

Modification of three point linkage system of medium tractor drawn sowing machine to operate by mini tractor

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Received : 26.05.2017; Revised : 12.03.2018; Accepted : 23.03.2018

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■ **ABSTRACT** : The study of the three point linkage system of the sowing machine revealed that the sowing machines can be easily operated by the mini tractor, if the specification of three point linkage system were standardized as: Optimum distance between lower hitching points should be kept as 70 cm and Vertical distance between the hitching system of top link and lower link should be made at 60 cm. These three point linkage systems provide versatility of use of the different farm tractors viz., Mini as well as medium size tractors. During the operation front ballasting of the mini tractor was required according to the weight of sowing machine however 100 kg front ballasting was found appropriate. The manufacturers were requested to adopt the specification of the hitching system for fabricating new sowing machines it will enable to use the machine either by the medium tractor or mini tractor.

■ **KEY WORDS** : Three point linkage system, Sowing machine, Mini tractor

■ **HOW TO CITE THIS PAPER** : Swarnkar, R., Mandloi, Kapil and Yoganandi, Yagnik C. (2018). Modification of three point linkage system of medium tractor drawn sowing machine to operate by mini tractor. *Internat. J. Agric. Engg.*, **11**(1) : 249-256, DOI: 10.15740/HAS/IJAE/11.1/249-256.

Mechanization in agriculture refers to the use of machines in agriculture to ensure reduction of drudgery associated with various farm operations as well as timely sowing. In India, there were more than 80 per cent farmers have less than 2 ha of land so, economically it was not feasible for them to own big tractor for their farm operations.

Most of farmers were purchasing and using tractors of 35 to 45 hp which were cover powered for small land holding. For economical use at least 70 per cent of the tractor power must be utilized for farm operation (Anonymous, 1989).

The population of medium size tractor in India was maximum as compared to other ranges of tractor powers. Mini tractors have approximately half cost advisable and 30 to 40 per cent less operating cost than medium sized tractors and hence, the researchers are initiated to

introduce a low cost technology to perform various farm operation with mini tractors for small and marginal farmers.

The mini tractor will cost 40-50 per cent lesser than the cheapest tractor of medium size tractor and will demand 25 per cent and 60 per cent lesser cost in fuel and maintenance also. Mini tractor was available with an ideal range 10-20 hp engine, which was best, suited for the small and medium sized Indian farms.

It has been observed sowing operation was most important operation among other farm operation that only 10-20 per cent of available power of medium size tractors being utilized for sowing operation. The study was undertaken with the objectives:

- To study various available sowing machine for three point linkage system.
- To evaluate performance of zero till drill using

medium size tractor (35 to 45 hp).

–To assess the suitability of mini tractor to operate and evolves performance of zero till drill.

■ METHODOLOGY

Experiments were conducted in the field of Agricultural Engineering and Technology, Anand Agricultural University Godhra, districts Panchmahal. All the parameters of the tractor-implement performance were measured and recorded as per the recommendations of RNAM test codes and procedures for farm machinery technical series (1995). The tractor was used Yuvraj (15hp), Sonalika (35hp) and New Holland. The matching implements for sowing operation selected were used Multi crop planter and modular maize planter

One commonly used implement was selected to investigate their effect on soil with respect to soil physical properties and implements performance for sowing operation. The various soil parameters like soil texture, soil moisture content, bulk density and machine parameters like field capacity, fuel consumption, draft and energy requirement, draft power requirement, travel reduction etc. were recorded and evaluated.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads and Fig. 1 to 14.

Study of suitability of mini tractor to operate different sowing machines designed for medium size tractor :

A number of sowing machines were available in the Deptt. of Farm Machinery and Power Engineering, College of Agricultural Engineering and Technology, AAU, Godhra. Zero till drill of eleven row was selected for the study.

The modified three point linkage system of the zero till drill was assemble to the mini tractor (Yuvaraj Mahindra) and operated in the field and it was found that operation of mini tractor without ballasting was not proper satisfaction, enhance different ballasting 50 kg, 80 kg, 100 kg and 120 kg using and operate the mini tractor with all thwas ballasting separately. It was found that depth of zero till with 100 kg ballasting gave satisfactory performance. Also the mini tractor was operated without ballasting with zero till drill. The result

of mini tractor with zero till drill work compared with the result of medium size tractor operating with zero till drill.



Fig. 1 : Mini tractor with front ballasting



Fig. 2 : Zero till drill

The Table 1 were show that the using of mini tractor have shown the selected zero till drill and other implement were easily operated by use of mini tractor. looking to the and top linkage space should be standardized 0.70 m and vertical distance between top linkage to lower

linkage should be taken as 0.60 m if the all sowing machine three point linkage machine were standardized at 0.70

m and 0.60 m the sowing machine can be easily operated either by mini tractor or medium tractor.



Fig. 3 : Mini tractor with front ballasting under operation with ZTD



Fig. 4 : Mini tractor without ballasting under operation with ZTD

Table 1: Specification of three point linkage for sowing/planting implements

Name of implement	Lower linkage (m)		Top linkage to lower linkage (m)		Ground wheel located of implement	Front wheel dwastance (m)
	Maximum	Minimum	Maximum	Minimum		
Pneumatic planter	0.70	0.70	0.55	0.55	Back	0.57
Multi crop planter (kiran corporation)	0.65	0.55	0.51	0.51	Back	0.55
Zero till drill (khedut)	0.76	0.60	0.46	0.46	Back	0.37
Multi crop planter (kiran corporation)	0.75	0.65	0.76	0.76	Front	0.47
National rawased bad planter (kiran)	0.75	0.65	0.46	0.46	Front	0.51
Zero till drill (national ludhiana)	0.75	0.65	0.48	0.48	Front	0.44

Table 2 : Three point linkage of mini tractors

Name of mini tractors	Lower linkage		Top linkage to lower linkage	
	Maximum (m)	Minimum (m)	Maximum (m)	Minimum (m)
Mahindra Yuvraj	0.80	0.40	0.65	0.50
Mitsubwashi	0.75	0.45	0.60	0.40
Captian	0.70	0.40	0.60	0.35

Table 3: Speed of during operation of mini tractor with ballasting

Matching implement	Tractor (RPM)	Pass	Distance cover (m)	Time taken (sec)	Speed (m/s)	Average Speed (m/s)	Speed (km/h)	Average (km/h)
Zero till drill	1000	1	20	17.14	1.16		4.17	
		2	20	17.22	1.16	1.16	4.17	4.17
		3	20	17.10	1.16		4.17	
	1500	1	20	15.01	1.33		4.78	
		2	20	14.89	1.34	1.38	4.82	4.98
		3	20	13.40	1.49		5.36	
	2000	1	20	13.08	1.52		5.47	
		2	20	13.30	1.50	1.51	5.40	5.44
		3	20	13.15	1.52		5.47	

Field performance study of zero till drill:

Physical properties of soil:

The mean data on soil moisture content before sowing operations at 0 - 20 cm depth was recorded as 10.96 (%) and bulk density was found as 1.79 g/cm³.

Operating speed:

The operating speed was measured under each treatment and found that the average speed for respective operation are presented in Table 3 and 4.

Wheel slippage of tractor:

Travel reduction affects the traction efficiency of any tractive device. Table 5 presents the results of the travel reduction derived from the field test of mini tractor (with ballasting and without ballasting) and medium tractor drawn zero till drill with three different speeds.

The mini tractor with zero till drill with ballasting (100 kg front ballasting) at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the wheel slippage

18.82 per cent, 21.54 per cent and 22.99 per cent, respectively during the operation.

The mini tractor with zero till drill without ballasting at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the wheel slippage 6.93 per cent, 7.71 per cent and 16.16 per cent, respectively during the operation, it

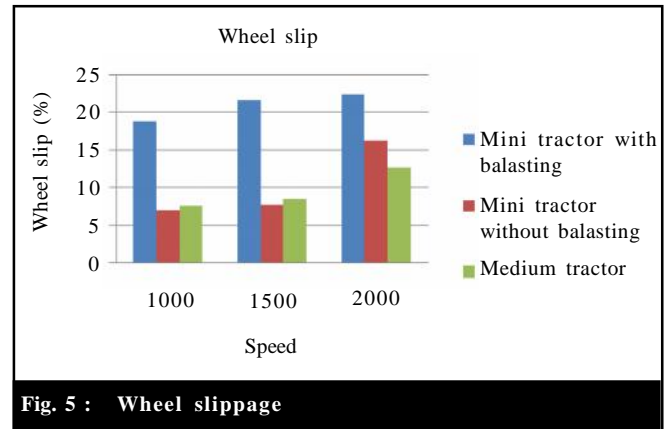


Fig. 5 : Wheel slippage

Table 4: Speed of during operation of mini tractor without ballasting									
Matching implement	Tractor (RPM)	Pass	Distance cover (m)	Time taken (sec)	Speed (m/s)	Average speed (m/s)	Speed (km/h)	Average (km/h)	
Zero till drill	1000	1	20	23.93	0.83	0.80	2.98	2.9	
		2	20	25.66	0.77		2.77		
		3	20	24.34	0.82		2.95		
	2000	1000	1	20	17.00	1.17	1.14	4.21	4.1
			2	20	17.18	1.16		4.17	
			3	20	18.27	1.09		3.92	
		2000	1	20	14.76	1.35	1.46	4.86	5.32
			2	20	12.81	1.56		5.74	
			3	20	13.39	1.49		5.36	

Table 5: Speed of medium tractor during operation								
Matching implement	Tractor (RPM)	Pass	Distance cover (m)	Time taken (sec)	Speed (m/s)	Average speed (m/s)	Speed (km/h)	Average (km/h)
Zero till drill	1000	1	20	16.79	1.19	1.23	4.28	4.42
		2	20	16.47	1.21		4.35	
		3	20	15.50	1.29		4.64	
	1500	1	20	12.70	1.57	1.58	5.65	5.71
		2	20	12.70	1.57		5.65	
		3	20	12.33	1.62		5.83	
	2000	1	20	10.40	1.92	1.95	6.91	7.01
		2	20	10.25	1.95		7.02	
		3	20	10.08	1.98		7.12	

was seen that the depth of zero till drill was not adjusted at proper depth than recommended.

The medium tractor with zero till drill at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the wheel slippage 7.71 per cent, 8.49 per cent and 12.65 per cent, respectively during the operation (Fig. 5).

The result shows that, the slippage increases with increase with speed. The mini tractor with ballasting gave the maximum slippage, minimum slippage obtained with medium tractor.

Draft measurement:

The results of the draft measurement for the sowing implements were shown in Fig 6.

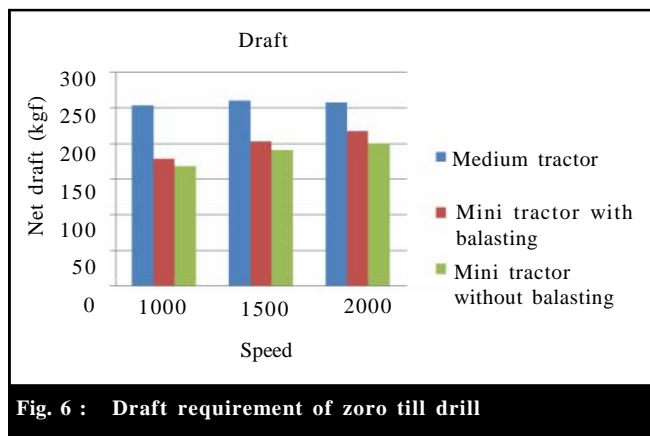


Fig. 6 : Draft requirement of zero till drill

The mini tractor with zero till drill with ballasting (100 kgf front ballasting) at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the draft 254.33 kgf, 260.33 kgf and 258.66 kgf, respectively during the operation. The mini tractor with zero till drill without ballasting at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the draft 178.33 kgf, 203.00 kgf and 218.00 kgf, respectively during the operation. The medium tractor with zero till drill at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the draft 221.66 kgf, 229.33 kgf and 232.33 kgf, respectively during the operation (Fig. 6) (Singh and Singh, 2006).

The result shows that, the draft will increase with increase speed.

Fuel consumption:

The parameters for fuel consumption have been recorded for 450 m² required and given table show considerable differences between the different

treatments. The result indicated that the fuel consumption for sowing operation per hectare.

The mini tractor with zero till drill with ballasting (100 kg front ballasting) at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the average fuel



Fig. 7 : Draft measurement of mini tractor with ballasting



Fig. 8 : Draft measurement of medium tractor



Fig. 9 : Draft measurement of mini tractor without ballasting



Fig. 10 : Draft measurement of mini tractor with ballasting



Fig. 11 : Fuel measurement with mini tractor

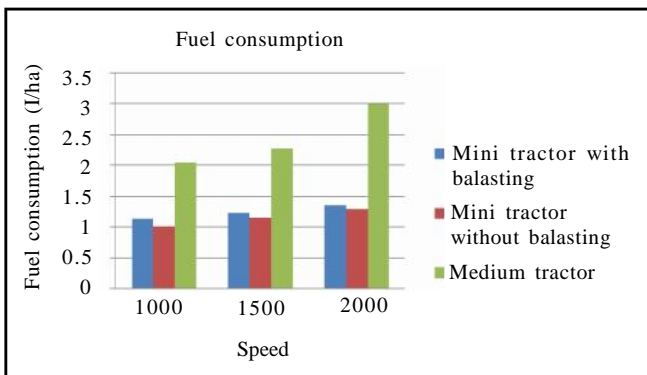


Fig. 12 : Fuel consumption

consumption to cover werea 1 hector 1.13 lit, 1.22 lit and 1.35 lit, respectively during the operation (Fig. 12).

The mini tractor with zero till drill without ballasting at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the average fuel consumption to cover werea 1 hector 1.00 lit, 1.14 lit and 1.29 lit, respectively during

the operation (Fig. 13).

The medium tractor with zero till drill at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the average fuel consumption to cover werea 1 hector 2.04 lit, 2.28 lit and 2.66 lit, respectively during the operation.

The result shows that, the fuel consumption will increases with increase speed.

Field capacity :

Field capacity and soil disturbance has been reported as two major factors in determining the performance of sowing implements (Bukhari *et al.*,1988). The field capacity of a machine was a function of its width, speed and efficiency of operation. The data regarding these parameters was presented.

Field capacity (used by medium tractor):

The mini tractor with zero till drill with ballasting (100kg front ballasting) at speed *viz.*, 1000,1500 and 2000 tractor engine rpm gave the total time required to cover 1 ha were a operation 1.34 hr, 1.08 hr and 0.80 hr, respectively during the operation (Fig. 13).

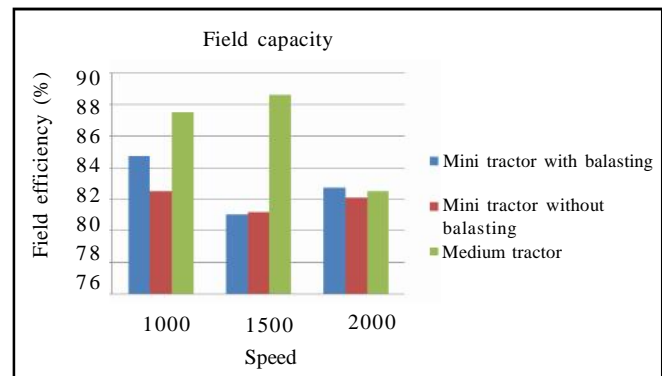


Fig. 13 : Field capacity

The mini tractor with zero till drill without ballasting at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the total time required to cover 1 ha were a operation 1.23 hr, 1.13 hr and 0.82 hr, respectively during the operation .

The medium tractor with zero till drill at different speed *viz.*, 1000,1500 and 2000 tractor engine rpm gave the total time required to cover 1 ha operation were 1.22 hr , 0.74 hr and 0.58 hr, respectively during the operation (Fig. 13).

Drawbar power:

Drawbar power was a function of draft and speed. The results pertaining to the drawbar power was presented in Fig. 14

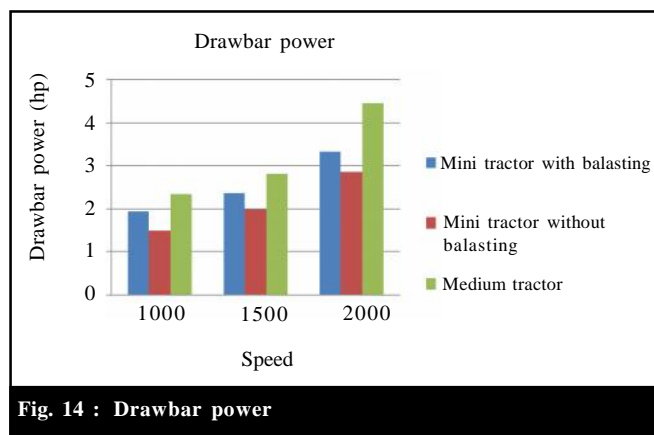


Fig. 14 : Drawbar power

The Zero till drill was easily operated by use of Mini tractor. To make possible attachment of zero till drill with mini tractor lower link of the drill was changed from 75 to 55 cm. The top linkage spacing was standardized 0.70 m.

Based on the results obtained from the field performance of sowing implement (zero till drill). The soil moisture content at the time of operation was 10.96 per cent and bulk density of soil layer upto 20 cm depth was 1.79 g/cc (Fig. 14).

Effect on wheel slippage :

The mini tractor with zero till drill with ballasting (100 kg front ballasting) at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the wheel slippage 18.82 per cent, 21.54 per cent and 22.99 per cent, respectively during the operation .

The mini tractor with zero till drill without ballasting at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the wheel slippage 6.93 per cent, 7.71 per cent and 16.16 per cent, respectively during the operation, it was seen that the depth of zero till drill was not adjusted at proper depth than recommended.

The medium tractor with zero till drill at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the wheel slippage 7.71 per cent, 8.49 per cent and 12.65 per cent, respectively during the operation.

The result shows that, the slippage increases with increase with speed. The mini tractor with ballasting gave

the maximum slippage, minimum slippage obtained with medium tractor.

Effect on net draft:

The mini tractor with zero till drill with ballasting (100 kgf front ballasting) at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the net draft 254.33 kgf, 260.33 kgf and 258.66kgf, respectively during the operation.

The mini tractor with zero till drill without ballasting at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the net draft 178.33 kgf, 203.00 kgf and 218.00 kgf, respectively during the operation.

The medium tractor with zero till drill at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the net draft 221.66 kgf, 229.33 kgf and 232.33 kgf, respectively during the operation.

The result shows that, the net draft will increases with increase speed.

Effect on fuel consumption :

The mini tractor with zero till drill with ballasting (100 kg front ballasting) at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the average fuel consumption to cover 1 hectare were 1.13 lit, 1.22 lit and 1.35 lit, respectively during the operation.

The mini tractor with zero till drill without ballasting at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the average fuel consumption to cover a 1 hectare were 1.00 lit ,1.14 lit and 1.29 lit, respectively during the operation.

The medium tractor with zero till drill at different speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the average fuel consumption to cover 1 hectare were 2.04 lit, 2.28 lit and 2.66 lit, respectively during the operation.

The result shows that, the fuel consumption will increases with increase speed.

Effect on field capacity:

The mini tractor with zero till drill with ballasting (100kg front ballasting) at speed *viz.*, 1000, 1500 and 2000 tractor engine rpm gave the total time required to cover 1 ha operation were 1.34 hr, 1.08 hr and 0.80 hr, respectively during the operation.

The mini tractor with zero till drill without ballasting at different speed *viz.*, 1000, 1500 and 2000 tractor engine

rpm gave the total time required to cover 1 ha werea operation 1.23 hr, 1.13 hr and 0.82 hr, respectively during the operation.

The medium tractor with zero till drill at different speed viz., 1000, 1500 and 2000 tractor engine rpm gave the total time required to cover 1 ha area of operation were 1.22 hr, 0.74 hr and 0.58 hr, respectively during the operation. Similar work related to the present investigation was also carried out by Ahaneku *et al.* (2011); Ambike and Schmiedeler (2007); Baloch *et al.* (1991) Boydafil (2007) and Gerg and Dixit (2004).

Conclusion:

The results of the study reavelead that :

The sowing machines drawn bty medium tractor can also be operated by the mini tractor if hitching system of the sowing machines is modified/adjusted to fit in the hitching system of the mini tractor.

It was found that if the horizontal spacing between lower linkage hitching poits on the sowing machines is kept 70 cm and the vertical distance between top and lower link as 60 cm, this combination provide versatility of using different sizes of tractors to operate the sowing machines efficiently.

When mini tractor is being used as a power source to operate the sowing machines (developed for medium size tractor) front blasting is required according to the weight of the machine for smooth operation. 100 kg front blasting was found sufficient for the smooth operation of the sowing machine when drawn by mini tractor.

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