Performance Evaluation of 4-WD Tractor at Various Gear rpm Combinations with Three Bottom M. B. Plough

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Abstract: *The power of the tractor needs to be utilized maximum with the use of suitable size of matching implements also the economical operational settings must be known to the operators to reduce the cost of operation and for the safe use of the tractors. Keeping these points in view the study was undertaken to evaluate the performance of three bottom mould board plough with four wheel drive tractor. The tractor were operated at an engine speed of 1750 and 2400 rpm in different gears giving a forward speed in the range of 3 to 5 km/h and the wheel slip in the range of 10 to 15 per cent. All the field tests were conducted as per the RNAM test codes. In A-III gear with 2400 rpm, A-III gear in 1750 rpm and B-I gear with 1750 rpm, the field capacity was found to be 0.384ha/h, 0.282 ha/h and 0.375 ha/h resp. whereas the fuel consumption was 8.1 lit/ha, 7.94 lit/ha and 6.02 lit/ha respectively. The gear B-I at 1750 rpm engine speed found to be work and fuel efficient setting.*

Keywords: *four wheel drive tractor, field capacity and fuel consumption.*

1. Introduction:

The bigger size tractors (50 hp and above) are becoming popular and day by day are available readily in the Indian market. The trend of the farmers is towards the selection of high power tractors and bigger size implements for the completion of the various farm operations in time. The two wheel drive tractors may not be fully utilized for its capacity due to the poor traction form the rubber tires also the fuel consumption per unit area coverage and increased tire wear may be the added advantages. The four wheel drive mechanism may be the solution for this. The selection of a matching implement according to the tractor size (hp) plays an important role in minimizing the expenditure on the field operations also he operational settings of the tractor are equally important. The selection of the improper operating settings of a tractor may cause overload, excessive tire slippage, increase in fuel consumption and unsatisfactory performance in general. The production and sale of high size (hp) and four wheel drive tractors has started in the country but the operators of such a tractors are not trained and not much aware of the correct operational settings giving the better performance.

The information related to the proper selection of gear and corresponding engine speed settings needs to be brought to the attention of tractor operators and manufacturing for the efficient and economical operation of the tractor implement system. By keeping these points in view the study was undertaken to evaluate the work and fuel efficient settings of three bottom mould board plough with 55 hp four wheel drive tractor.

2. Materials and Methods

The study was carried out in the field left after the harvesting of the paddy. Initially the three bottom MB plough was attached to the tractor and tested for overloading and increased slip in various gears at 1750 rpm and 2400 rpm keeping 9 inch depth of ploughing. Three gears rpm combinations viz. A-III gear in 2400 rpm, A-III gear in 1750 rpm and B-I gear in 1750 rpm were selected giving the speed of operation and wheel slip less in the recommended range.

The theoretical forward speed and slip at different gears-rpm combinations in given in Table 1.

Table 1: Theoretical forward speed and slip at different gears-rpm combinations

Sr. No.	Gear	Engine speed, rpm	Forward speed. Km/h	Wheel slip, %
1	A-III	2400	3.95	17
2	A-III	1750	3.5	15.30
3	B-I	1750	3.85	14.40

2. 1 Speed of travel

The speed of operation was measured in the field by fixing two poles in the test plot 30 m apart. Time required to cover 30 m distance was measured with the help of stopwatch and actual speed of operation in km/h was calculated from an average of 5 readings. The forward speed during the experiments was kept in recommended range.

2.2 Fuel consumption

It is the major of amount of fuel required for given tractor-implement system to cover one hectare field. Fuel consumed by the tractor during field operation was measured using an auxiliary fuel system. The fuel system consisted of auxiliary fuel M. S. tank that was fixed on the tractor. A supply pipe was connected in between fuel injectors and fuel tank. To find out the consumption of fuel, the auxiliary tank was filled up to full level before starting of operation and measured quantity of fuel was taken out in a separate jar to avoid spoilage of fuel during operation. After the operation, tractor was stopped and fuel taken out in jar was added to the auxiliary fuel tank and was filled to the previous level by adding fuel in measured quantity with the help of measuring cylinder. The additional fuel added to fill the fuel tank to the marked level was taken as fuel consumption. It was calculated as:

$$F = F \times A$$

Where, F = Fuel consumption, Lit/ha

A = Covered plot area, ha

2.3 Effective field capacity

It was defined as the actual area covered by the implement, based on its time consumed and its width. It was calculated as:

$$EFC = A/T_1$$

Where, A = actual area covered, ha

T_1 = total time covered, hr

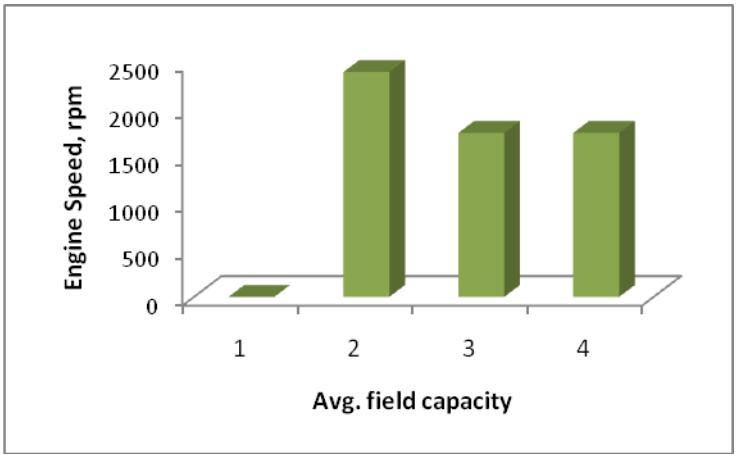
3. Results and Discussion

The cost of operation is related with the fuel consumption and effective field capacity of any tractor implement system among the other field testing parameters. In this section performance of tractor and MB plough for different gear –rpm combinations is discussed mainly on the basis of reduction in fuel consumption and increase in effective field capacity. The results and discussion are summarized in Table-2

3.1 Field Capacity at various gear-rpm combinations

Amongst the three gear-rpm settings for the three bottom MB plough, the average field capacity was found highest with A-III gear at 2400 rpm followed by with the gear B-I at 1750 rpm and with gear A-III at 1750 rpm. The field capacity with A-III gear at 2400 rpm was 2.4 per cent and 36.65 per cent more than with gear B-I at 1750 rpm and with gear A-III at 1750 rpm respectively. The different values of field capacity in different gear rpm settings are presented in Table 2.

The highest values of field capacity with A-III gear at 2400 rpm are due to the higher speed of operation achieved at higher engine speed.



3.2 Fuel consumption at various gear-rpm combinations

The average consumption of fuel with the time was found higher for A-III gear at 2400 rpm followed by with gear B-I at 1750 rpm and with gear A-III at 1750 rpm. The fuel consumption with A-III gear at 2400 rpm was

37.61 per cent and 39.46 per cent more than with gear B-I at 1750 rpm and with gear A-III at 1750 rpm respectively. The different values of fuel consumption in different gear-rpm settings are presented in Table-2. The higher values of fuel consumption with A-III gear at 2400 rpm was may be the higher speed of operation and increased wheel slip achieved at higher engine speed.

3.3 Selection work and fuel efficient gear-rpm combinations

The ploughing operation in gear A-III at 2400 rpm is advantages from stand point of more coverage of field per unit time whereas the gear A-III at 1750 rpm required the least amount of fuel per unit time. But the gear B-I at 1750 rpm showed the average field capacity found near to the gear A-III at 2400 rpm having highest field capacity and fuel consumption per unit time near to the gear A-III in 1750 rpm having least fuel consumption.

When the consumption of fuel per unit area ploughed is compared the gear B-I at 1750 rpm seems to be advantages than other gear-rpm combinations. The average fuel consumption per unit area ploughed was 24.08 per cent and 25.68 per cent less than found with gear A-III at 1750 rpm and gear A-III at 2400 rpm respectively.

Table 2: performance of tractor with plough

S.No	particulars	Repl-1	Repl-2	Repl-3	Repl-1	Repl-2	Repl-3	Repl-1	Repl-2	Repl-3
1	Gear used	A-III	A-III	A-III	B-I	B-I	B-I	A-III	A-III	A-III
2	Engine speed, rpm	2400	2400	2400	1750	1750	1750	1750	1750	1750
3	Depth of operation, inches	9	9	9	9	9	9	9	9	9
4	Total time, sec	1572	1569	1575	1365	1374	1381	1360	1350	1364
5	Total area covered, m^2	1650	1701	1680	1440	1438	1416	1040	1060	1090
6	Total fuel consumed, ml	3790	3750	3780	2390	2365	2426	2370	2315	2345
7	Field capacity, ha/hr	0.377	0.390	0.384	0.379	0.377	0.369	0.275	0.283	0.288
8	Fuel consumption, lit/ha	8.269	7.933	8.1	5.975	5.923	6.168	8.203	7.862	7.745
9	Fuel consumption, lit/hr	3.124	3.097	3.110	2.269	2.231	2.277	2.258	2.222	2.228

4. Conclusions

1. The tractor and plough combination when operated in A-III gear at 2400 rpm shows higher values of filed capacity (ha/hr) and fuel consumption (lit/hr) followed by with gear B-I at 1750 rpm and with gear A-III at 1750 rpm.
2. B-I gear at 1750 rpm has shown the least fuel consumption followed by A-III gear at 1750 rpm and A-III gear at 2400 rpm.
3. The gear B-I at 1750 rpm engine speed was observed to be a suitable combination with respect to higher field capacity and low fuel consumption.

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