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# Development and testing of tractor operated slasher

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**ABSTRACT :** Uprooting, collection, transportation, size reduction, compost making and then again transportation in to the field needs one year period and involve huge cost of operation. Hence, this method is not suitable and practicable on farmer's field. In this point of view the investigation taken study with the objectives to development of tractor operated slasher to evaluate performance of developed tractor operated slasher. A prototype slasher evaluated the performances in various crops. The average speed of operation was observed to be 5.29 km/h with working width of 120cm. The average actual field capacity was found 0.533 ha/h. The average field efficiency of the slasher was recorded as 83.44 %. Among all the treatment, the minimum value of cost of operation of Rs. 282.00/ha was observed in sunhemp crop and maximum was recorded in PKV H 2 variety of cotton crop value of Rs. 385/ha. In respect of saving in cost, the maximum values of savings in cost 81per cent, in sunhemp crop over traditional method.

**KEY WORDS :** Cotton, Field capacity, Field efficiency, Slasher

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Cotton (*Gossypium* spp.), "the king of fibre" and "white gold" is one of the most important crops commercially grown over 111 countries throughout the world. India ranks first in the world under cotton cultivation and accounts for 11 million ha area (Anonymous, 2011). Cotton accounts for around 80 per cent of the total fibre consumption in textile sector, which accounts nearly 30 per cent of India's industrial.

In India, there is diverse farm mechanization scenario in country due to varied size of the farm holdings and socio-economic disparities. Cotton crop is taken on 33% land of the central and western Vidarbha. During and check row planting methods are adopted for sowing the cotton crop. Plants are grown up to a normal height of 1.0 to 2.0 m with branches. Removal of these plants is very tedious job. Due to drudgery prone operation labours are reluctant to do this job, more over the labour problem is also found during this period. Hence, the farmer use to burn it, though knows the value of this residue. Traditionally the crop residue of the cotton crop was carried out by bullock drawn harrow and tractor drawn harrow. The cost of operation and time required in bullock drawn method is very high. The cost of operations of these methods are Rs. 1750 and 1300 per hectare, respectively. Recently the farmers are using the rotavator for residue management of cotton. The rotavator destroy only 50 per cent cotton stalk and not prepare the land properly also, the cost of operation is Rs. 1200 per hectare.

Uprooting, collection, transportation, size reduction, compost making and then again transportation in to the field needs one year period and involve huge cost of operation. Hence, this method is not suitable and practicable on farmer's field. The *in-situ* size reduction only can serve the purpose. The irrigated Bt cotton gives high yield; in that case the plant size and canopy will be very large. In that case the small machines will fail to work satisfactory. In view of the above, the tractor-operated slasher was developed and tested on the crop with the objectives to evaluate performance of developed tractor operated slasher.

Traynor (2005) observed and reported that, vine removal is best with a flail pulveriser where the flails are shaped to the contour of the bed. A standard slasher or pulveriser cannot remove material between the rows and causes chopping into the top of the hill and damaging the roots. As a result, the remaining vines can be cut on both sides of the hill with large sharp coulters mounted on a tool bar. Jorge *et al.* (2009) reported that as the speed of the blades increases, in flail shredders, the height and the distance to which the residues are thrown increases and so do the friction with the air and the demand for power. Md. Akhir (2010) reported that rotary mower cannot cut the vines between the rows of some varieties, another vine removal machine that works very well

is a flail chopper they contoured to fit the rows. Amer *et al.* (2011) studied on the design, manufacture and choice of the best slasher for cutting and fragmentation of stems and leaves (vegetative portion) for the crop to facilitate the process of harvesting and extraction of tubers. A survey on various types and forms of cutters (mowers) and knives normally used for cutting vines and leaves was conducted and concluded that the vertical type and flail type mowers are the most effective in removing of the vegetative growth. In addition there is a need to design an integrated harvester, which combines both the cutting and digging in a single pass in order to reduce the time taken for harvesting, the fuel consumption and the number of machines used since this will give some economical advantages. In addition to the design requirements, it is recommended that number of tests should be conducted to select the suitable speed for the tractor, the velocity for cutters and the length of knives for both sides of the ridges to avoid damage to the tubers.

## METHODOLOGY

The tractor operated slasher was developed at Department of Farm Power and Machinery, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The main functional components developed slasher are gear box, PTO shaft, main frame, cover body, rotor assembly and transmission assembly. The specification of the tractor-operated slasher is given in Table A. The orthographic view of slasher is given in Fig. A.

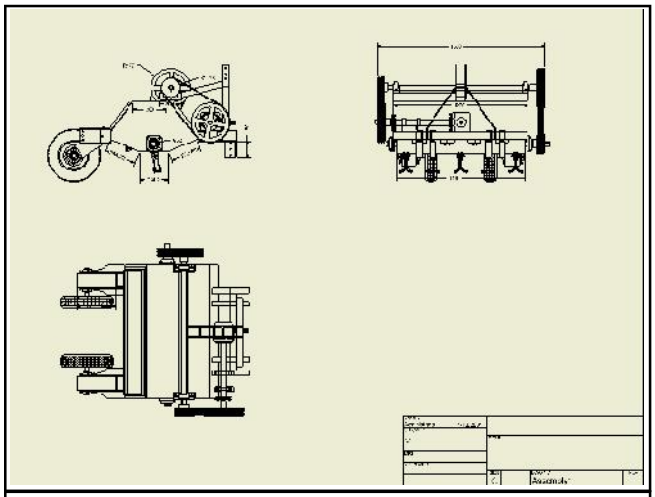

**Fig. A : Orthographic view of tractor operated slasher**

**Table A : Specification of tractor-operated slasher**

| Sr. No. | Particulars | Specifications |
|---|---|---|
| 1. | Gear box | Bevel gear box mounted on main frame of the body for receiving transmission from PTO of tractor |
| 2. | PTO shaft | A telescopic with universal joint |
| 3. | Main frame | Made from square section of length 1200 mm attached with three point linkage |
| 4. | Cover body | Made from MS sheet of 10 gauge with attachment of support frame for shaft. Size 1200x700 mm |
| 5. | Rotor assembly | Made from pipe and shaft mounted with 36 'L' shaped carbon steel blades. |
| 6. | Transmission assembly | Through PTO shaft gear box, belt and pulley |
| 7. | Weight of the machine | 485 kg |

**Testing of tractor operated slasher:**

The tractor-operated slasher was tested as per the test code. The developed tractor operated stasher was operated in various crops at university and out side. Field observations were noted for the field performance of the machine and its feasibility for the crop residue management. The slasher in operation in various fields is shown in Plate A-D. The slasher were tested in cotton crop (deshi and hybrid variety ), wild grasses and in sunhemp crop at various fields. RNAM test code followed for field testing.


**Plate A : Slashing operation in PKV H 2 variety of cotton crop**

Following different parameters were noted at the time of testing of tractor operated slasher.

**Travelling speed:**

For calculating travelling speed, two poles 30 meters apart were placed. On the opposite side also two poles were placed to form the corner of the rectangle, parallel to at least one long side of the test plot. The speed was calculated from the time required to machine to travel the distance (30 m) between the assumed connecting two poles on sides. The average of such 5 readings was taken to calculate the travelling

**Place B : Slashing operation in Bt cotton crop**

**Plate C : Slashing operation in wild grass**

**Plate D : Slashing operation in sun hemp crop**

speed of machine in km/hr.

**Width of operation:**

Width of slasher operation was taken randomly in the field at the different location.

**Actual field capacity:**

For calculating actual field capacity the time consumed for real work and that lost for other activities such as turning at head land, time adjustment were taken into consideration. The time required for actual operation and time lost were measured by stopwatch.

$$\text{Actual field capacity was given by} = \frac{\text{Actual area covered (ha)}}{\text{Total time required to covered area (hr)}} \quad (1)$$

$$\text{Theoretical field capacity} = \frac{\text{Theoretical with (m) x Speed, (km/h)}}{10} \quad (2)$$

**Theoretical field capacity:**

For calculating theoretical field capacity working width and travelling speed was noted. Theoretical field capacity of tractor operated slasher was calculated by following formula (Sahay, 2008).

**Field efficiency:**

Field efficiency is the ratio of actual field capacity to the theoretical field capacity; field efficiency is expressed in %, (Sahay, 2008).

$$\text{Field efficiency} = \frac{\text{Actual field capacity}}{\text{Theoretical field capacity}} \text{ x } 100 \quad (3)$$

**Fuel consumption:**

The method was used for measuring of fuel consumption as follows. The tank was filled to full capacity before the operation with petrol. Amount of refuelling after the test was the fuel consumption for the test. When filling of the tank, care was taken to keep the tank horizontal and did not to leave empty space in the tank.

**Cost of operation by using tractor drawn slasher:**

The operational cost of tractor drawn slasher was determined as per specification of BIS. The cost of operation of tractor drawn slasher was calculated by using standard procedure.

## ■ RESULTS AND DISCUSSION

The result of performance evaluation trials for different

crop namely PKV H 2, H6 Bt cotton, wild grasses and sunhemp crop which were carried out in farmers field at Sanghavi, Dist-Yeovtmal and University field. The field trial were conducted as per RNAM and BIS test codes and procedures. The following treatment were selected for conducting field evaluation trials.

$T_1$= slashing operation PKV H2 variety of cotton crop
$T_2$= slashing operation H6 Bt variety of cotton crop
$T_3$= slashing operation crop sunhemp crop
$T_4$= slashing operation wild grasses.

Field observations like operational speed, width of operation, the data collected during field evaluation trails were analyzed to determine the actual field capacity, field efficiency, fuel consumption. The cost of slashing in different crop were computed and compared with that of conventional method *i.e.*, manual uprooting.

The data pertaining to field evaluation trials of shlasher in PKV H2 variety of ctootn crop are given in Table 1. The average values of speed of operation of machine was 4.7 km/hr. The machine has the average actual field capacity of 0.468 ha/h with operational width of 120 mm and maximum fuel consumption was observed in for this treatment *i.e.* 8.5 l/ha.

The data collected during field evaluation trials in H6 Bt cotton crop were analyzed to determine the field capacity, field efficiency, fuel consumption and their average values are presented in Table 2. The average values of speed of

**Table 1 : Test results of tractor operated stasher in PKV H 2 variety of cotton crop**

| Sr. No. | Particulars | Cotton project CRS PDKV Akola |
|---|---|---|
| 1. | Field size | L - 120 m, W - 160 m A - 1.92 ha |
| 2. | Average time to cover the length of field, min | 1.53 |
| 3. | Avg. speed to operation, km/hr | 4.7 |
| 4. | Time lost in | |
| | Turning at head land in min | 45 |
| | Time lost in adjustment in min | - |
| | Time lost in repairs in min | Nil |
| 5. | Avg. Width of operation, cm | 120 |
| 6. | Avg. theoretical field capacity, ha/hr | 0.564 |
| 7. | Avg. actual time required to cover the area, h | 2.13 |
| | Avg. actual field capacity, ha/h | 0.468 |
| 8 | Avg. field efficiency, % | 82.97 |
| 9. | Avg. fuel consummation l/ha | 8.5 |
| 10. | Cost of operation , Rs. per ha | 385 |
| 11. | Cost saving over traditional method in % (Estimated cost for uprooting, collection, and Rs. 1500/ha) | 74 |

**Table 2 : Test results of tractor operated stasher in H6 Bt cotton crop**

| Sr. No. | Particulars | Farmers field at Sanghavi Dist. Yavatmal |
|---|---|---|
| 1. | Field size | L - 130 m, W - 190 m A – 2.47 ha |
| 2. | Average time to cover the length of field, min | 1.50 |
| 3. | Avg. speed to operation km/hr | 5.2 |
| 4. | Time lost in | |
| | Turning at head land in min | 52 |
| | Time lost in adjustment in min | - |
| | Time lost in repairs min | Nil |
| 5. | Avg. width of operation, cm | 120 |
| 6. | Avg. theoretical field capacity, ha/hr | 0.624 |
| 7. | Avg. actual time required to cover the area, h | 1.76 |
| 8 | Avg. actual field capacity , ha/h | 0.534 |
| 9 | Avg. field efficiency, % | 85.55 |
| 10 | Avg. fuel consummation, l/ha | 7.5 |
| 11 | Cost of operation , Rs. per ha | 350 |
| 12 | Cost saving over traditional method in % (Estimated cost for uprooting, collection and Rs. 1500/ha | 76 |

**Table 3 : Test results of tractor operated stasher in wild grass**

| Sr. No. | Particulars | at CRS Dr. PDKV, Akola |
|---|---|---|
| 1. | Field size | L-110 m, W-70 m A-0.77 ha |
| 2. | Average time to cover the length of field, min | 1.25 |
| 3. | Avg. speed to operation km/hr | 5.25 |
| 4. | Time lost in | 30 |
| | Turning at head land in min | 30 |
| | Time lost in adjustment in min | 7 |
| | Time lost in repairs min | Nil |
| 5. | Avg. width of operation, cm | 120 |
| 6. | Avg. theoretical field capacity, ha/hr | 0.63 |
| 7. | Avg. actual time required to cover the area, h | 1.85 |
| 8 | Avg. actual field capacity , ha/h | 0.42 |
| 9 | Avg. field efficiency, % | 66.66 |
| 10. | Avg. fuel consummation, l/ha | 8.33 |
| 11. | Cost of operation , Rs. per ha | 368 |
| 12. | Cost saving over traditional method in % (Estimated cost for uprooting, collection and Rs. 1500/ha) | 75 |

**Table 4 : Test results of tractor operated stasher in Sunhemp crop**

| Sr. No. | Particulars | Akola |
|---|---|---|
| 1. | Field size | L-250 m, W-110 m A- 2.75ha |
| 2. | Average time to cover the length of field, min | 2.30 |
| 3. | Avg. speed to operation km/hr | 6 |
| 4. | Time lost in | |
| | Turning at head land in min | 65 |
| | Time lost in adjustment in min | 5 |
| | Time lost in repairs min | Nil |
| 5. | Avg. width of operation, cm | 120 |
| 6. | Avg. theoretical field capacity ha/hr | 0.72 |
| 7. | Avg. actual time required to cover the area, h | 3.82 |
| 8. | Avg. actual field capacity, ha/h | 0.71 |
| 9. | Avg. field efficiency, % | 98.61 |
| 10. | Avg. fuel consummation, l/ha | 5.75 |
| 11. | Cost of operation , Rs. per ha | 282 |
| 12. | Cost saving over traditional method in % (Estimated cost for uprooting, collection and Rs. 1500/ha) | 81 |

operation of machine was 5.2 km/hr. The machine had the average actual field capacity of 0.534 ha/h with operational width of 120 mm and Avg. fuel consumption of tractor drawn slasher was found 7.5 l/ha in Bt cotton crop.

Table 3 reveals the test result of tractor drawn slasher in wild grass. The average values of speed of operation of slasher was found 5.25 km/hr. The machine had the average actual field capacity of 0.42 ha/h with operational width of 120 mm. Avg. fuel consumption of tractor drawn slasher was 8.33 l/ha.

The data pertaining to field evaluation trials of sunhemp are given in Table 3. The average values of speed of operation of machine was 6 km/hr. The machine has the average actual field capacity of 0.71 ha/h with operational width of 120 mm and among all treatment a minimum avg. fuel consumption of tractor drawn slasher was found 5.75 l/ha for sunhemp crop.

The values of cost of operation in terms of Rs/ha and savings in cost and time of slashing operation in different crop are shown in Table 1, 2, 3 and 4. It is clearly reflected among all the treatments, the minimum value of cost of operation of Rs. 282.00/ha was observed in sunhemp crop and maximum was recorded in PKV H 2 variety of cotton crop value of Rs. 385/ha. Among all the treatments, the maximum values of savings in cost 81per cent, in sunhemp crop over traditional method.

**Conclusion:**

The tractor drawn slasher has been developed at Department of Farm Power and Machinery, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. Field test trials on slasher were carried out at various crops. From the performance result of these trials following conclusions could be drawn.

– The average speed of operation was observed to be 5.29 km/h.

– The average actual field capacity was 0.533 ha/h

– Average fuel consumption was 7.52 l/ha

– The cost of operation was from Rs. 346 per ha.

– Cost saving was from 76.5 % over traditional method.

– Incorporation of residue gives immediate utilization to enrich the soil for the immediate season.

– The average field efficiency of the slasher was 83.44 %.

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