Operational Manual for Turbo Happy Seeder

(Technology for managing crop residues with environmental stewardship)

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The Cereals Systems Initiative for South Asia (CSISA) is mandated to enhance farm productivity and increase incomes of resource-poor farm families in South Asia through the accelerated development and inclusive deployment of new varieties, sustainable management technologies, partnerships and policies. The project is being implemented by the CGIAR institutions; CIMMYT, IRRI, IFPRI and ILRI and supported by USAID, and The Bill and Melinda Gates Foundation. The ICAR-CA research grant by the Indian Council of Agricultural Research (ICAR), Govt of India to CIMMYT is mandated to strategic research on CA to develop; fine tune and upscale CA based management practice in wheat and maize systems in India. The ICAR-CA project is being implemented by CIMMYT in collaboration with Indian NARS. The specific outputs of CSISA and ICAR-CA fills into the CRPs on CCAFS and WHEAT.

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(Technology for managing crop residues with environmental stewardship)

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Contents

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Foreword

The current and future food security of South Asian countries has twin challenges of resource fatigue and decelerating productivity growth of food grain crops. These are being further exacerbated with the sharp rise in the cost of food and energy, depleting water resources, soil degradation, indiscriminate and imbalanced use of external production inputs and the overarching effects of changing climates. This has and will further lead to lower farm profits, making farming unsustainable. Although there has been a tremendous shift in the production variables of modern farming from the traditional plow based farming systems, the most agronomic works revolved around tillage and labour intensive farming. Declining soil organic carbon (SOC) status of soils has been major consequence of the shift in agriculture from 'traditional animal based subsistence' to 'intensive chemical and tractor based' agriculture, which further exacerbated problems associated with sustainability of natural resources. The SOC concentration in most cultivated soils of South Asia is less than 5 g/kg compared with 15 to 20 g/kg in uncultivated virgin soils, attributed to intensive tillage, removal/burning of crop residue and mining of soil minerals.

Conservation Agriculture (CA) - based crop management practices have proved to produce more at less costs, reduce environmental pollution, promote conjunctive use of organics (avoids residue burning), improve soil health and promote timeliness of planting and other farm operations to address issues of terminal heat stress. One of the key elements of CA is rational soil cover with organics (crop residues, cover crops etc), which has great relevance not only in terms of managing the agricultural waste but also in eliminating residue burning, improving soil health, conserving water, help in adaptation to and mitigating of climate change effects. In India alone, more than 140 meter tonne of crop residues are disposed of by burning each year. In rice-wheat system of the Indo Gangtic Plain(IGP) of South Asia, the disposal of rice residues is one of the key challenges and in most combines harvested rice fields of western IGP, the rice residues are burnt before planting wheat. Burning of crop residues is a major contributor to poor air quality (particulates, greenhouse gases), human respiratory ailments, and the death of beneficial soil fauna and micro-organisms.

Managing the residues of combine-harvested fields for direct drilling (no-till) as surface mulch provides multiple benefits such as of improved crop yields, conserved soil moisture, saving of irrigation, buffered soil temperature, improved SOC, adaptation to terminal heat in addition to environmental benefits through eliminating burning. ***Turbo Happy Seeder****, an innovative planter, has been developed and distributed at farm level in India. However, capacity development of extension agents, operators, custom service providers and farmers on calibration, operation, field/situation-specific adjustments and maintenance is critical for its efficient use.

I am happy to note that an Operational Manual for Turbo Happy Seeder has been developed in a lucid style, which will be of immense use in out-scaling this planter and reduce residue burning as well as reducing the levels of environmental contamination. I compliment the authors as well as CIMMYT and ICAR for bringing out this manual.

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(Alok K Sikka)
Deputy Director General (NRM)

Operational Manual for Turbo Happy Seeder

1. Introduction

Multiple challenges associated with plough based conventional production practices that include deteriorating natural resources, declining factor productivity, yield plateau, shortages of water & labour and escalating costs of production inputs coupled with emerging challenges of climate change both in irrigated intensive systems as well as low intensity rainfed ecologies are the major threat to food security of South Asia (Jat et al, 2009; Ladha et al, 2009; Chauhan et al, 2012). Water and labour scarcity and timeliness of farming operations specially crop establishment under the emerging climatic uncertainties are becoming major concerns of farming all across farmer typologies, production systems and ecologies in the region (Chauhan et al, 2012). In many parts of South Asia, over-exploitation and poor management of groundwater has led to declining water table and negative environmental impacts.

Conventional tillage based flooded rice receiving the largest amount of fresh water compared to any other crop is the major contributor to the problems of declining groundwater table ranging from 0.1– 1.0 m year-1 specially in north-west India and increasing energy use and costs. The problem has further been intensified with the unavailability of labour in time, and multi-fold increase in labour costs. Fragmented land holdings and nucleus farm families further exacerbates the problem of availability of farm labour. Potential solutions to address these issues include a shift from intensive tillage based practices to conservation agriculture (CA) based crop management systems (Saharawat et al, 2010; Jat et al, 2012; Gathala et al, 2013). Direct drilling (seeding/ planting with zero tillage technology) is one such practice that potentially addresses the issues of labor, energy, water, soil health etc (Malik et al 2005; Gupta and Sayre, 2007; Jat et al, 2009; Ladha et al, 2009; Gathala et al, 2011; Jat et al, 2013) and adaptations to climatic variability (Jat et al, 2009; Malik et al, 2013).

One of the key elements of CA is rational soil cover with organics (crop residues, cover crops etc) has greater relevance not only in terms of managing the agricultural waste but particularly for eliminating burning, improving soil health, conserve water, help in adaptation to and mitigating of climate change effects. Globally, annual production of crop residues is estimated at 3440 million tonnes of which large quantities are not managed properly. In India alone, more than 140 million tonnes of crop residues are disposed of by burning each year. In rice-wheat system of the IGP of South Asia, the disposal of rice residues is one of the major challenges due to poor quality for fodder, bioconversion, and engineering applications. In most combine harvested rice fields of western IGP, the rice residues are burnt before planting of wheat. The field burning of crop residues is a major contributor to poor air quality (particulates, greenhouse gases), human respiratory ailments, and the death of beneficial soil fauna and micro-organisms. During burning of crop residues around 80% of carbon is lost as CO_2 and a small fraction is evolved as CO. Burning involving incomplete combustion can also be a source of net emissions of many greenhouse gases including CO, CH_4, SO_2 and N_2O. Crop residue burning accounts 6.6 million tonnes of CO_2 equivalent emission annually in India (INCCA, 2010). Apart from loss of carbon, up to 80% loss of N and S, 25% of P and 21% of K occurs during burning of crop residues (Ponnamperuma, 1984; Yadvinder-Singh et al., 2010).

For managing residues of combine harvested crops and field (loose as well as anchored) as surface mulch and realize multiple benefits of improve crop yields, conserve soil moisture, saving of irrigation, buffer soil temperature, improve SOC, adapt to terminal heat effects in addition to environmental benefits through eliminating burning, 'Turbo Happy Seeder', is now available, which is capable of direct drilling (ZT) into heavy surface residue loads in a single operation. Many of the farmers in India and elsewhere have started using Turbo Happy Seeder for residue management. However, one of the major constraints in large scale adoption of this technology as well as sub-optimal use efficiency of planter is the lack of skills/knowledge on operation, calibration and maintenance of the machinery. There are different field situation specific adjustments needed before the use of the machine in the field. These adjustments include proper seeding depth, fertilizer rate and the seed rate etc as per the crop and field conditions to realize the potential benefits of the technology. There are several machinery manufacturers who supply these planters but the operational manuals are not available for making adjustments, calibrations under local conditions. In absence of the proper operational guidelines and protocols for efficient use of this machine by the farmers, service providers, extension agents, many a times the desirable results are not achieved and even contradictory results are observed. This results in slow down the adoption rates of the technology. Also, in absence of simple guidelines for maintenance of the machine, the farmers/service providers need to make huge investments on repairing at the start of the season. Therefore, we attempted to develop an operational manual to provide simple guidelines for calibration, operation, maintenance and troubleshooting for efficient use of turbo happy seeder by the range of stakeholders including farmers, service providers, extension agents and researchers.

2. Importance of turbo happy seeder vis-à-vis residue retention

Conservation Agriculture (CA) based management practices has been reported as potential strategy to address the labour, water, energy, soil health farm profitability and climate change issues generally encountered under the conventional tillage based crop production systems. Turbo happy seeder is a planter capable of direct drilling in the fields with surface retention of residues and without any soil disturbance which in turn take care of 2 of the 3 basic elements of CA. The direct drilling (zero tillage) operation saved on labour, water, energy, reduce cost of production and improved maintain soil heath while facilitating timely planting with similar or higher crop productivity (Sidhu et al., 2007, 2011). The residue retention on the soil surface reduce evaporative losses, buffers the soil moisture & temperature, as well as canopy temperature (Jat et al, 2009); and help is adapting to terminal heat effects (Gupta et al, 2010). Residue retention also leads to significant improvement in C sustainability index (Jat et al, 2011), reduced GHG emissions (Alvarez and Steinbach 2009; Jat 2013). With the invention of Turbo Happy Seeder (THS), farmers need not burn the crop residues for sowing of next crop even with the heavy residue loads in high yielding crops harvested using combines. The THS has a provision of direct drilling of seed and fertilizers at desired seed and fertilizer rates, depth and spacing in one go.

With further improvement in the technology, having additional attachment of seed box having inclined plate seed metering systems, the THS become precise multi-crop planter. This type of arrangement allows the planter for direct drilling of different small and coarse grain crops with change in inclined plates and gear in accordance to the optimal geometry of different crops.

Under the scenario of small holder farm typologies across the South Asia, it is neither affordable not advisable to purchase planter for the planting of different crops by all the farmers. The multi-crop THS is capable of planting different crops and provides simple solution not only for planting but also improve working efficiency of the planter and extended employment to the service provider. In addition to provisions for adjustments in row spacing, depth, gears for power transition to seed and fertilizer metering systems, the multi-crop THS have precise seed metering system using inclined rotary plates with variable grove number and size for different seed size and spacing for various crops.

3. Major components and description of turbo happy seeder

The turbo happy seeder has nearly 20 major components as described in figure 1 and the individual components are described in further sub-section.

3.1. Frame

The frame of this machine is made of mild steel. All the parts of machine are attached to it. It works as a body in the machine. The frame of the 9- tyne machine is of the size of 198 × 60 cm. It is made of two mild steel angle irons (6.5 × 6.5 × 0.5 cm) welded together to provide the desired strength and rigidity. It is welded on the needed parts which increase the strength of frame. Tynes are attached to the frame which is used to drill the soil. Tynes are attached by U-Clamping as shown in Figure 1. These U- shaped clamps can be unbolted to change the distance between furrow openers or number of furrow openers. Mainly 9 tynes are used at equal spacing. However, 8-12 tyne turbo happy seeders are available in the market for tractors of different horse powers.

3.2. Slit and furrow openers

Furrow openers or slits are attached to the lower portion of tines which are used to drill the soil and place the seed and fertilizer at desired place. As the furrow openers drill the soil, the seeds and fertilizers dropped in the delivery pipes and passed through the seed and fertilizer boots through the action of drive wheal and finally placed into the slits opened by the furrow opener. Various component of the furrow opener/slit are depicted in Figure 2.

There are various types of furrow openers/slits. The inverted T-type slits/furrow openers are used in THS. The spacing between two furrow openers is generally kept about 20-22 cm. The cutting portion of furrow openers (point of share) is made of 8 mm thick high carbon bit welded to a mild steel plate. The working front edge of the slit/furrow openers has a piece of carbon steel (hardness 65 RHN) welded all round the nose, tip and sides to reduce wear and tear.

A 4-cm wide, 5-cm thick and 6-cm long stiffener plate is provided at back bottom of the T-type slit/furrow opener (5.0 x 1.2 cm) which is attached to the frame with nuts and bolts or directly with clamps. The furrow opener is welded to the mild flat steel shank (straight leg standard mounted with T-type slit openers).The blades can be of “welded on” or “bolted on” or even “knock down” type. The

Figure 1. *Major Components of turbo happy seeder*

1.Seed box 2. Fertilizer box 3. PTO drive mechanism 4. Three point linkage 5. Machine cover 6. Flail cover 7. Drive wheel 8. Stand 9. Furrow openers 10. Extra multi crop planter seed box attachment 11. Seed and fertilizer box cover 12. Fertilizer rate adjustment lever 13. Seed rate adjustment lever 14. Drive mechanism15. Fertilizer delivery pipe 16. Seed delivery pipe 17. Frame 18. Flails 19. Seed boot 20. Depth control wheel

disadvantage of "welded on" blades is that they require machine shop for replacement, whereas, a farmers himself can replace the other two types of blades. The quality of material used to make the slit/furrow openers will ultimately decide the operational quality and durability of the machine. Double boot is provided behind each furrow opener to receive a tube (steel ribbon or polyethylene tube with a minimum diameter of 25 mm) each from seed and fertilizer metering devices. The furrow openers are adjusted to make 3-5 cm wide slits.

3.3 Flails

The flails are wings made of mild steel and attached to a shaft, called flail shaft (Figure 3). Flail blades are placed on the rotor and arranged in such a way that flails blades are in exactly ahead of machine furrow openers. When the flail

***Figure 2**. Major parts of furrow opener/slit*

1. Seed boot 2. Fertilizer boot 3. Slit 4. Tynes 5. Furrow opener changing nuts 6. Point of share

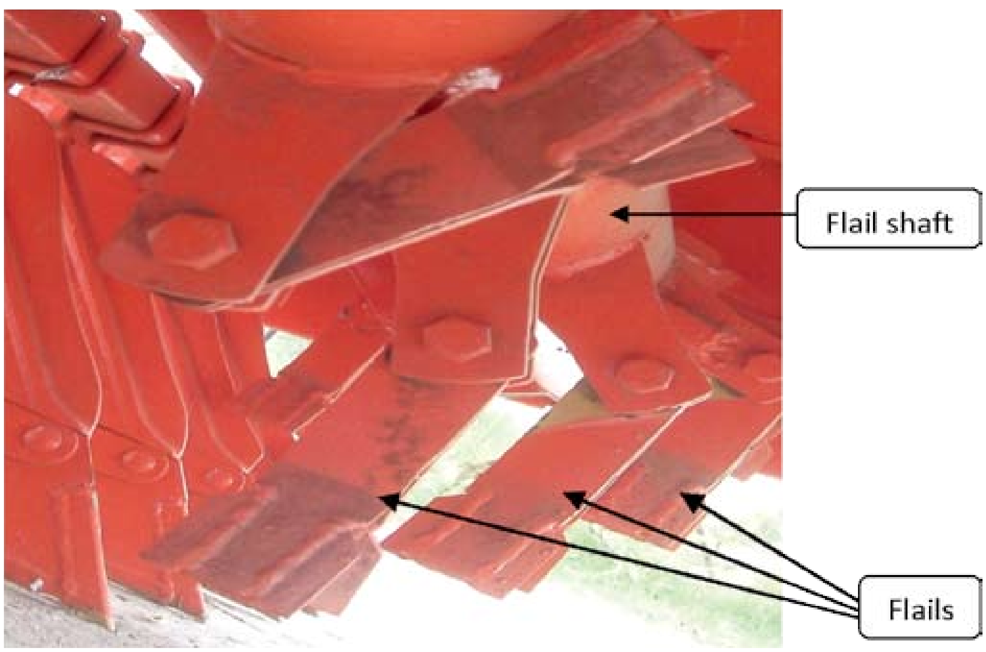


***Figure 3**. Flails and flail shaft*

shaft rotates, the flails also rotate and clean the residue left in front of tynes to facilitate drilling of seed and fertilizers in the seed rows. Each furrow opener has two set of flail blades which clean the furrow opener twice in one rotation of machine rotor. The accumulation of residues over machine tynes is dependent on clearance between rotating flail blades and machine tines i.e. if clearance is more than the optimum level, then accumulation of residue will start to occur on the other side if clearance is on less, then machine load on tractor increases. The critical dimensions in respect of size and shape of flail blades, diameter of straw management and clearance between machine tines and flail blades is shown in Figure 4 and appendix 1.

3.4 Seed and Fertilizer Box

The seed and fertilizer box set is depicted in figure 5. Trapezoidal shaped seed and fertilizer boxes, made of mild steel sheet (2 mm thick), are mounted side by side on the frame, fertilizer box in front and seed box in the rear. The boxes

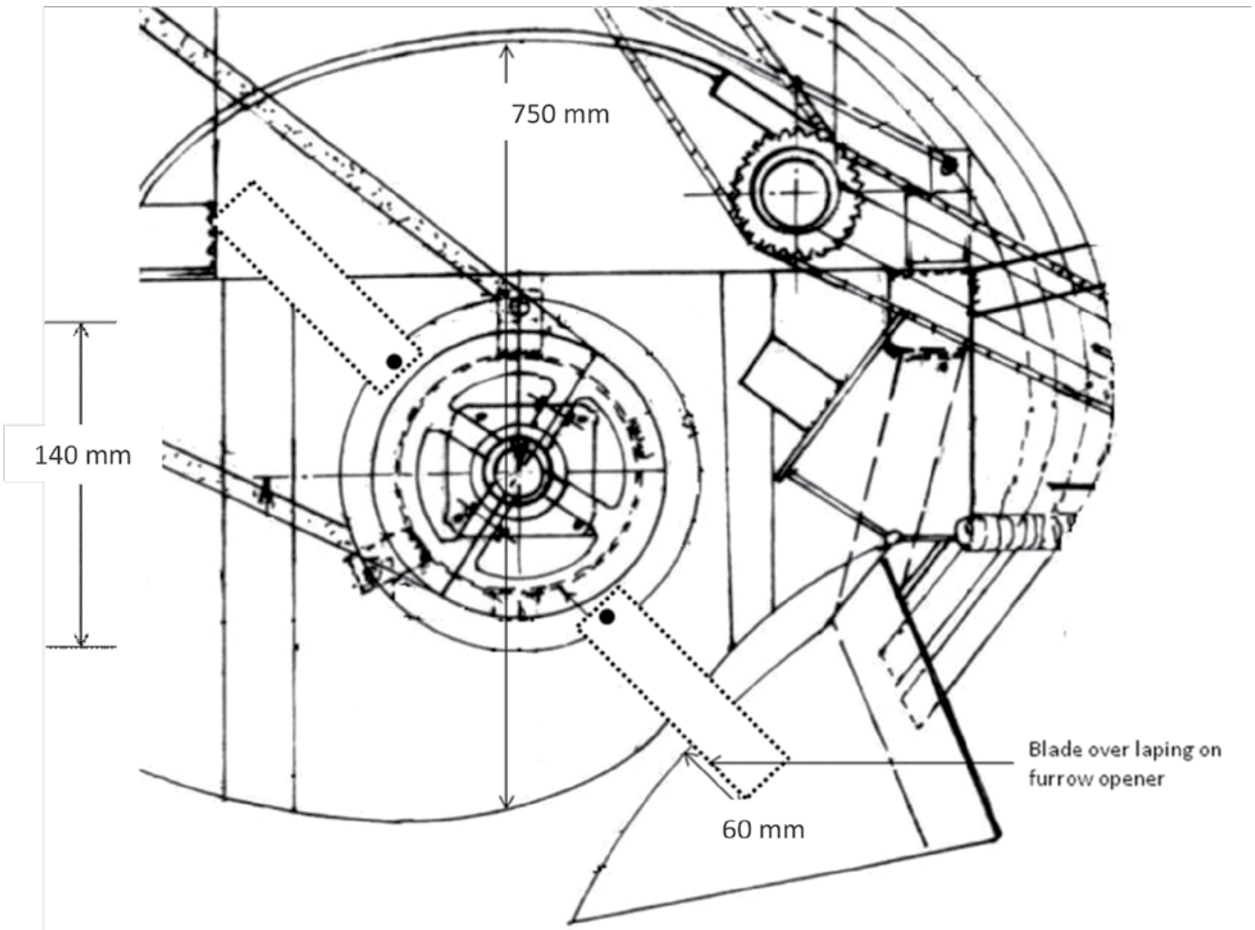


Figure 4. *Straw management rotor dimensions and flail blades clearance with machine tynes*

are generally 198 cm long and 24 cm deep. Box dimensions can vary but these generally depend upon the effective width of the machine and will increase with the increase in the number of the slit/furrow openers. For example in case of 9-tine drill, the length of seed and fertilizer boxes will be around 198 cm. A provision has also been made for an extra and modified seed box (Figure 6) the THS to mount inclined seed metring systems. This type of arrangement allows the planter for multi-crop use and more precise seeding of different crops.

3.5 Seed metering mechanism

The key elements of the seed metering system are depicted in Figure 7, 8 and 9 and described as under

- Seed box: It is used to store the seed in the machine
- Fluted rollers: Fluted rollers are attached to the shaft. As the shaft rotates, the fluted roller also rotates and seed delivered to the seed delivery pipe through the flow control tongue.

***Figure 5**. Seed box and fertilizer box*

- Seed rate adjusting lever: Seed rate adjustment lever is attached to the seed box for increasing or decreasing the rate of seed into the fluted rollers. There is a scale on the adjusting lever which helps us in increasing or decreasing the seed rate.
- Flow tongue adjustment lever: There is a flow tongue adjustment lever also. It controls the flow of seed into the seed delivery pipe dropping from fluted roller.

***Figure 6**. Modified seed box of turbo happy seeder*

Figure 7. Seed metering mechanism

- Seed pipe: It is used to take the seed from flow control tongue to the seed boot
- Seed boot: Seed boot finally drops the seed into the slit in the soil opened by the furrow opener.

The seed metering system of the modified version (with extra seed box having inclined rotary plates) with its different component is shown in Figure 10 and described as under

1. Seed box: It is used to store the seed in the machine. When an additional seed box is attached to the machine then the chain mechanism also changes. The chain drive goes to the additional seed box first, then it goes to the fertilizer shaft.
2. Inclined rotary plates: These are rotating plates which guide the seed and drop it in to the cups. The inclined rotary plates hub contains the number of inclined plates

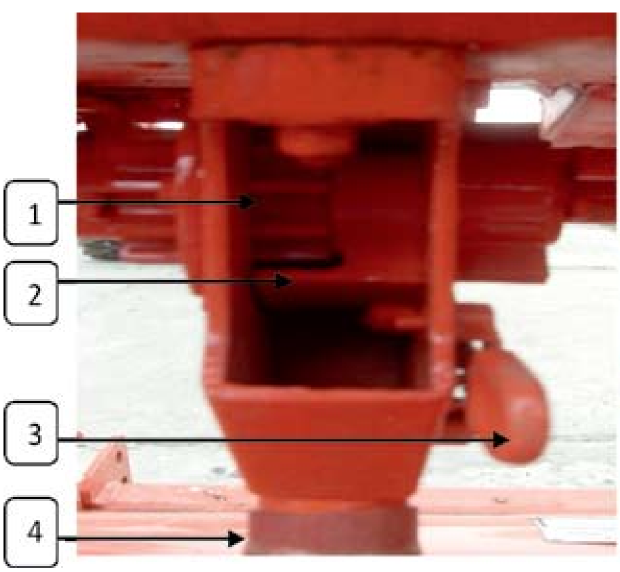


***Figure 8**. Fluted roller and components*
1. Fluted roller 2. Flow tongue 3. Flow tongue adjusting lever 4. Seed pipe

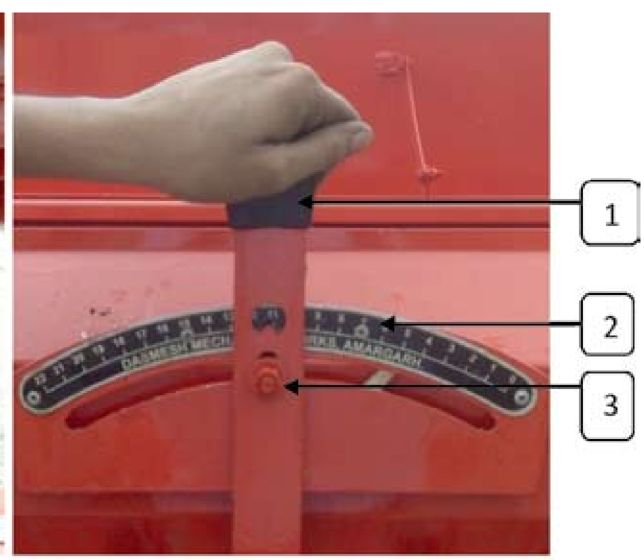
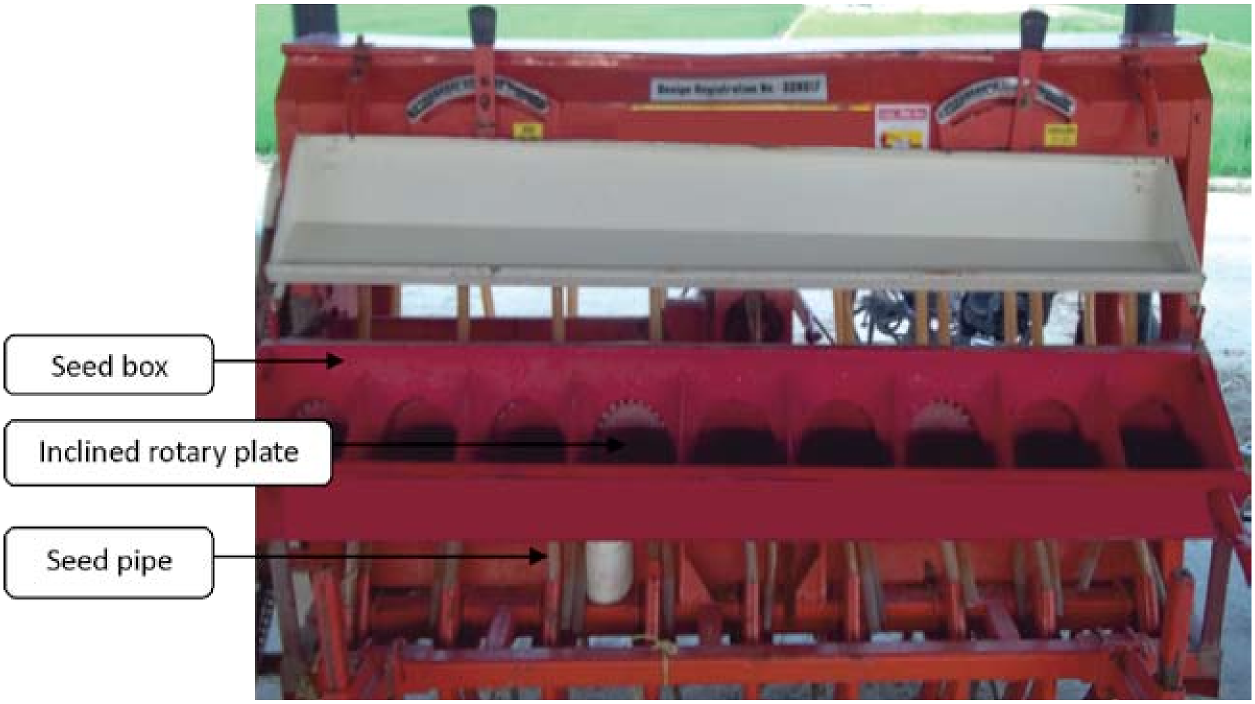


***Figure 9**. Seed adjustment lever*
1. Lever 2. Scale 3. Adjusting nut



equal to the number of tynes. The inclined rotary plates contain grooves, which guide the seeds to the seed cups. There is a plate adjusting nut in the center of each plate which is used to change the plates. There are different plates for different crops as shown in Figure 11. The plates vary in size of groove, number of grooves and shape of the grooves from each other. The size, number and shape of the groove is designed to suit to specific crops.

3. Seed metering strip: The seed metering strip is mounted on the seed box. It is attached to the seed box in such a manner that the seed box is tilted when there is an adjustment on the system. It is a strip of iron on which equally spaced holes are provided. The holes connect the strip to the seed box with the help of nut. By changing the holes the seed rate is adjusted. The seed rate is generally written on the corresponding hole. The seed rate may

***Figure 10**. Inclined rotary plate type seed metering mechanism*

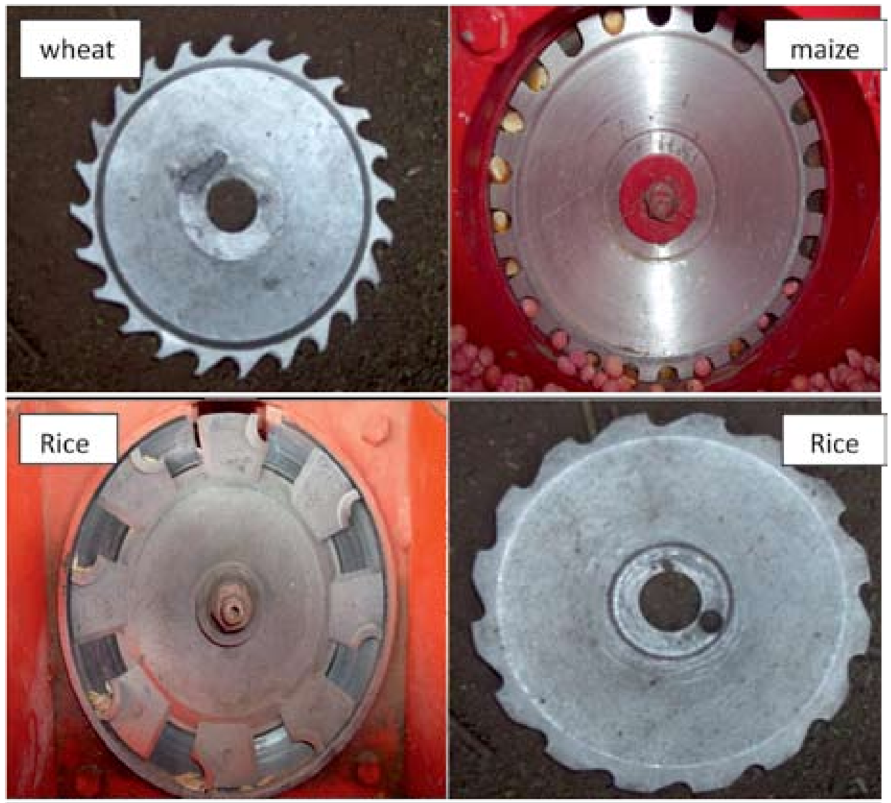


Figure 11. *Types of inclined plates used in modified THS*

also be adjusted by putting the chain on different gears. Using the gear with higher teeth will lower down the seed rate and vice-versa.

4. Seed cups: These cups receive seeds that have been dropped by the inclined rotary plates and then dispense the seeds to the seed pipe.
5. Seed delivery pipe: It is used to take the seed from cups to the seed boot.
6. Seed boot: Seed boot finally drops the seed into the slit in the soil opened by the furrow opener.

3.6 Fertilizer metering system

The fertilizer metering system controls the rate of fertilizer application in the field for a specific crop. The fertilizer metering system is depicted in Figure 12. Generally there are two type of fertilizer metering systems which are depicted in Figure 13 and 14.

The fertilizer metering system as shown in figures 12, 13 and 14 generally consists of following components.

1. Fertilizer box
2. Lever
3. Drive shaft
4. Flutted roller
5. Fertilizer delivery pipe
6. Fertilizer boot

The fertilizer rate is adjusted with the help of the lever as shown in Figure 14. The lever is set to the recommended fertilizer level. Before setting the fertilizer rate by the lever, the nut as shown in Figure 14 is loosened and after the setting it is tightened again. After setting to a particular fertilizer rate, the fluted rollers pick the fertilizer from the fertilizer box and then drop it in to the fertilizer cup. The cup

Figure 12. *Fertilizer metering system*

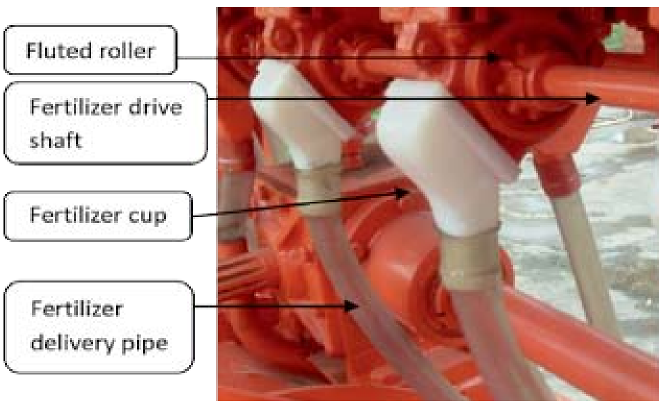


Figure 13. *Fluted rollers*

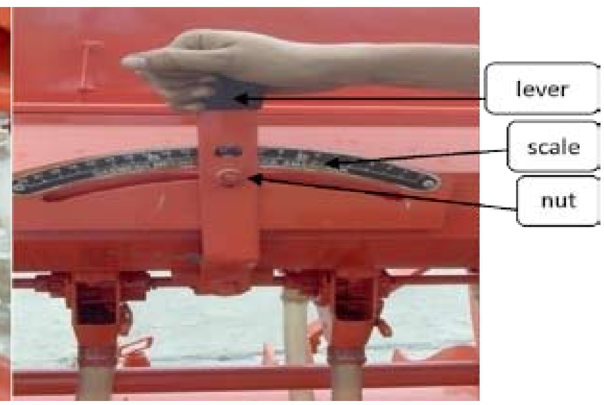


Figure 14. *Fertilizer adjustment lever*

then drops the fertilizer in to the fertilizer delivery pipe which is finally reaches in to the soil through the fertilizer boot (shown in Figure 2) attached to the furrow opener.

3.7 Double row turbo happy seeder for fertilizer placement

A double row turbo happy seeder is also a modified turbo happy seeder in which an additional urea fertilizer box is attached (Figure 15). The urea is placed into the soil through the the slits opened with the help of double discs coulters. The urea is placed between the 2 seed rows. This version of THS is increasingly important for placement of fertilizer nitrogen (urea) under the surface residue conditions to reduce losses on N and improve nitrogen use efficiency.

3.8. Drive wheel

Drive wheel is mounted on the side of the frame and placed either on front or back (Figure 16). The function of drive wheel is to provide drive to the seed and fertilizer metering systems. The diameter of the drive wheel is 70 to 75 cm. Chains are attached to the drive wheel and the driving shaft. There are lugs on the circumference of drive wheel to avoid or minimize slippage. The trapezoidal lugs are of generally 6 cm height.

3.9. Depth control wheel

Two Depth control wheels are attached back side bar of the frame. The diameter of wheels is about 30-35 cm. it is made of mild steel. The function of these wheels is to regulate insertion of the furrow openers into the soil to place the

***Figure 15**. Double row turbo happy seeder*

***Figure 16**. Drive wheel and components*

seed at desired depth in all the rows and across the field. The depth of the seed placement can be increased or decreased with the help of depth adjusting screw pointed in Figure 17. It is a nut and bolt mechanism attached to the frame. However, depending on the manufacturer, the adjustment mechanism could be different. The depth control wheels should be adjusted for the desired seed placement depth under the real filed condition specific to a particular

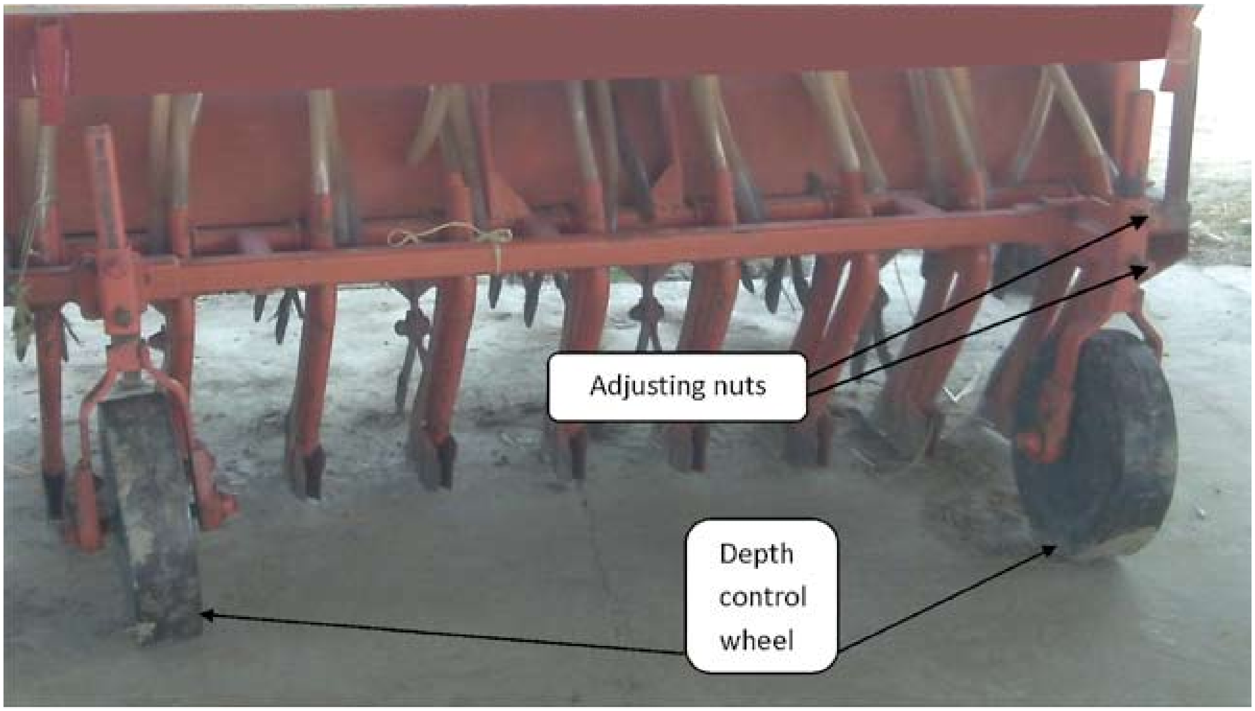


Figure 17. *Depth control wheel and adjustment*

plot or field and should be done for each field. Care should be taken to adjust both the depth wheels at equal depths to ensure uniformity in the depth of seed and fertilizer placement.

3.10. Power transmission unit

There are two power transmission systems in turbo happy seeder-

3.10.1 PTO Shaft

The power transmission system by the PTO shaft is depicted in Figure 18. PTO shaft provides drive to the flails. The PTO shaft of tractor is first attached to the PTO gear box with the help of PTO attachment shaft. There is a PTO drive shaft in the machine which provides the drive to the PTO drive pulley. A belt joins the PTO drive pulley to the flail drive pulley which rotates the flail shaft and hene, the flails get drive from PTO shaft and start to rotate.

3.10.2 Drive wheel

Drive wheel provides necessary power to meter the seed and fertilizer delivery from machine to the soil. As the drive wheel rotates, the chain mechanism starts to move through driving and driven shafts as shown in Figure 19 a and 19 b. The chain rolls over the fertilizer and seed sprockets/gear. These sprockets/ gears rotate the seed and fertilizer shafts.As the seed and fertilizer shaft rotates, the fluted rollers (seed and fertilizer metering mechanism) start to work and the seed and fertilizer delivers to the the seed and fertilizer delivery pipes. There is flip gate which can be opened to apply oil/grease to the chain whenever necessary (Figure 19 b).

3.11. Seed and Fertilizer delivery pipes

Seed and fertilizers delivery pipes are attached to the seed and fertilizer box through the seed and fertilizer cups (Figure 20). These pipes carry the seed/fertilizer from the seed and fertilizer metering systems through aluminium flow control tongue/ cups to the seed/ fertilizer boot. Tubes should be connected firmly so that

Figure 18. *Power transmission system by PTO shaft*

these may not come out during field operation. The precautions as outlined below must be taken for fixing/ use of delivery pipes:

- The pipes should be protected from bending and breakage.
- Old/bent pipes should be replaced.
- Excessive bend in the pipes should be avoided otherwise the bend will cause obstruction in free flow of seed/fertilizer and results in non-uniform seed placement and crop establishment.
- The pipes must be inserted about one inch into the seed/ fertilizer boot.

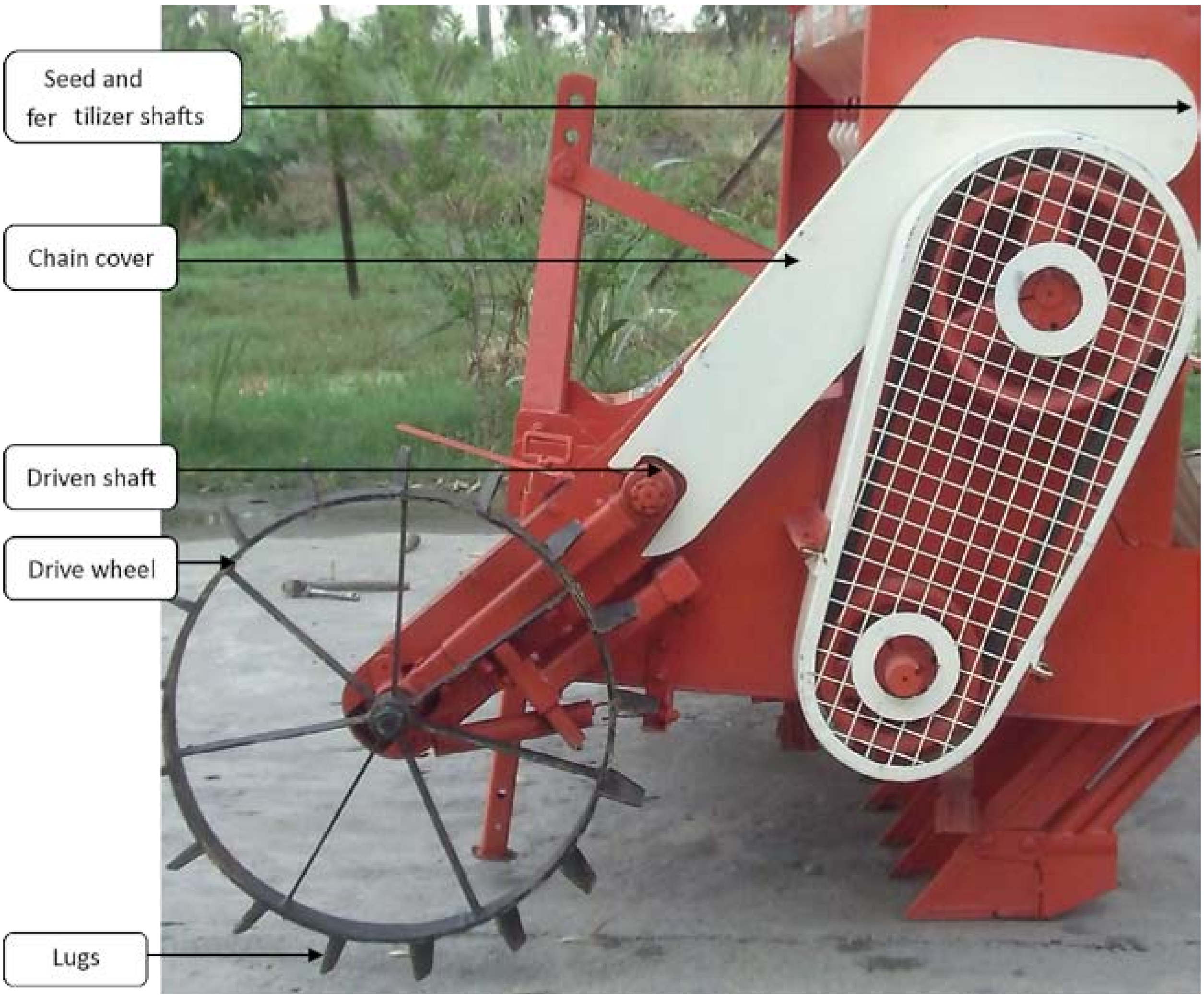


***Figure 19a**. Transmission through drive wheel*

4. Calibration of machine for seed and fertilizer rates

4.1 Calibration in laboratory

Seed and fertilizer calibration is done to ensure the placement of right amount of seed and fertilizer in the field. The laboratory method of calibration for the turbo happy seeder is given below:

1. Jack up the machine and check the free rotation of driving wheel and seed and fertilizer feed-shafts.
2. Place container or polythene bag under each seed tube (Figure. 1).

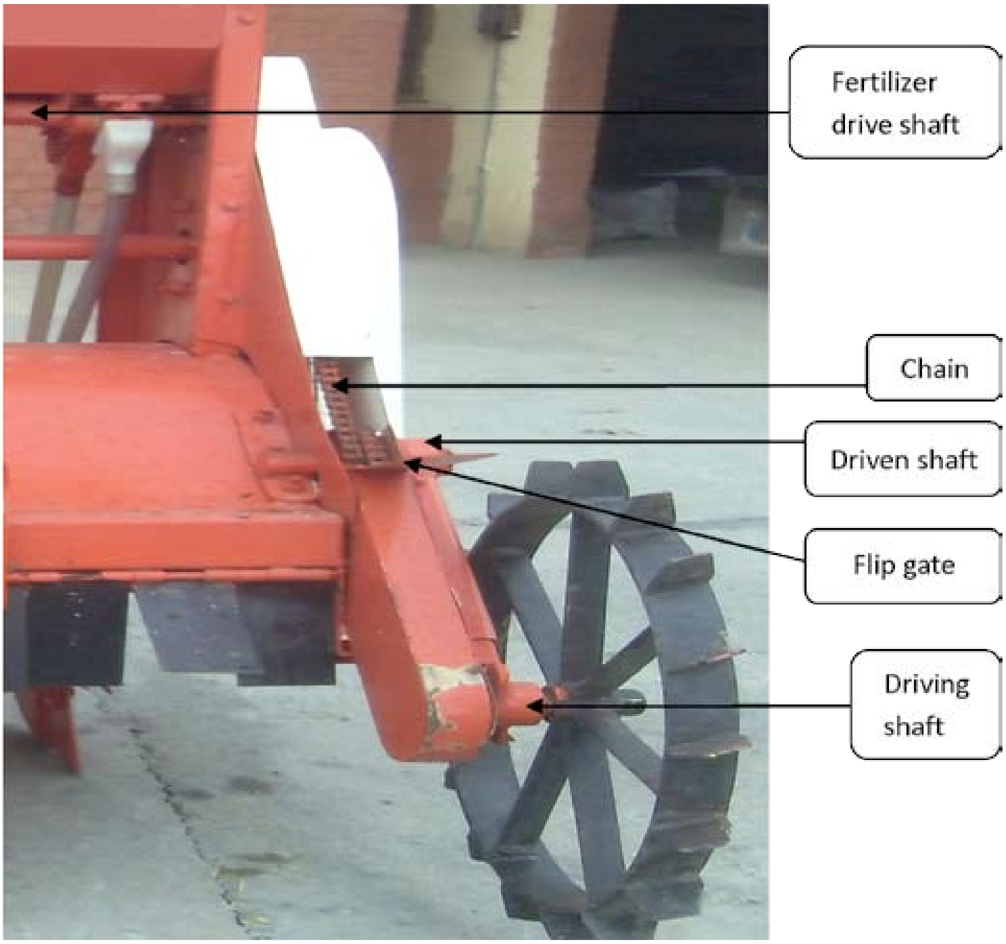


Figure 19b. *Power transmission through drive wheel*

Figure 20. *Seed and fertilizer delivery pipes.*

3. Measure the circumference of the driving wheel (Figure 22. The circumference gives the distance covered in one revolution of wheel

4. Find out the width of machine by multiplying the number of furrow openers by the distance between the furrow openers (Figure 23).

5. Find out number of revolutions required to plant one acre area as follows:

$$Number\ of\ revolutioms = \frac{Area\ of\ acre\ (4000\ sq.m.)}{size\ of\ drill\ (m)\ X\ Circumfrence\ of\ wheel\ (m)}$$

Multiply this by 9/10 to take care of wheel skid in the field

6. Mark a point on the rim of wheel. Rotate the wheel by 1/50th of the number of revolutions required to plant one acre as obtained in step 5. Collect the seed from each pipe and weigh it.

7. For getting seed rate per acre, multiply by 50.

8. Adjust the shift lever on the feed box for grain rate accordingly, i.e. if the seed rate seems to be less than the actual quantity required per acre, then move the indicator a little to the higher side or vice-versa.

9. If the quantity collected from each container is not uniform, then check for defect in seed dropping mechanism.

10. Similarly calibrate for the fertilizer.

It is cautioned that calculated seed and fertilizer rates can differ from the actual rates due to drag and slippage of the drive wheel depending upon the soil moisture, surface roughness, presence of crop residue and field level. Therefore, it is advisable that the calibrations should be done under real field conditions .

4.2 Calibration in field

First of all, fill the seed and fertilizer in the respective boxes. Set the indicator at desired seed and fertilizer rates (as shown in Figure 10). Mark a distance of 50 meters in the field.

Figure 21. *Seed and Fertilizer calibration in laboratory*

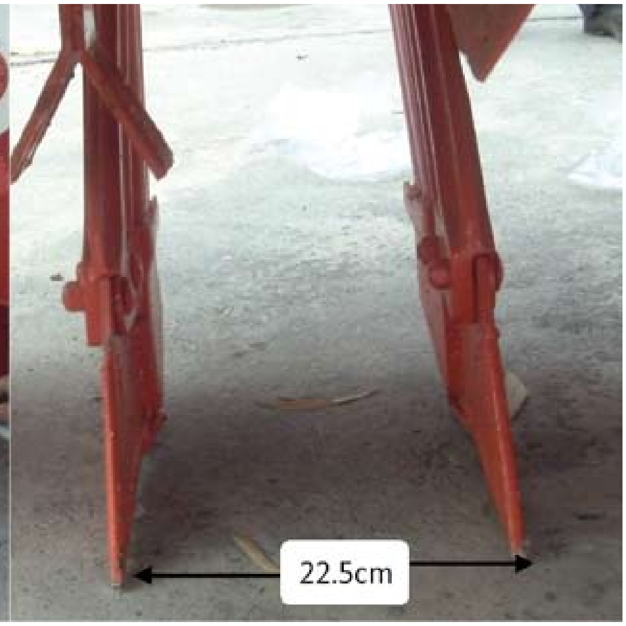


***Figure 22**. Radius of drive Wheel*

***Figure 23**. Distance between two furrow openers*

Take the seed and fertilizer delivery pipes out from the boots and put delivery outlets of the pipes in the polythenes bags and tight them using rubber rings (Figure 21). Run the machine and collect the seeds/fertilizers from each delivery pipes after 50 meter run of the machine. The amount of seed and fertilizer collected from each delivery pipes in 50 meter run is then weighed in grams. Then we calculate the seed rate and fertilizer rate by the given formula

One acre = 4000 m^2

Width of planter = x (m)

Distance = 50 m

Weight of seed or fertilizer in pipes = y (kg)

Seed or fertilizer rate (kg/ acre) =

$$\left(\frac{\text{weight of seed or fertilizer (kg)} \times Area/acre\ (4000\ m2)}{\text{Width of planter (m)} \times \text{distance covered (m)}}\right)$$

If the seed or fertilizer rates are not as per the desired rates, then re-set the indicators or the inclined plates, gears etc in accordance to the desired rates and repeat the whole process of field calibration as described above.

5. Hitching of machine

The machine has three standard hitch points; two lower and one upper. The machine is attached to tractor through these three hitch points with the help of link pins (Figure 24). The top link hitch point also helps in leveling the machines. The three point hitch adjustments where the machine fixes to the tractor should be adjusted. The machine should be level from side to side and have just enough forward and backward adjustment to enter the soil at the proper angle.

6. Operating the turbo happy seeder

With the help of three point linkage, the machine is attached to the tractor of optimal capacity (hp) as per the size of planter. After hitching the planter, the PTO shaft of tractor is attached to the PTO shaft linkage of machine which gives drive to the flail with the help of belts The planter is to be calibrated and adjusted as per the requirements i.e. seed rate and fertilizer rate, depth of sowing, plant

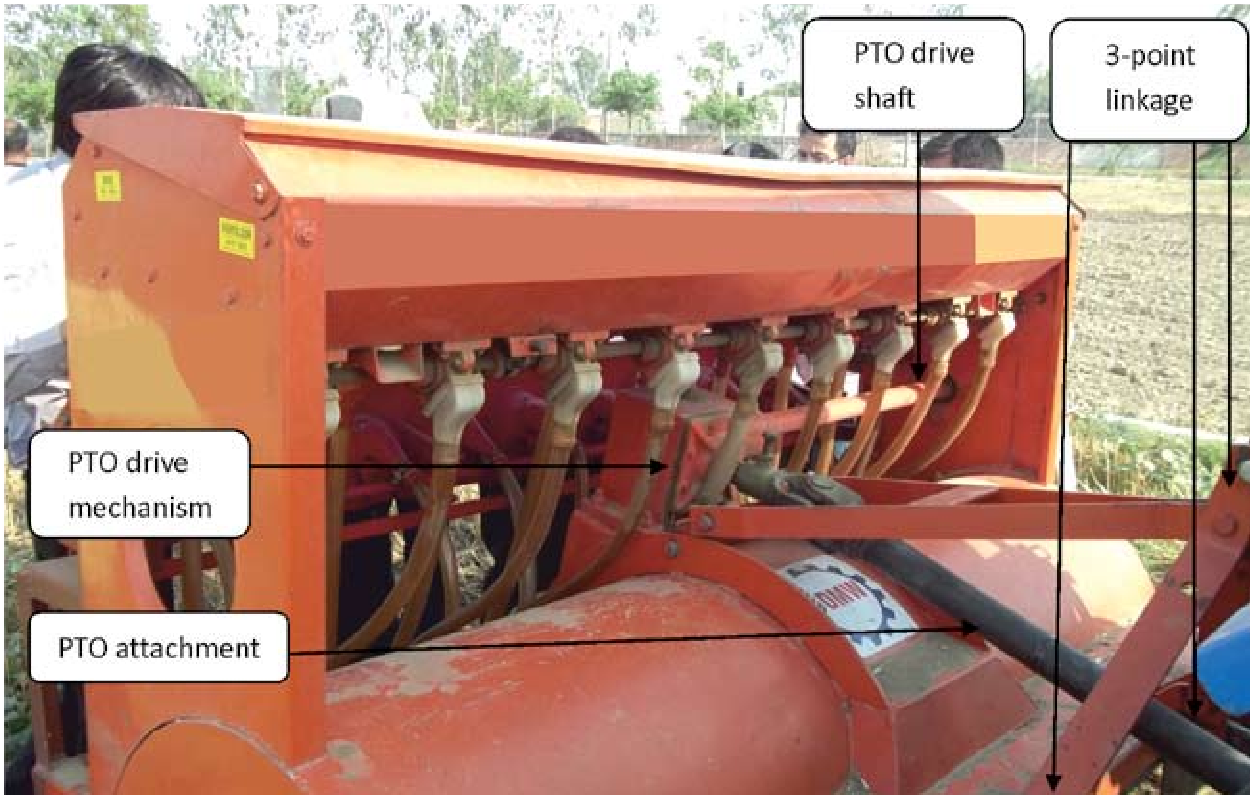


***Figure 24**. Hitching of machine through three-point linkage.*

to plant spacing as per the crop and field conditions. As the tractor moves, the drive wheel starts to rotate which gives drive to the seed and fertilizer shaft. As the shafts start to move, the seed and fertilizer metering (fluted rollers, inclined p lates) also start to move and the fertilizer and seed drops fertilizer and seed delivery pipes and further to the seed and fertilizer boots. The seed and fertilizer boots are attached to the slits. Now the fertilizer and seed placed into the soil as the furrow openers are penetrating in soil. As the machine gets power from PTO shaft, the flails start rotating and they clean and shift the residue in front of the furrow openers so as the residues doesn't drag and accumulate in seed rows.

6.1 Tips for proper working of the machine

The soil moisture must be optimum for the operation of the machine. For proper operation of turbo happy seeder, the soil moisture must be slightly lower than the field capacity. The ruts will be formed if the moisture content of the soil is more than optimum which will lead to the uneven placement of the seeds. To obtain the proper efficacy of the machine (uniform and good plant stand) it is advisable to uniformly distribute the crop residue in the field before operating THS either by straw spreader or manually. There are chances of the more moisture content in the residue in the morning time due to dew which may cause wrapping of the loose straw on the flails which hinders the rotary movement of the flails. Therefore, it is advised to operate the THS after the dew dries. Adjust the depth of sowing through depth control wheels instead of using the hydraulic lift. Using the hydraulic lift to control the sowing depth may cause the touching of flails to the ground which may damage flails and also cause uprooting of the anchored residue. The ground clearance of the flails must be about 2.5 to 3 cm. The broken flail must be replaced before the further operation of the machine. Otherwise the excessive vibrations in the machine will lead to further breakage of other parts of the machine.

6.2 Maintenance

The machine should be properly serviced and maintained. It should be checked before use to ensure that all the nuts and bolts are tightened and that all the parts are in good condition. For example, if the furrow openers are worn out, they should be replaced. If the flails are broken they must also be replaced. The fertilizer and seed boxes should also be in good condition to allow free flow of seed and fertilizer. Chains should be adjusted and oiled. The tension of the belt should be proper. After use at the end of each day, the machine should be checked, the seed and fertilizer boxes cleaned, and the moving parts oiled.

6.3 Operating notes for the machine

6.3.1 Before operation

1. Before operating the THS planter for the first time, carefully read this manual and understand all the steps. Become familiar with the mechanism, adjustments, and operating methods. Before each use in the field, review this list to make sure all necessary items are checked and adjusted.
2. Preferably the fields should be laser leveled for direct drilling of crops so as to ensure uniformity in soil moisture across the field. Laser land leveling helps in achieving uniform depth of seeding and thus helps to achieve good crop establishment in residue conditions.
3. The cutter bar height of combine harvester during harvesting of crops (rice for example) should be such that after harvesting 50% of total straw remain anchored and rest 50% as loose residues (Figure 25).
4. Uniformly distribute the loose residues over the anchored residues across the field so that the residue load becomes uniform across the field (Figure 26).
5. During the early morning hours, the moist residues (due to due and high surface soil moisture etc) tend to clog the planter during the early morning. Therefore, the turbo happy seeder may be operated after sufficient evaporation of moisture from residues. Depending upon the field conditions a 12 row happy seeder can plant 7-8 acres of rice crop with full residue retention conditions. The efficiency will be different for other crops and situations, for example during summer and with wheat residues, it can plant >10 acres in a day with more operating window.
6. Ensure that the soil moisture content at the time of planting is optimal and uniform so as to have uniform crop establishment.
7. Soil moisture content is critical for machine operation as excess soil moisture can cause uprooting of anchored resides, followed by machine choking and on the other side low soil moisture affects the wheat germination (Figure 27).
8. Check the condition of the seeder and make any adjustments or repairs necessary. In particular, the fasteners, blade bolts and welds before operating. Replace any broken or worn out parts.
9. Select the proper row spacing, seed quantity, and depth according to the field and crop. (Re-adjust seed rate and planting depth after trial.)

10. Make sure that the seeds to be planted are clean, and free of soil and pebbles. Do not mix fertilizer with the seeds when seeding, as this will damage the seed metering device.
11. Add the seed to the seed box. Do not fill the seed box more than three quarters full, in order to prevent the buckling of the seed box.
12. Make sure that the fertilizer is clod free.
13. Calibrate the machine as given in heading 4.1 and 4.2.

6.3.2 During operation

1. Use double clutch tractor to operate the machine in field. 45-55 hp tractors are sufficient to operate 9 to 12 tyne turbo happy seeder.
2. Use double clutch lever to reduce forward speed of tractor to clear occasional residues build up during machine operation.
3. Engage the PTO gear of tractor, set the tractor engine to 1800-2000 RPM and operate the tractor in 1st low or 2nd low gear depending on the residue load in the field.

Figure 25. *Rice field after combine harvesting (50% anchored residues and 50% loose residues).*

Figure 26. *Combine harvested rice field with uniformly distributed rice residues.*

4. Ensure optimal depth of planting through adjustment of depth control weels.
5. Raise turbo happy seeder while turning on headland without disengaging PTO gear.
6. Adjust top link of the machine to keep machine straight while operating in field.
7. Use recommended seed and fertilizer rate through calibrating the planter.
8. Oil level of Gear box should be checked after a specified interval as suggested by manufacturer.

6.3.3 After operation

1. Proper cleaning of the machine parts should be done after use, i.e., seed box, fertilizer box, metering mechanism, seed tubes, furrow openers, window drum, ground wheel etc should be cleaned and washed at the end of the season after completion of planting operationsAfter drying the planter, grease all bearing, points, chain and sprockets.
2. Store the planter in a cool and dry place.

Figure 27. *Uprooting of anchored rice residues due to high soil moisture content.*

7. Trouble shooting

Problem	Cause	Remedy
Straw clogging/ dragging while operation of machine for planting	1. Residues are too wet due to overnight due and high surface soil moisture 2. Tractor engine RPM less than 1800-2000 3. Turbo happy seeder flails are hitting the soil 4. High soil moisture content	1. Residues are too wet due to overnight due and high surface soil moisture 2. Increase the engine RPM by adjusting throttle accordingly 3. Increase the length of top link accordingly and ensure that flails don't touch the soil while rotating 4. Better to operate the THS in relatively less soil moisture. It should be relatively less than the conditions where we operate ordinary zero till planter

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Problem	Cause	Remedy
	5. PTO is not engaged before moving the machine in field	5. Engage the PTO gear, set the tractor engine RPM at 1800-2000 and move the tractor in 2nd low gear.
	6. Worn out machine flails	6. Flail blades should be reversed/ changed after planting of 100 acres of crop in rice residues residues. It could be little more for other crop residues.
	7. Depth of seeding is more	7. Adjust the depth of seeding with depth control wheels
	8. Uneven residue load	8. Ensure that residues are spread uniformly and there is no piling of residues.
	9. Use of single clutch tractor	9. It is always advised to use double clutch tractor for THS
Clogging of residues in particular tyne	1. It may be due to improper alignment of tyne behind the flails	1. Contact the machinery supplier to rectify this fault
	2. Broken/worn out flail blades	2. Replace the flail blade
	3. Excess clearance between tyne and flail blades	3. Contact the machinery supplier to rectify this fault
Excessive vibrations in the machine	1. It may be due to broken or imbalanced flail blades	1. Replace the faulty flail blade.
Machine uprooting the anchored residue	1. Flails are hitting the ground/ clearance is not optimum 2. Excess soil moisture	1. Use lift to prevent the flails touching the ground. The optimum clearance is 2.5 to 3 cm. 2. Operate the planter under optimal soil moisture condition and the operations under excess soil moisture
Seed/fertilizer is not delivered in slit/furrow opener	1. The seed/fertilizer box is empty 2. The furrow opener or seed tube is blocked due to wet soil / mud or benting of fertilizer/seed delivery pipes	1. Refill the seed/fertilizer box 2. Clean mud out of the opener and/or seed tubes. Unbent the delivery pipes or replace if required

Contd...

Problem	Cause	Remedy
	3. The drive wheel does not touch the ground 4. Broken chain/sprocket 5. Fertilizer fluted roller is blocked.	3. Lower down the hitch to get the drive wheel in contact with the soil 4. Change the broken part 5. Clean the fluted rollers

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Annexure

Specifications of turbo happy seeder

1. Horse Power Requirement	:	45-55 hp tractor with double clutch
2. Capacity, ha/hr.	:	0.25-0.35 ha/hr
3. Weight of machine	:	500-550 kg
4. Working width of machine	:	2.0-2.5 m
5. Row to row distance	:	225 mm
6. No. of rows	:	9-12
7. Type of Furrow openers	:	Inverted 'T' type
8. Rotor drum diameter	:	750 mm
9. Rotor diameter	:	140 mm
10. Window area (C/s area between two furrow openers)	:	0.200 x 0.450 = 0.09 m 2
11. Ground clearance of furrow opener with working PTO	:	0.30 m
12. Rotor rpm	:	1360 rpm at 540 rpm of tractor PTO
13. Types of flail blades	:	Reversible straight gamma type
14. Flails length from rotor surface	:	240 mm
15. Blade length	:	165 mm
16. Bottom width of blade	:	85 mm
17. Top width of blade	:	50 mm
18. Blade Overlap with furrow openers	:	60 mm
19. Horizontal clearance between the edges of the blades	:	75 mm
20. No. of Depth wheels	:	Two nos. with adjustable depths
21. Minimum Diameter of Ground Wheel	:	550 mm
22. No. of lugs on periphery of GW	:	15 (with sharp and long edges)

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