Pakistan Journal of Applied Sciences 2(9): 889-891, 2002

Evaluation of Tractor Operated Potato Planter

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Abstract: The experiment was carried out to evaluate the performance of potato planter at Latif Experimental Farm, Sindh Agriculture University, and Tandojam during 2001. The potato planter was powered by Fiat-480 diesel tractor at low 3rd gear speed. The parameters were determined at moisture content of 15.73%, fuel consumption was 24.04 1/ha. The travel reduction was 5.04% field efficiency was 67.47%, field capacity was 0.80 ha/hr. The farmers are interested to plant more potato by using potato planter, because it covers more area in less time. It is labour saving machine.

Key words: Tractor Operated, Potato Planter, Field Efficiency, Field Capacity

Introduction

The mechanization of potato culture when draught animals were employed the potato received more cultivation, particularly after planting, than any other crop. Operations varied some what with the soil type but typically, in some English potato-growing areas, preliminary shallow cultivation immediately after the harvest of the preceding crop, probably grain, to uproot weeds, was followed by deep ploughing before winter to break up the ground.

The physical structure of the soil and its depth can have a considerable influence on root growth and hence on the growth of the plant. Roots penetrate soil by way of the pores between the particles up to a point, larger the pores the more readily do the roots proliferate. In a clay soil, with very small pores in the main bulk, root growth may be restricted to cracks between the clay crumbs. Potato roots normal have a mean diameter of about 1 mm and needs pores of these dimensions for their proliferation. Compacted soils, in which such pores are rare or absent, present an almost impenetrable mechanical barrier to root penetration. Dry conditions restrict root growth, but at the other extreme water-logging can result in the death of the root because of the associate anaerobic conditions which rapidly prove fatal.

The function of potato-planting machine is to place potatoes singly in furrows at predetermined regular intervals. In the simplest machine, where the potatoes are dropped into the furrow by hand, the spacing is dependent on the efficiency of the feeder, although there may be a mechanical device, worked off a land wheel to indicate when the potatoes should be dropped. Usually the spacing is done mechanically either by simple hand fed or by relatively more complicated, fully automatic devices; the commonest type of hand-fed mechanism is a services of cups on an endless belt driven from the land wheels. The cups carry the potatoes down a chute and release them near the furrow. The research was conducted to determine the field efficiency and the fuel consumption of potato planter.

Materials and Methods

The research study to evaluate the performance of potato planter was conducted at Latif Experimental Farm, Sindh Agriculture University and Tandojam during 2001. The performance parameters studies were the moisture content field efficiency, field capacity and fuel consumption. All the variable of machine performance were measured and recorded according to the recommendations of RNAM Test Codes and Procedure for Farm Machinery, Technical Series No. 12, 1983. The following instruments and machines were used in the study, Fiat-480 Tractor, Potato planter, Stopwatch, Ranging poles, Steel tape, Graduated cylinder, Half meter scale, Chalks and markers, Weight balance, Polythene bags, Jericane and Camera, Potato seed.

Machine: The machine used in the research study is four row potato planters. The machine was standard field machine, and was operated by Fiat-480 diesel tractor.

Speed of Operation: Outside the long boundary of the test plot. Two poles of 90m apart (A: B) were placed approximately in the middle of the test run. On the opposite side also two poles were placed in a similar position, 90m apart (C, D). So that all four poles form corners of a rectangle, parallel to at least one long side of the test plot. The speed was calculated from the time required for the machine to travel distance (90m) between the assumed line connecting two poles on opposite side AC and BD.The easily visible point of the machine was selected for measuring the time.

Working Width of Operation: Working width of the machine was measured by using a steel tape. The width was measured from the furrow wall to total area at randomly selected places for each test run.

Depth of Operation: The working depth was measured with half meter scale from the bottom of the furrow to surface level of soil randomly selected places for each test run was 0.148m.

Wheel Slip: A simple method of determining the

drive wheel with chalk and the distance moves forward was measured 10 revolutions under no load (A), and on the same surface with the same number of revolution with load (B) was measured. The travel reduction was calculated by using the formula.

$$\text{Wheel slip\%} = \frac{A-B}{A} \times 100$$

Where:

A=Distance traveled without load (m)
B=Distance traveled with load (m).

Fuel Consumption: The fuel tank of fiat-480 tractor was filled up to its top level before planting potato in the test plot of 1350m2. After planting the potato in the test plot the tractor engine was stopped and the fuel tank was refilled up to the same level with graduate cylinder quantity of diesel fuel needed to refill the tractor tank up to the same level was 3.3lit/1350m2, fuel consumption per hectare was calculated from the data obtained, and following formula was created.

$$\text{TF} = \frac{F \times 10000}{A}$$

Where:

TF=Total fuel consumed Lit/ha
F=Fuel consumed Lit
A= Area covered ha.

Field Capacity: The field capacity was measured for each plot the time lost at corners, and seed was also recorded. Field capacity of the machine was calculated in hectares per hours, by using the formula with reference (RNAM) test codes and procedures for farm machinery (1983).

$$S = \frac{A}{Tp + Ti}$$

Where:

S = Effective field capacity ha/hr.
A = Area covered ha and acre.
Tp = Productive time, min
Ti = Non production time sec.
(Time lost for turning and adjustment).

Effective Field Capacity: The parameters for determining, effective field capacity was actual speed of plowing, actual width of plowing and the efficient of the plowing operation. The actual speed of plowing for three patterns of plowing were measured and calculated from the field data of plowing trip.

Machine capacities are expressed and reported as theoretical field capacity and effective field capacities. Theoretical field capacity of any machine is the rate of field coverage which can be obtained of the machine were performing its intended function 100% of the available time at the rated speed and utilizing 100% of the rated width. Whereas the effective field capacity as distinguished from theoretical capacity is the actual rate of field coverage by the machine based upon total field time committed to machine for the intended operation.

Field Efficiency: Field efficiency gives an indication of the time lost in the field and the failure to utilize the full working width of the machine it is calculated by formula.

$$Ef = \frac{We \times Tp}{Wt(Tp + Ti)}$$

Where:

Ef = Field efficiency %
We = Effective working width (cm)
Wt = Theoretical working width (cm)
Tp = Productive time (min)
TI = Non productive time (sec).

Results and Discussions

The study is related to evaluate the field performance of potato planter. In order to determine the field capacity, field efficiency, travel reduction and fuel consumption were observed. The potato planter used for planting at average moisture contents of 15.73% (Table. 1).

Table 1: Moisture Content of Soil (Wet Weight Basis)

Observation	Ww (g)	Wd (g)	M (%)
1	242.46	212.23	12.47
2	165.63	151.26	8.68
3	171.26	139.09	18.79
4	165.71	140.36	15.29
5	185.00	165.41	10.59
6	156.56	126.50	19.07
7	159.56	129.31	18.95
8	181.32	161.41	10.99
Average	178.41	153.19	15.73

Table 2: Field Capacity of Potato Planter

Observation	Area (m2)	Productive Time (min) Tp	Non-productive Time (min) T1	Field Capacity ha/hr.
1	337.5	2.5	7.5	0.80
2	337.5	2.4	7.6	0.80
3	337.5	2.4	7.3	0.80
4	337.5	2.6	7.9	0.80
5	337.5	1.9	6.5	0.80
6	337.5	2.2	7.4	0.80
7	337.5	2.1	7.3	0.80
8	337.5	2.5	7.1	0.80
Average	337.5	2.3	7.2	0.80

Field Capacity: The field capacity of potato planter is the function of width of planting, speed and efficiency of potato planter. The data on field capacity of machine has also been presented in table 2. The minimum field capacity of 0.80 ha/hr was observed at operation speed of 6.04 km/hr. However, the average productive and non-productive was also calculated (Table. 2).

Travel Reduction: The travel reduction affects the traction efficiency of potato planter. Less the wheel slip more will be the efficiency of the potato planter. The data regarding the travel reduction of potato planter is given in Table3.

The travel reduction of potato planter on the field increased with increase in speed. The reason of more wheel slip was due to the faster revolutions of drive wheels of the tractors. The average travel reduction determined for low 3rd gear speed was 5.04 %.

Fuel Consumption: The fuel consumption of potato planter is the most important parameter. Less quantity of fuel consumption with higher out put is the potato planter, because it is directly related with the economics of the machine. The fuel consumed by potato planter at low 3rd gear speed was recorded. Field capacity 0.80 ha/hr and fuel consumption was 0.814 l/test plot (Table 4).

Table3: Travel Reduction of potato planter (speed 3rd low gear).

Obser-vation	Depth of operation (cm)	Distance covered by potato planter without load (A) (m)	with load (B) (m)	Travel reduction T.R. (%)
1	0.165	31.71	28.75	9.39
2	0.148	32.00	30.35	5.16
3	0.146	31.50	29.25	7.15
4	0.153	31.20	30.10	3.50
5	0.144	30.40	29.32	3.55
6	0.141	31.59	30.30	4.08
7	0.163	32.11	31.30	2.53
8	0.154	31.12	29.56	5.01
Average	0148	35.35	33.56	5.04

Table4: Fuel Consumption of potato planter. (Speed 3rd low gear).

Observation	Area of Test Plot (m2)	Fuel Consumption Litre/Test Plot	Fuel Consumption litre/ha
1	337.5	0.80	23.70
2	337.5	0.80	23.70
3	337.5	0.90	26.66
4	337.5	0.80	23.70
5	337.5	0.82	24.40
6	337.5	0.70	23.60
7	337.5	0.80	22.90
8	337.5	0.90	23.80
Average	337.5	0.84	24.06

Table 5: Field Efficiency

Obser-Vation	Effective Working width Operation Row to Row Distance We (cm)	Theoretical Working Width Distance Between Seed and Seed wt (cm)	Productive Time Tp (min)	Non-productive Time loss and Adjustment (tl) sec	Field Effici-ency%
1	78.00	30.0	10	30	65.00
2	77.50	28.0	10	30	69.19
3	78.10	29.5	10	30	66.18
4	77.95	27.5	10	30	70.86
5	77.81	29.7	10	30	65.49
6	77.39	28.4	10	30	68.12
7	78.15	30.1	10	30	64.90
8	78.50	27.8	10	30	70.59
Average	77.92	28.87	10	30	67.47

Field Efficiency: The field efficiency of potato planter at low 3rd gear speed was found 67.47 % (Table. 5). On the basis of the field trials of the potato planter the following conclusion are drawn. The performance parameter were determined at soil moisture level of 15.73 % the result of research study reveal that a 67.47 percent field efficiency was recorded with travel reduction of 5.04 % field capacity of 0.80 ha/hr and fuel consumption of 24.06 lit./ha. The findings shown that high capacity is possible with less consumption of time and cost: based on the performance result farmers are suggested to use this machine for better results. These results are supported by (Smith and Wilkes, 1977., Mari *et al.*, 1986., Hussain and Munir, 1986 and Bukhari *et al.*, 1988).

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