Plant Archives Vol. 24, No. 1, 2024 pp. 1043-1048 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2024.v24.no.1.143

COMPARATIVE STUDY OF SEED-CUM FERTILIZER DRILLS FOR WHEAT CROP

Indraveer Singh[1]*, Atul Kumar Shrivastava[1], Manish Patel[1] and Babban Yadav[2]

[1]Department of Farm Machinery and Power Engineering, College of Agricultural Engineering, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur - 482 004, M.P., India.

[2]Department of Farm Machinery and Power Engineering, Vaugh Institute of Agriculture Engineering & Technology, Sam Higginbottom University of Agriculture Technology & Sciences, Allahabad - 211 007 (U.P.), India.

*Corresponding author E-mail : indraveer128@gmail.com

(Date of Receiving- 15-12-2023; Date of Acceptance-10-03-2024)

ABSTRACT

Comparative performance of zero till seed drill and roto till seed drill for wheat crop was evaluated and also compared with traditional method. Parameters evaluated includes effect of speed of operation (km/h) and depth of sowing (cm) with respect to fuel consumption (l/h), wheel slippage (%), field capacity (ha/h), field efficiency (%), yield (tones/ha). The study leads to conclusion that speed of operation and ground drive wheel skid was positively correlated with fuel consumption in addition to depth of operation, speed of operation with slippage. Field test demonstrated thatthe working performance was more proper at the forward speed of 3.0 km/h with an average depth of sowing of 4.5 cm for zero till seed drill and forward speed of 3.5 km/hr and depth of 4.5 cm for conventional seed drill and roto till seed drill. In case of zero till drill the capacity at the forward speed was 0.4431 ha/h with a field efficiency of 81% and in case of roto till seed drill field capacity was found to be 0.3796 ha/h with a field efficiency of 77%. The average seed rate obtained in the field was observed as 124kg/ha, 154kg/ha and 117kg/ha for conventional seed drill, zero till seed drill and roto till seed drill, respectively.

Key words : Seedling depth, Seeding speed, Comparison of zero tiller, Rotary tiller, Conventional seeder performance.

Introduction

India is one of the major wheat producing and consuming country in the world. After the green revolution, the production of wheat has increased dramatically. The major states involved include Uttar Pradesh, Punjab and Haryana, accounting for around 70 percent of the total wheat production the country. Rice-wheat copping system is very common in India. It contributes to over 70 percent of total food grain production of the country, with an area of 12 million hectares under this cropping system. It is necessary that production of rice and wheat must keep pace with the growing population of our country. Delay sowing after mid-November, due to presence of crop residue reduced crop yield of 30-40 kg per ha per day (Singh *et al*., 1983). This loss can be saved through early and fast seeding of wheat using seed cum fertilizer drill compared to broadcasting method. Also the yield by conventional method is very much less than the potential. Considering the above points, feasibility testing of seed cum fertilizer drill was done at farmer's fields for three years (2009/2010/2011). The comparison was made between seed cum fertilizer drill and conventional method of sowing (broadcasting). Seed cum fertilizer drill not only conserves the time and energy, but also reduces the cost of cultivation, improves soil environment for better crop yield. Agriculture is the foundation on which the entire superstructure of the growth of industrial sector and other sector of the economy has to stand. Indian economy still displays explicit character typical of the most underdeveloped countries of the world (Payton *et al*., 1985). Crop cultivation requires application of both animate (bullock, human power) and inanimate (tractors, tillers etc.) forms of energy at Different stages. Nutrients are provided through farm yard manure (manually and animal operated) or through diesel/electric pump sets (to lift ground) after that fluted roller fluted roller for metering of seed and adjustable opening for fertilizer gave better results for placement of seed and fertilizer gave better results for placement of seed fertilizer (Dubey and Srivastava, 1985).

The main constraint with zero-till seed cum fertilizer drills, widely used for flat planting has been when farmer want to retain loose residues of the previous crop. Also the other difficulty was how to use zero-till drill for planting wheat and other crop in raised bed and furrow irrigation system. In order to meet these twin needs the national agricultural Research and extension system developed several versions of zero till seed-cum-fertilizer Drill and bed planter prototypes are being improved continuously by manufactures with Active involvement of the national scientists using the feedback from user farmers. As a Result of these efforts even add-on machine which serves both the purpose of a zero-till Drill which serves both the purpose of a zero-till drill and of a bed planter and which can seed most of the common crop is now available (Collins and Flower, 1996).

In the present research, an attempt has been made to develop a manual for zero-till-combed planter to provide the essential and relevant information on how to use and maintain these agricultural machines properly for obtaining the optimum performance (Asadi *et al*., 1998).

Barriers

- Uneven and low plant population in *rabi* crop due to broadcasting.
- Low grain yield of *rabi* crops.
- Lack of knowledge about tractor sowing equipment.

Materials and Methods

Primary data collection : Primary data collection was from laboratory experiment. The nine furrows tractor mounted seed cum fertilizer drill was tested in laboratory before taking to actual field condition. AKW-381 variety of wheat was selected for the study. The seed were passed through the grooves of the fluted roller to check the regularity of flow and damage. The line to line spacing of seed cum fertilizer drill was adjusted at 20 cm. The machine was calibrated for 100 kg/ha normal conditions. The calibration for fertilizer per hectare was also done.

Secondary data collection : Journals, publications, online sources and laboratory/library in university of Agricultural (UP). Field testing data and formulas has been used to collect secondary data.

Fig. 1 : Calibration of selected seed-cum fertilizer drills.

Fig. 2 : A view of sowing of wheat by eleven tyne zero till drill.

Zero-till seed-cum-fertilizer drill : With the significant increase in the adoption of zero-tillage and bed planting technologies in several areas of Indo-Gangetic plains, zero-till seed-cum-fertilizer drill has become a very useful and important agricultural machine for the farmers. It helps them to seed a crop directly into the cultivated field just after the harvest of the previous crop with the least disturbance of the soil. It eliminates or reduces time and energy intensive conventional tillage operations reducing the cultivation costs and risk of *Phalaris minor* in wheat apart from improving crop yields and farmers profits.

Zero-till seed-cum-fertilizer drill comes in many models and size. Basically all the new many models and sizes. Basically all the new models are improved versions of the Rabi seed drill. Used by the farmers for decades. The seed drilling is accomplished in a narrow slit created by a zero-till seed-cum-fertilizer drill (May *et al*., 1988).

Calibration of seed-drill : Seed-drill was calibrated by wheat sowing using the metering mechanism. The following steps were followed for calibration of seed-cum fertilizer drill

Determine the nominal width (W) of drill

$W = M \times S$

Where, M - Number of furrow openers, S - Spacing between the openers (m), W - Width (m)

Find the length of a strip (L) having nominal width W necessary to cover 1/25th of a hectare

$$L = \frac{10000}{W} \times \frac{1}{25} = \frac{400}{W}$$

Determine the number of revolutions (N) the ground wheel has to make to cover the length of strip (L).

$$N = \frac{400}{\pi \times D \times W}$$

Jack up the drill so that the ground wheel turns freely. Make a mark on the drive wheel and a corresponding mark at a convenient place on the body of the drill to help in counting the revolutions of the drive wheel. Put the selected seed and fertilizer in the respective in the hoppers. Place a sack or a container under each boot for seeds and fertilizers. Set the rate control adjustment for the seed and the fertilizer for maximum drilling. Mark this. Engage the clutch or on-off adjustment for the hoppers and rotate the drive wheel. Weigh the quantity of seed and fertilizer dropped from each opener and record on the data sheet. Calculate the seed and fertilizer dropped in kg/ha and record on the data sheet. Repeat the process by suitable adjusting the rate control till desired rate of seed and fertilizer drop is obtained

Field capacity : The effective field capacity, theoretical field capacity and field efficiency is calculated by recording the time consumed for actual work and the time lost for other miscellaneous activities such as turning , adjustments under field conditions.(Rizwan *et al*., 2017).

Theoretical field capacity : The rate of field coverage of the implement, based on 100 percent of time rated speed and covering 100 percent of its rated width.

Theoretical field capacity in hectare / h.

$$TFC = \frac{Width(m) \times speed\left(\frac{km}{hr}\right)}{10}$$

Actual field capacity : The actual area covered by the implement, based on its total time consumed and its width.Actual field capacity is calculated as follows:-

$$AFC = \frac{A}{(Te + Ta + Th)}$$

Where, AFC = Actual field capacity in (ha/hr)

A = Actual area covered (ha)

Te = Effective operating time per hectare

Ta = Time lost per hectare which is proportional to area e.g. turning time

Th = Time lost per hectare which is not proportional to area e.g. time for filling, emptying

Field efficiency : The ratio of the actual field capacity and theoretical field capacity expressed in percent.

$$\eta = \frac{AFC}{TFC} \times 100, \ \eta = \frac{1/TA}{1/TT} = \frac{TT}{TA} = \frac{Tt}{Te + Ta + Th}$$

Where, TFC = Theoretical field capacity (ha/hr),

AFC = Actual field capacity (ha/hr)

TA = Time taken per hectare,

TT = Theoretical (ideal) time taken per hectare

Wheel Slippage : To calculated the wheel slippage was operated at implement with load and without load condition. A mark on the rear wheel was put to count the number of revolutions. The distance travelled by the tractor in 10 revolutions of the tractor rear wheel was measured and slip was calculated as follows:

Wheel slip (%) = $((D_1 - D_2)/D) \times 100$

Where, D_1 = Distance travelled by the rear wheel for a given no. of revolutionsunder no load.

D_2 = Distance travelled by the rear wheel for a given no. of revolutionsunder load.

Moisture content of the soil : To determine the moisture content, soil sample were taken up to the full depth of core sampler *i.e.* 115 mm. the soil samples were kept in an oven for 24h at 105 degree centigrade. After this, the weight of the oven dried samples was taken and moisture content (d.b.) was calculated by using the following equation (Singh and Moses, 2022).

MC (%) = $((W_{1-} W_2)/W_2) \times 100$

Where, MC = Moisture content, per cent on dry basis,

W_1 = Weight of the wet sample, g

W_2 = Weight of the oven dried sample, g

Bulk density of soil : Bulk density of a soil sample is defined as mass per unit volume. Soil sample were collected randomly from each location of experimental plot with a core sampler. Weight of sample was measured by using electronic balance and approximately 100 g soil from sample was taken. Weighed and kept in an oven at constant temperature of 105 degree centigrade for 24 h and weight of the oven dried sample was taken. The bulk density of each sample was calculated by using the following relationship (Derpsch *et al*., 2010).

$$Bulk\ density = \frac{Dry\ weight\ of\ soil\ sample, g}{Volume\ of\ soil\ sample, cc}$$

Depth and width of operation : The depth of sowing is measured at different location with the help of scale and average was taken. Actual width of machine is measured with the tape.

Speed of operation : To calculate the speed of operation two poles 20m apart were placed approximately in the middle of the run. The speed is calculated from time required for the machine to travel distance of 20m.

Operating time for each operation : To determine operating time, time was noted at starting and ending point of sowing by using stop watch, so that actual time required for sowing by seed drill was computed in terms of h/ha. The time required for one turn of seed drill and time consumed for adjustments were also noted to compute time loss in operation (Altikat and Celk, 2012).

Fuel consumption : The fuel consumption has direct effect on economics of the machine. The fuel consumption was measured by top fill method. The fuel tank of the tractor was filled at its full capacity. The tractor along with seed drill was run in the test plot at constant speed. After completion of the test operation, the fuel was refilled in the tank up to the top level. The quantity of refilled fuel was measured by measuring cylinder. This observation was used for consumption in l h^{-1} and l ha^{-1}.

Operating cost : Operating cost includes fuel cost, lubricants, repairs, maintenance and other costs.

Fuel cost : Fuel cost was calculated on the basis of actual fuel consumption of the machine.

Repairs and maintenance : Cost of repairs and maintenance was taken as 5 per cent of the initial investment of the machine.

Results and Discussion

The experiments were conducted in the field as well as in the laboratory to evaluate the performance of the zero till seed drill.

Wheel slippage : Roto-Till seed drill the wheel slippage at 2.5 km/hr speed and 3.5 cm depth of sowing was found to be 1.29% (min.) and it was found to be 3.58% (max.) value at a speed of 3.5 km/hr having depth of 5.5 cm. Wheel slippage increased with increase in depth since resistance of soil increased due to more draft requirement of the machine.

Field capacity : The field capacity basically depends upon size, shape of field and method of operation. The effective field capacity of the machine at different

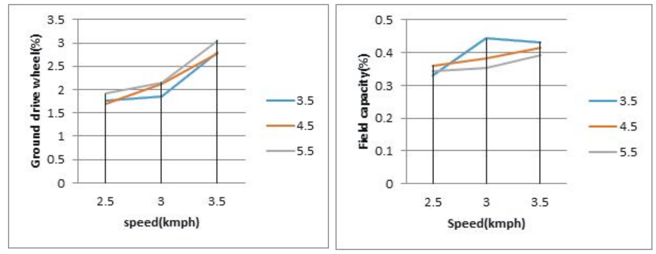

Fig. 3 : Effect of speed on ground drive wheel Skid and effect of speed on field capacity according to depth of operation for Roto till seed drill method.

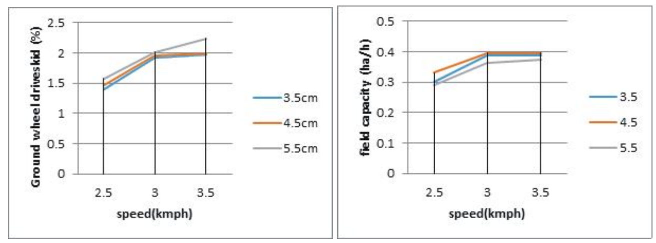

Fig. 4 : Effect of seed on Ground drive wheel skid and effect of seed on field capacity according to depth of operation of zero till drill.

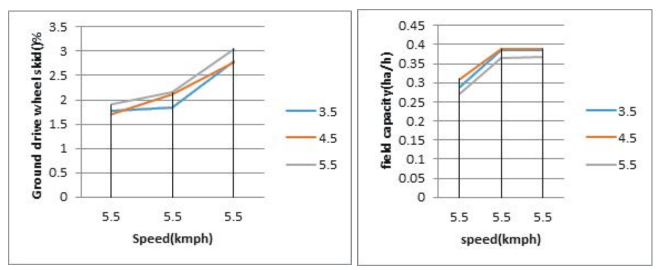

Fig. 5 : Effect of forward speed and depth of operation on ground drive wheel skid and field capacity for conventional seed drill.

operation speed and depth the roto-till seed drill it was found to be highest of 0.3897 ha/h at 3.5 km/h and lowest of 0.289 ha/h at 2.5km/h., when the speed was increased from 2.5km/h to 3.0 km/h the field capacity increased from 0.2899 ha/h to 0.3796 ha/hr and when the speed was increased from 3.0 km/h to 3.5km/h the field capacity increased from 0.3796 ha/h to 0.381ha/h.

Field efficiency : It can be noted that for Roto Till seed drill the maximum field efficiency was found to be 77% at a speed of 2.5 km/h at 3.5cm depth and minimum was 61% at speed of 3.0 km/h having depth of 4.5cm for the conventional seed drill maximum field efficiency was found to be 74% at a speed of 3.5 km/h at 5.5cm depth and minimum was 57% at a speed of 3.5 km/h. For all the operational depths field efficiency increased with increase in speed from 2.5 km/h to 3.0 km/h and was decreased when the speed was increased from 3.0km/h to 3.5 km/h. this trend was found to hold good for all the three operational depths *i.e.* 3.5cm, 4.5cm, 5.5cm as the depth increase field efficiency also increased thereafter

Table 1 : Effect of forward speed and depth of operation wheel slippage and field capacity for Roto till Seed drill.

S. no.	Depth (cm)	Speed (km/h)	Wheel Slippage (%)	Field capacity(ha/h)
1	3.5	2.5	1.77	0.33
2	3.5	3.0	1.85	0.4431
3	3.5	3.5	2.80	0.4312
4	4.5	2.5	1.70	0.361
5	4.5	3.0	2.12	0.3826
6	4.5	3.5	2.77	0.4158
7	5.5	2.5	1.91	0.342
8	5.5	3.0	2.15	0.3546
9	5.5	3.5	3.05	0.3906

Table 2 : Effect forward speed and depth of operation on ground drive wheel skid and field capacity for zero till seed drill.

S. no.	Speed (km/h)	Depth (cm)	Ground wheel drive skid(%)	Field capacity (ha/h)
1	2.5	3.5	1.4	0.301
2	3	3.5	1.92	0.3881
3	3.5	3.5	1.97	0.3876
4	2.5	4.5	1.47	0.332
5	3	4.5	1.95	0.3953
6	3.5	4.5	1.99	0.3962
7	2.5	5.5	1.58	0.2915
8	3	5.5	2.01	0.3649
9	3.5	5.5	2.24	0.3754

decreased because of variation in the effective field capacity. These findings are in close agreement with the result reported by Payton *et al*. (1985).

Fuel consumption : It was noted that for the conventional seed drill the minimum fuel consumption was recorded as 14.12 l/h at 2.5 km/h and 3.5cm depth and maximum was 17.25 l/h at 3.5 km/h and 5.5 cm depth. For Roto Till seed drill the minimum fuel consumption was recorded as 16.08 l/h at 3.5cm depth and maximum was 20.20 l/h at 3.5 km/h and 5.5cm depth. The fuel consumption was found to increase with increase in depth as well as speed. The increase in depth as well as speed caused increase in wheel slippage as well as draft which demanded more torque *i.e.* more power and more fuel was needed to burn to supply the increased demand for power (Rautaray, 2002).

Cost of operation : The cost of sowing wheat from Roto Till seed drill was found to be Rs 1032.19 per hectare and Conventional Seed drill was found to be Rs 819.21 per hectare. Conventional seed drill had lesser cost of

Table 3 : Effect of forward speed and depth of operation on ground drive wheel skid and field capacity for conventional seed drill.

S. no.	Speed (km/h)	Depth (cm)	Ground wheel drive skid(%)	Field capacity (ha/h)
1	2.5	3.5	1.92	0.289
2	3	3.5	2.02	0.3847
3	3.5	3.5	3.01	0.3861
4	2.5	4.5	2.02	0.310
5	3	4.5	2.4	0.3891
6	3.5	4.5	3.26	0.3897
7	2.5	5.5	2.08	0.2707
8	3	5.5	2.6	0.3650
9	3.5	5.5	3.58	0.3672

sowing because it had lesser fuel consumption due to lesser draft and its purchase cost was less than that of Roto Till seed drill by an amount of Rs. 10000. These findings are in close agreement with the result reportedfinal report of ICAR (1984-1988).

Sowing parameters of seed drills : The sowing parameters include seed rate, depth of sowing and seed to seed spacing were measured and noted to assess the performance of seed drills (Yadav *et al.*, 2002).

The recommended seed rate, average depth of sowing and average seed to seed spacing for zero till seed drill of wheat crop was 122 kg/ha, 3-5 cm and 5-10, respectively. The lowest seed rate obtained in the field for zero till seed drill for wheat crop was observed as 102.45 kg/ha with an average seed spacing of 9.8 cm.

The recommended seed rate, average depth of sowing and average seed to seed spacing for Roto till seed drill 120 kg /ha, 3.5-5.5 cm and 8.5 cm. The lowest seed rate obtained in the field for Roto till drill 100 kg/ha with an average seed spacing of 7.5cm.

Conclusion

The ground drive wheel skid at 2.5 km/hr and 3.5cm depth was to be found to be 1.4% and 1.92% (minimum) and it was found to be 2.24 and 3.58% (maximum) at 3.5 km/hr and 5.5cm depth of sowing in case of zero till drill and conventional method, respectively.

Field capacity was found to be highest of 0.3897 ha/h at 3.5km/h and 0.3585 ha/h at 3.5 speed in case of roto till seed drill and conventional method, respectively.

The field efficiency was found to maximum of 77% at 3.0km/h for Roto till seed drill and conventional method, respectively.

Field capacity increased with increase in forward speed thereafter it decreased, whereas it increase with increase in speed of operation. The ground drive wheel skid of tractor increase with increase in forward speed and the fuel consumption increased linearly with the increase in speed of operations and that overall cost of operation for Roto till drill was found to be less than that of conventional seed drill. The optimum operational depth and speed for both the machines were found to be 4.5cm and 3.0km/h, respectively.

References

Altikat, S. and Celk A. (2012). Effects of different no-till seeders and tractor forward speeds on the soil physical properties and seed emergence of summer vetch and winter wheat. *J. Agricult. Sci*., **1(8)**, 21-30.

Asadi, A., Hemmat A. and Taki O. (1998). The effect of different methods of tillage in wheat production on irrigated farming. *J. Res. Agricult.*, **332**, 77.

Collins, B.A. and Flower D.B. (1996). Effects of soil characteristics, seeding depth, operating speed and opener design on draft force during direct seeding. *Soil and till Res*.

Derpsch, R., Friedrich T., Kassam A. and Hongwen L. (2010). Current status of adoption of no-till farming in the world and some of its main benefits. *Int J Agric & BiolEng*., **3(1)**, 1-25.

Dubey, A.K. and Srivastava N.S.L. (1985). Development of furrow openers for animal drawn seed-cum-fertilizer drill for black soils. *Proc. ISAE Silver Jubilee conventional, CIAE, Bhopal*, **1(2)**, 11-44

May, D.J., Stobble E.H. and Iverson A.T. (1988). Education of three zero drills paper 88-206, CSAE, Ottawa, Ont.

Muhammad, R., Junaid N.C., Umer D.K. and Muhammad A. (2017). Effects of Different Tillage Implements on the Growth and Yield of Wheat in Cotton-Wheat Zone of Pakistan. *Pak. J. Life Soc. Sci.*, **15(1)**, 7-10.

Payton, D.M., Hyde G.M. and Simpson J.B. (1985). Equipment and methods for no-tillage wheat planting Trans. *ASAE*, **2(8)**, 1419-1424.

Singh, I. and Moses S.C. (2022). Effect of solar tracking on the drying behaviour of potato chips in box type of solar dryer. *Ecol., Environ. Conser*., **28(22)**, S393-S398.

Singh, S., Matzen R. and Pedersen T.T. (1983). The effect of type of seeding machines on seed emergence, Plant growth and yield of spring wheat and oats. *J. Agric. Eng*., **20(3)**, 1-8.

Yadav, A., Malik R.K., Bansal N.K., Gupta R.K., Singh S. and Hobbs P.R. (2002). Manual for using zero-till seed-cum-fertilizer drill and zero-till drill-cum-bed planter, Rice-Wheat Consortium Technical Bulletin Series 4, New Delhi-110 012, India: Rice-Wheat Consortium for the Indo-Gangetic Plains. pp 24.

Final report of ICAR advocating of No till drill and planting machine system (1984-1988). Department of farm power and machinery. Punjab Agriculture UniversityLudhiana. Submitted to ICAR.NewDelhi(1989).

Payton *et al*. (1985). D.M. Payton, G.M. Hyde, J.B. Simpson equipment and methods for no-tillage wheat planting. *Trans. ASAE*, **28**, 1419-1424.

Rautaray, S.K. (2002). Tractor mounted zero till seed cum fertilizer drill, published by coordinating cell-AlCRP on farm implements and Machinary and Natp mission mode project on ricce wheat mechanization cae, Bhopal.