International Journal of Agricultural Engineering, Vol. 2 No. 2 (October 2009 to March 2010) : 212-215

Research Paper :

Evaluation for cost effective combination of different seed bed preparation implements with large size tractors

S.B. PATIL, R.C. SALUNKHE, S.K. JADHAV AND S.S. PATIL

Accepted : *June, 2009*

ABSTRACT

Land development, tillage and seedbed preparation, together account for a major share of power utilization in the crop cycle. The implements used for seedbed preparation needs to be evaluated for maximum field capacity with reduced cost of operation. The field tests were conducted in 65 x 150 m size plot .Two tractors 45 and 55 HP were selected for seedbed preparation with single bottom and double bottom reversible M.B. Plough for ploughing operation, two rotavators with working width of 1.2 m and 1.5 m for clod crushing after the ploughing and a two bottom ridger and single bottom reversible M.B.Plough for making ridges and furrows .The average depth of operation was 30 cm and both the tractors were operated in II –L gear for all the operations with all implements. The parameters selected for the study namely effective field capacity, theoretical field capacity, field efficiency, fuel consumption were measured and calculated as per RNAM test code. Among all the implements evaluated the total cost of seedbed preparation was found minimum (Rs. 5110.58/-per ha) in case of 45 HP tractor with 2 bottom reversible M.B.Plough, rotavator with 1.2 m working width and 2 bottom ridger . Tractor 55 HP accounted least total cost of seedbed preparation (Rs. 5345.66/- per ha) with a 2 bottom reversible M.B.Plough, rotavator with 1.5 m working width and 2 bottom ridger.

See end of the article for authors' affiliations

Correspondence to:
S.B. PATIL
Department of Farm Machinery and Power Engineering, Padmashree Dr. D. Y. Patil ,College of Agricultural Engineering and Technology, Talsande, KOLHAPUR (M. S.) INDIA

Key words : Seed bed, Cost, Large size tractors

The use of animals and animal drawn implements have been replaced by tractors and tractor drawn implements. The growing population in India calls for the mechanization for timely field operations to reduce cost of farm operations. The growth in use of tractor drawn machinery has been in the range of 9-17%. It is generally believed that only large size farm holding farmers have adopted mechanization inputs. However, data from Input Survey 1981-82, 1986-87 and 1992 of Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, reveal that farmers of all farm holding sizes have adopted implements and equipments from bullock-drawn implements to pump sets, threshers and tractors. Infact, the data shows that the percentage growth of tractors, pump sets and threshers was higher in the marginal and small farm holding categories.

Tractors are manufactured in India ranging from less than 25 HP to more than 45 HP but most popular range is 31-35 HP. The market is segmented in terms of horsepower into the 30 HP and less (lower) segment, the 30 HP – 40 HP segment and the higher segment above 40 HP. All major manufacturers cater to all the three segments. There has been a trend to move towards higher HP tractors, in recent years. This has been prompted by the need for newer applications and increasing awareness among farmers about new mechanization options. Punjab, Uttar Pradesh and Haryana have large demand for markets for tractors. These status account for more than 50 per cent of sales. Land development, tillage and seedbed preparation, together account for a major share of power utilization in the crop cycle (Mani and Panwar, 1992). Keeping these points in view a study was conducted to evaluate cost effective combination of different implements with different sizes used for the seed bed preparation with two different Hp tractors.

METHODOLOGY

The field tests were conducted in the field left after the harvest of sugarcane crop. Tractors of 45 HP and 55 HP were selected for the study of operation of different implements used for ploughing, clod crushing and making ridges and furrows. The details of implements used for various operations are given in Table 1.

The average depth of ploughing was 30 cm and both the tractors were operated in II-L gear. The fuel consumption was measured by connecting an auxiliary fuel supply system on the tractors. The different parameters selected for the evaluation of performance were measured in the field and calculated as per RNAM test code.

Table 1 : Implements selected for the study

Sr. No.	Name of the implements	Size	Purpose
1.	M.B. Plough (reversible)	Single bottom	Ploughing
2.	M.B. Plough (reversible)	Double bottom	Ploughing
3.	Rotavator	1.5 m	Clod crushing
4.	Rotavator	1.2 m	Clod crushing
5.	Ridger	2 bottom	Making ridge and furrow
6.	M.B.Plough	Single bottom	Making ridge and furrow

RESULTS AND DISCUSSION

Comparison of ploughing performance with different sizes of tractors operated with different sizes of ploughs:

A 45 HP tractors with 2 bottom reversible M.B. plough has 40.98% more effective field capacity, 7.82% less fuel consumption and 14.84% less cost of operation as compared to single bottom M.B. plough .

A 55 HP tractor with 2 bottoms reversible M.B. plough has 49.51% more effective field capacity, 9.87% less fuel consumption and 20.81% less cost of operation as compared to single bottom M.B. plough.

The reason for higher values of effective field capacity and reduction in fuel consumption and cost of operation was observed with increase of size of implements due to increase of total area ploughed and lesser time lost in turning due to the large size of plough.

Single bottom reversible M.B. plough operated with 55 HP tractor has 23.72% more effective field capacity and 9.42% and 1.2% less fuel consumption and cost of operation, respectively as compared to 45 HP tractor.

The higher cost of operation of 55 HP tractor with single bottom reversible M.B. plough with more effective field capacity and lesser fuel consumption may be due to the higher cost of 55 HP tractor than 45 HP tractor.

Where as double bottom reversible M.B. plough operated with 55 HP tractor has 31.63% higher effective field capacity and 11.44% and 8.13% less fuel consumption and cost of operation, respectively (Table 2).

Among both the ploughs and tractors, 45 HP tractor with single bottom reversible M.B.Plough has least effective field capacity, highest fuel consumption and cost of operation , where as an opposite trend was found in case of 55 HP tractor with 2 bottom reversible M.B.Plough. Reason for this may be more working width of plough, which covered more area in less time and less number of turns.

Comparison of clod crushing performance with different sizes of tractor operated with different sizes of Rotavator:

Tractor of 45 HP was not used with 1.5 m rotavator due to reason of overloading and a 55 HP tractor was not used with 1.2 m rotavator due to the possibility of damage of rotavator blades.

A 45 HP tractor with 1.2 m working width has 13.04%, 30.91% and 29.00 % less effective field capacity, fuel consumption and cost of operation, respectively than 55 HP tractor (Table 3).

The reason for this lower values of fuel consumption, cost of operation and effective field capacity was observed with decreasing working width of rotavator and size of tractor and the cost of tractor and implement. An opposite trend was observed in 55 HP with 1.5 m working width of rotavator implement.

Comparison of ridges and furrow making performance with different sizes of tractors operated with different sizes of ridger:

Tractor of 45 HP with 2 bottom ridger has 11.47 % more effective field capacity and 10.95 % and 10.26%

Table 2 : Ploughing performance with different sizes of tractors

Tractor HP	Implement size	E F C ha/hr	F.E %	Fuel Consumption Lit/ha	Cost of operation Rs/ha
45	Single bottom	0.0832	67.8	36.21	3094.71
45	Double bottom	0.117	70.78	33.38	2635.63
55	Single bottom	0.103	71.69	32.80	3057.52
55	Double bottom	0.154	70.63	29.56	2421.30

Table 3 : Clod crushing performance with different sizes of tractor

Tractor HP	Implement size	E F C ha/hr	F.E. %	Fuel consumption Lit/ha	Cost of operation Rs/ha
45	1.2 m	0.322	73.27	22.71	1430.02
55	1.5 m	0.364	75.75	29.73	1844.64

less fuel consumption and cost of operation, respectively as compared to single bottom reversible M.B. plough.

Tractor of 55 HP with 2 bottom ridger has 8.80% more effective field capacity and 9.12% and 8.60% less fuel consumption and cost of operation, respectively as compared to single bottom reversible M.B. plough.

The reason for higher value of effective field capacity and reduction in fuel consumption was observed with increase of size of implement in case of both sizes of tractor may be due to increase of total area covered in lesser time and reduction in time lost in turnings due to higher size of ridger.

Single bottom M.B. plough which is used for making ridges and furrows operated with 55 HP tractors has 5.46% and 1.45% more effective field capacity and cost of operation, respectively and 6.30% lesser fuel consumption as compared to 45 HP tractor.

The higher cost of operation of 55 HP tractors with single bottom M.B. plough with more effective field capacity and lesser fuel consumption may be due to the higher cost of 55 HP tractors than 45 HP tractors.

Where as 2 bottom ridger operated with 55 HP tractor has 2.94% and 3.33% more effective field capacity and cost of operation and 5.82% lesser fuel consumption as

Table 4 : Ridges and furrow making performance with different sizes of tractors

Tractor HP	Implement size	E F C ha/hr	F.E %	Fuel Consumption Lit/ha	Cost of Operation Rs/ha
45	Single bottom M B Plough	0.366	58.89	18.25	1164.37
45	Double bottom Ridger	0.408	81.33	16.50	1044.93
55	Single bottom M B Plough	0.386	76.49	17.1	1181.26
55	Double bottom Ridger	0.42	66.19	15.54	1079.72

Table 5 : Comparison of performance of tractors and implements

Tractor Power HP	Tillage operation	Implement used	Time hr/ha	Total time For seed bed preparation	Cost of operation	Total cost of seed bed preparation
45	Ploughing	1 Bottom M. B. Plough	12.01	17.84	3094.71	5689.1
	Clod crushing	1.2 m Rotavator	3.1		1430.02	
	Ridges and furrows making	1 Bottom M. B. Plough	2.732		1164.37	
45	Ploughing	1 Bottom M. B. Plough	12.01	17.56	3094.71	5569.66
	Clod crushing	1.2 m Rotavator	3.1		1430.02	
	Ridges and furrows making	2 Bottom Ridger	2.45		1044.93	
45	Ploughing	2 Bottom M. B. Plough	8.54	14.37	2635.63	5230.02
	Clod crushing	1.2 Rotavator	3.1		1430.02	
	Ridges and furrows making	1 Bottom M. B. Plough	2.732		1164.37	
45	Ploughing	2 Bottom M. B. Plough	8.54	14.09	2635.63	5110.58
	Clod crushing	1.2 m Rotavator	3.1		1430.02	
	Ridges and furrows making	2 Bottom Ridger	2.45		1044.93	
55	Ploughing	1 Bottom M. B. Plough	9.708	15.04	3057.52	6083.42
	Clod crushing	1.5 m Rotavator	2.747		1844.64	
	Ridges and furrows making	1 Bottom M. B. Plough	2.59		1181.26	
55	Ploughing	1 Bottom M. B. Plough	9.708	14.83	3057.52	5981.88
	Clod crushing	5 ft Rotavator	2.747		1844.64	
	Ridges and furrows making	2 Bottom Ridger	2.38		1079.72	
55	Ploughing	2 Bottom M. B. Plough	6.493	11.83	2421.3	5447.2
	Clod crushing	1.5 m Rotavator	2.747		1844.64	
	Ridges and furrows making	1 Bottom M. B. Plough	2.59		1181.26	
55	Ploughing	2 Bottom M. B. Plough	6.493	11.62	2421.3	5345.66
	Clod crushing	1.5 m Rotavator	2.747		1844.64	
	Ridges and furrows making	2 Bottom Ridger	2.38		1079.72	

compared to 45 HP tractor. (Table 4)

Among both the ridgers and tractors 45 HP tractor with single bottom M.B.plough has least effective field capacity, highest fuel consumption, where as reverse trend was found in case of 55 HP tractor with 2 bottom ridger. Reason for this may be more working width of ridger, which covered more area in less time and less number of turns.

A 45 HP tractor with 2 bottom ridger has least cost of operation where as 55 HP tractors with single bottom M.B. plough has higher cost of operation, this is due to higher cost of tractor. Tanihuhi *et al*. (1999) have also reported from Japan, the draft and soil maniputation by a mould board plough under different forward speeds and body attachment.

Comparison of performance of tractors and implements for timeliness and cost effectivity:

Among all the implements evaluated, the combination of 2 bottom reversible M.B. plough + rotavator with 1.2 m working width + 2 bottom ridger and 45 HP tractor was found to be a cost effective with the total cost of seed bed preparation of Rs.5110.58 per ha.

Tractor of 55 HP accounted the least total cost of seed bed preparation (Rs. 5345.66 per ha) with 2 bottom reversible M.B. plough + rotavator with 1.5 m working width + 2 bottom ridger.

The cost effective combination of implements with 45 HP tractor required 14.09 hrs to prepare complete seed bed in 1 ha area. Whereas the 11.62 hrs are required for the cost effective combination of implements with 55 HP tractor (Table 5).

Conclusion:

A 45 HP tractor with combination of 2 bottom reversible M.B. Plough + Rotavator of 1.2 m working width + 2 bottom ridger was found cost effective. This combination of tractor and implements required 14.09 hrs to prepare complete seedbed.

A 55 HP tractor with combination of 2 bottom reversible M.B. Plough + rotavator of 1.5 m working width + 2 bottom ridger was found cost effective. This combination of tractor and implements required 11.62 hrs to prepare complete seedbed.

Authors' affiliations:
R.C. SALUNKHE, S.K. JADHAV AND S.S. PATIL, Department of Farm Machinery and Power, Padmashree Dr. D.Y. Patil College of Agricultural Engineering and Technology, Talsande Dist: KOLHAPUR (M.S.)INDIA

REFERENCES

Agricultural Research Data Book (2003), IASRI, New Delhi.

Mani and Panwar, J. S. (1992). Requirement of energy and power for different tillage implements at part load settings. *Indian J. agric. Engg.*, (3-4) : 94-99.

Tanihuhi, T., Makhanga, J.T., Ohtoma, K. and Kishimoto, T. (1999). Draft and soil manipulation by a mould board plough under different forward speeds and body attachments. *Transactions of the ASAE*, **42** (6) : 1517-1521.

***