hopper bottom. It was also observed that the best position of conveyor was horizontal and the discharge was higher when the screw flight diameter was 116 mm was fabricated around the shaft and lowest when the screw flight diameter was 96 mm. The result also pertained that as discharge of vermicompost manure from tractor drawn applicator was decreased from 10.80 to 9.42 t ha^{-1} as the forward speed of tractor was increased from 2 to 4 km h^{-1} respectively. The chocking problem of screw conveyor was due to its amorphous characteristics of vermicompost manure.

Table 3: Technical characteristics of the horizontal single flight screw conveyor

Parameters	Notation	Design expression	Calculated value
Hopper design data			
Hopper volume, m^3	V	$\rho = \frac{W}{V_v}$	0.09
Hopper Outlet Diameter, mm	B	$B = \frac{\sigma_c H(\theta)}{\rho g}$	70
Thickness of a hopper sheet, mm	t	$BM_{max} = \frac{\rho h_3^2 b_2^2 \cos\theta}{8}$ $\sigma_{max\,allow} = \frac{BM_{max} I}{y}$	3
Discharge rate, kg s^{-1}	Q	$\frac{Q \times 10^4}{b \times s}$	0.460
Design Calculation of screw dimensions			
Outer diameter of screw, mm	D	2h	115.2
Height of screw flight, mm	H	2h	115.2
Screw flight development			
Pitch diameter, mm	D_p	$D - \frac{3}{4}h$	70.28
Root diameter, mm	D_r	$D - 2 \times 0.6495\, p$	0.9
Calculation of the size of washer to be selected			
Calculation of screw flight length, mm	l	$\sqrt{(\pi d)^2 + P^2}$	149.46
Maximum length, mm	L	$\sqrt{(\pi d)^2 + P^2}$	375.19
Inner diameter of washer, mm	d'	$d' = \frac{D-d}{\frac{L}{l} - 1}$	51.65
Outer diameter of washer, mm	D'	$D' = (D - d) + d'$	129.65
Degree of cut making in washer		$\theta(<) = \frac{l}{\left(\frac{\pi d'}{360}\right)}$	θ = 331.76 θ′ = 360° – 331.76° = 28.23 (29°)
Performance of screw conveyor	C_s	$47.2\,(D_s^2 - d_s^2) \times p \times n$	

Stress evaluated in the shaft			
Bending stress	σ_{bm}	$\frac{MY}{I}=\frac{M.\frac{d}{2}}{\frac{\pi}{64}d^4}$	20.46 × 10^6
Bending moment, N m	M	$\frac{wl^2}{8}$	110.22
Shear stress, MPa	τ	$\tau=\frac{Tr}{J}$	56
Equivalent torque , N m	T_{eq}	$\sqrt{M^2+T^2}$	226.20
Diameter of solid shaft	d	$\sqrt[3]{\frac{32T_e n}{\pi\tau}}$	40 mm
Power required by the shaft, W	P	$Q \times g \times (l_v.k_a \pm H).\ k_o$	24
Actual angular force	F_w	$\frac{2M_w}{D\tan(\alpha+\beta)}$	3.817 N
Driving force	F'_o	$q_m\ (l_v \pm H).\ f.g$	13.94 N

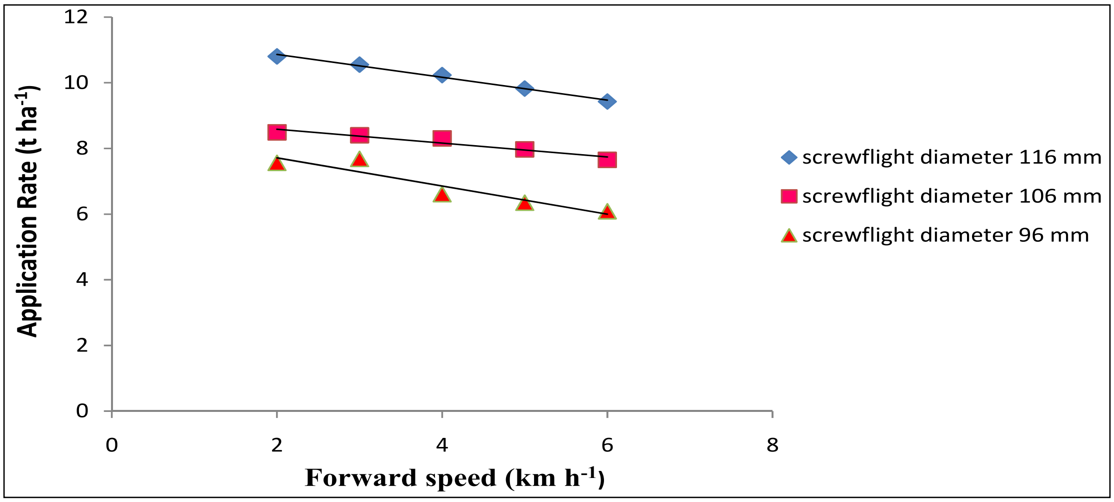

Fig. 7a: Effect of different screw flight diameter and forward speed on application rate of vermicompost manure

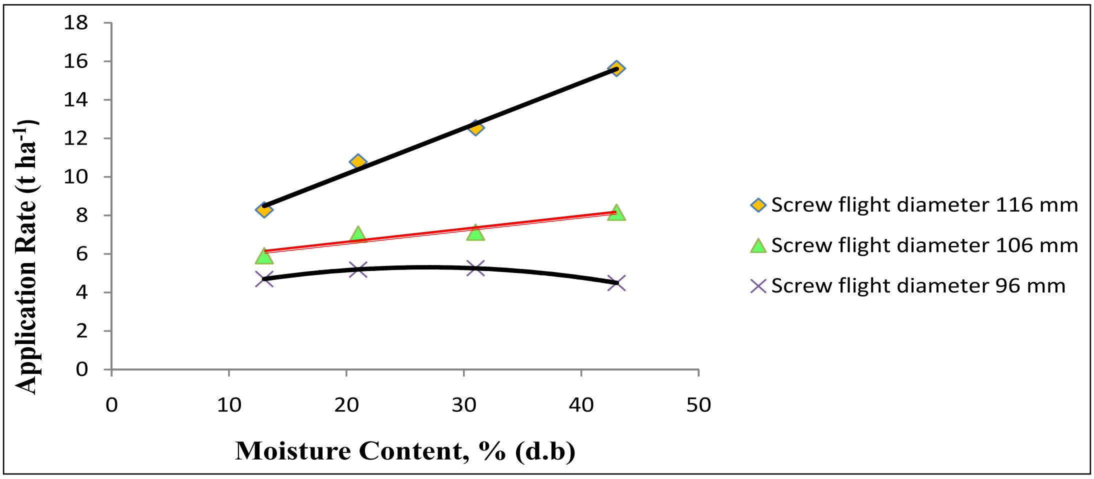

Fig. 7b: Effect of moisture content on the application rate of vermicompost manure for different diameter of screw flight

CONCLUSION

The screw conveyor mechanism was primarily developed and fabricated to eradicate problems involved in the placement of vermicompost manure. The screw conveyor metering mechanism was constructed using locally available materials and can be easily operated. Following conclusions were drawn out after testing of the metering mechanism were given below:

1. The performance parameters of the screw conveyor metering mechanism were largely influenced by the moisture content of vermicompost and rotational speed of screw conveyor. The vermicompost manure is hygroscopic in nature which absorbed air moisture from the atmosphere so to overcome this problem, vermicompost should be placed in closed shed or polyethylene bags.
2. Result obtained from the tests showed that the average output capacities were 11.81,7.05 and 4.91 t ha^{-1} at average moisture content 27 % (d.b) of vermicompost at corresponding screw flight diameters of 116,106 and 90 mm respectively.
3. Hence, with appropriate design consideration and adequate material selection to specification, the screw conveyor mechanism was successfully tested in the department as well as on the land. Hence the difficulties in manual loading and broadcasting of vermicompost into agriculture land shall be overcome and an eventual prevention of wastage and compensation will be achieved. This will also minimize the high cost of labour requirement in manually broadcasting.

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