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RESEARCH ARTICLE

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PERFORMANCE EVALUATION OF DHARTI SEED CUM FERTILIZER DRILL WHEAT PLANTER

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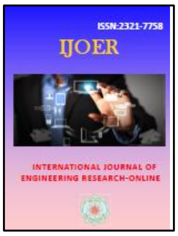

ABSTRACT

This study was undertaken to evaluate the performance of imported animal drawn row planter for wheat seeds at predetermined spacing and depths. Physical properties of seeds involved in the study were investigated to select metering roller and exposure scale number for desired seed rate. The evaluated row seeder have overall dimension of 1600 mm x 1000 mm x 1240 mm, height of hopper from ground level was 900 mm and total weight of the machine was 70 kg. Calibration of planter for wheat seeds and granular fertilizer (DAP) was carried out. The average seed rate under laboratory testing of evaluated row planter for wheat (Shorima variety) and fertilizer (DAP) were found to be 116.18 and 99.38 kg/ha respectively. The performances of row planter were evaluated in terms of seed rate of the seed, depth of planting, plant count/population, field capacity and field efficiency. Percent of visible mechanical seed damaged by the planter was found null. The mean speed of operation, field capacity and field efficiency were found to be 1.75 km/h, 0.15 ha/h (7.7 h/ha) and 82.08% respectively. Time to complete a hectare of land was 5.75 hr/ha. Based on the performance evaluation results, it was concluded that the desired opening exposure scale was identified 4 and 5 with metering roller number 5 and 3 respectively for wheat and fertilizer.

Keywords – Row planter, Seed rate, Animal drawn, Wheat, seed cum

1. Introduction

Agricultural work in Ethiopia is carried out by using manual, animal and mechanical power sources. Animal power contribution in the total power used in agriculture and draught animals are used for crop production and transportation purposes. Sixty nine per cent of farmers have less than or equal to 1 ha of land (CSA, 2012). Therefore tractor ownership is not economically viable for these farmers leaving draught animal power as the only source.

In Ethiopia wheat is the most important food crop and accordingly the crop is grown on 1.63 million hectare annually. The annual production was estimated to 3.43 million tons which is 17% of total cereal crops production. According to CSA (2014) the average national productivity is 2.01 tons per hectare which is one of the least productivity in the world compared to world average wheat productivity per hectare which is 4 tons (Jelle, 2009).

Under intensive cropping, timeliness of operations is one of the most important factors which can only be achieved if appropriate use of agricultural machines is advocated. Manual method of seed planting, results in low seed placement, low

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spacing efficiencies and serious back ache for the farmer which limits the size of field that can be seeding.

Wheat is one of the major staple food crops in many parts of Ethiopia covering about 11% of total land cultivated and production share of 17% of total cereals. However, land productivity is found to be among the lowest in the country from the world which is about 2.01 tons/ha (CSA, 2014). To increase this lowest productivity, among all others, good agronomic practices is the most important and to facilitate this practice row planting is the one major action to be taken by farmers. But even though farmers were convinced to practice row planting, absence of appropriate technology was the most bottlenecks for development. To overcome the problem considerable researchers and individuals were engaged to development and adaptation of wheat row planters.

With traditional and unverified methods of row planting, dramatic increase in yield and reduction of the quantity of seed required has been reported by farmers, DAs and experts. The research study done by (Tolesa *et al*, 2014) in highlands and lowlands of Arsi zone also reported that there is significant yield difference between row planted and broadcasted wheat farm (13.9%) in highlands but with low significant difference in lowland areas. But using the local material for row planting has encountered a number of problems like absence of accuracy, labor intensiveness and tediousness of the work.

2. Materials and Methods

2.1. Description of the study Area

Field test was carried out at Gedab Asassa (Huruba walkite) and Hetosa (Gonde fincama) woredas during the summer cropping season of 2017/18. The area is characterized by semi-humid climate with mid rainfall and potential for wheat production.

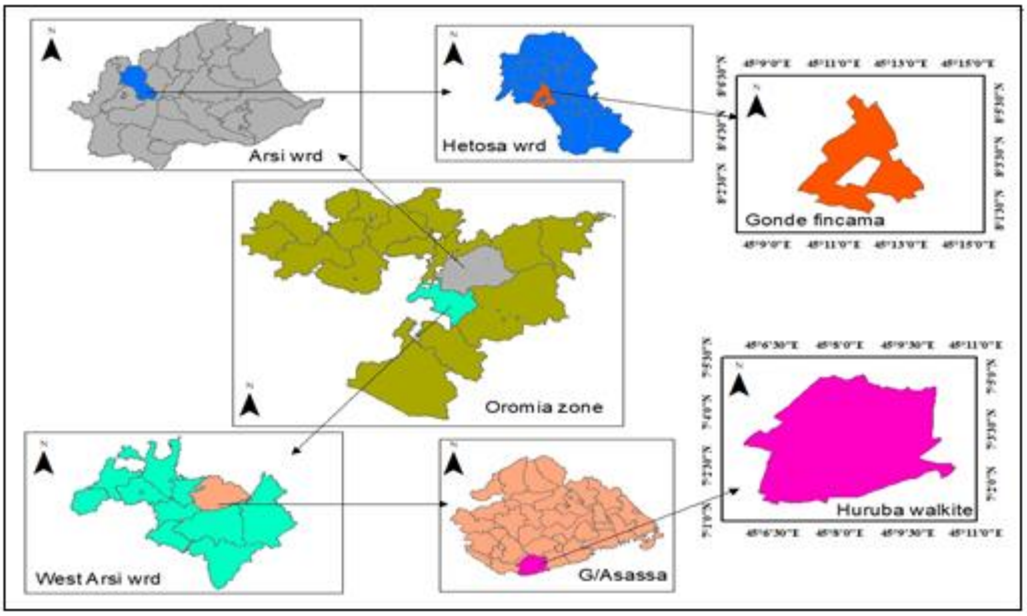

Figure 1. Study area map

2.2. Experimental Machine Details

The planter hopper capacity for seed was 9 kg and 11 kg for fertilizer. The experimental machine of seed cum fertilizer row crop planter is shown in figure 2 and the specification of planter is given in table 1 below.

Figure 2. Seed metering roller

Table 1. Specification of dharti seed cum fertilizer row planter

No	Part description	Theoretical details
1	Planter Metering mechanism	peripheral seed metering mechanism
2	Planter number of rows	Five
3	Row spacing	20 cm
4	Seed cum fertilizer box (L x B x h) cm	(42.5 x 19.5 x 28) cm
5	Power transmission system to planter	Ground wheel & chain, sprocket assembly
6	Width of furrow	4 cm
7	Depth of furrow	5-7 cm
8	Weight	70 kg

2.3. Experimental treatment and design

The randomized complete block design was adopted in experimental field with two treatments (Row planting (RP), Local row planting (LRP)) and control (Broadcasting (BC)) with six replications.

2.4. Physical Properties of Seed

The physical properties of seed are important factors for the design of seed drill machine. The performance of seed metering mechanism in terms of picking, metering and dropping was influenced by the physical properties of seeds. Therefore, seed properties relevant to select the seed metering roller size. Wheat varieties of Hidase, Shorima, Ogolcho seeds were selected for the study to determine the geometrical size of the seed based on their physical properties.

Thousand grain mass - The thousand grain mass (1000) were selected randomly and then weighed on the digital electronic weighting balance to obtain the thousand grain mass in gram.

Calibration of seed metering of wheat row planter - Calibration of the machine was conducted in the laboratory for metering the desired quantity of wheat seeds and fertilizer. It was calibrated in the laboratory for metering desired quantity of wheat seed and fertilizer. The following parameters were observed during a test.

Width of area covered by planter

$$W = N\,x\,D = 5\,x\,0.20 = 1m$$

Where: - D = Spacing between two furrow openers, D = 20 cm, N = Number of rows

Circumference of driving wheel

$$L = \pi\,x\,D_e = 3.14\ x\ 0.50 = 1.57m$$

Where *De* = effective diameter of seed metering ground wheel, *De* = 0.5 m

Area covered by seed metering ground wheel by one revolution

$$A = W\,x\,L = 1\ x\ 1.57 = 1.57m^2$$

Number of revolution of seed metering driving wheel for one hectare

$$R = \frac{10000}{A} = \frac{10000}{1.57} = 6369$$

Number of revolutions actually required to cover one hectare

$$M = R\,x\,0.9 = 6369\ x\ 0.9 = 5732$$

(Assuming 10% slippage during operations)

Seed rate (Q) to be sown per hectare

Wheat seeds delivered in 10 revolution (n=10) of metering ground wheel = 187 g = 0.187 kg

Seed rate (Q) to be sown per hectare.

$$Q = \frac{q\,x\,10000}{\pi\,x\,D_e\ x\ n\,x\,W} = \frac{0.187\,x\ 10000}{3.14\,x\,0.5\,x\,10\,x\,1} = \frac{1870}{15.7} = 119.11kg/ha$$

Effect of seed quantity in hopper on seed rate - Seed and fertilizer box was completely filled by seed and the seed rate was checked. The process was repeated by filling the hopper for 3/4, 1/2, 1/4 capacity and the corresponding seed rate were measured for comparison.

Mechanical seed damage by metering mechanism - During calibration, the seeds were collected from furrow putting a bag below the furrow openers and visually broken seeds were counted. The broken seeds were weighed and percentage of damaged seeds was determined.

2.5. Field Performance Test of the Drill Machine

In this section, the methods and procedure for measurement of various parameters associated with evaluation of the machine under field condition have been presented.

The test plot preparation of tillage operation was conducted with local plough and one pass of harrowing. After test plot preparation sowing was done with the five row animal drawn row planter.

The planter was operated with the draught animal at mean operating speed of 1.75 ± 0.1 km/h. The field performance was conducted in order to obtain actual data for overall machine performance, operating accuracy, work capacity and field efficiency.

Measurement of time - The five row animal drawn wheat row planter was operated length wise from one end to other. Time required to travel and turning at headland was recorded. The time loss in h/ha was also computed.

Operating speed - The speed of operation of planter was determined in test plots by putting two marks 40 m apart (A & B). The time was recorded with the help of stop watch to travel the distance of 40 m. The speed of operation was calculated in km/h as given below (Hunt, 1995).

$$S = \frac{D}{T}$$

Where, S = Speed of operation (km/h), D = Distance (m), T = time needed to cover 40 m distance (sec)

Width and depth of sowing - The depth of sowing was measured at different locations with the help of ruler scale by putting a tip of depth ruler scale in ploughed furrow and average was taken, the width of operation was calculated by dividing the total width of plot by the number of passes.

Theoretical field capacity - It is the rate of field coverage of the implement, based on hundred per cent of time at the rated speed and covering of hundred per cent of its rated width. It was determined as per the following formula given by (Hunt, 1995).

$$TFC\,(ha/h) = \frac{W\,x\,S}{10}$$

Where, TFC = Theoretical Field capacity (ha/h), W = Effective width of implement (m) and S = Speed of operation (km/h).

Actual field capacity - Actual field capacity was measured by taking an area of 40 x 20 m^2 i.e. 0.08 ha and measuring the time in actual field condition. It includes turning loss, filling time and obstacle down time also. There was continuously operated in the field for 0.08 ha to assess its actual coverage. The time required for complete operation was recorded and effective field capacity was calculated by (Hunt, 1995).

$$AFC\,(ha/h) = \frac{A}{T}$$

Where, AFC = Actual Field capacity (ha/h), A = Actual area covered (ha), T = Time required to cover the area (h)

Field efficiency - Field efficiency is the ratio of effective field capacity to theoretical field capacity. It was determined by the following formula given by (Hunt, 1995)

$$FE\,(\%) = \frac{AFC}{TFC}\,x100$$

Where, FE= Field efficiency (%), AFC=Actual field capacity (ha/h) and TFC=Theoretical field capacity (ha/h).

The data were recorded for all three planting methods of row planter, local row planting (hand metering method) and broad casting under actual field conditions and also compared. The yield data also was taken and compared.

Plant population - The average plant population was determined by count of the number of plants per square meter at six random places and the mean value was determined to represent the average plant population.

Distribution uniformity - Distribution uniformity indicates variation in delivery between openers. The coefficient of variation (CV) is a mathematical term used to describe distribution uniformity. The interpretation of coefficient of variation is as characterized by (Prairie Agricultural Machinery Institute, 1979)

$$CV = (stdev\ sample)\ x\ \frac{100}{Average\ sample}$$

Where: - CV- is Coefficient of Variation, Stdev - is standard deviation of sample data and Average sample - is arithmetic average of the sample data taken.

The interpretation of coefficient of variation is as characterized by PAMI (Prairie Agricultural Machinery Institute. It is Canadian Company working on machinery research) has accepted the following scale as its basis for rating distribution uniformity of seeding implements for wheat crop: CV greater than 15% -- unacceptable, CV between 10 and 15% -- acceptable, CV less than 10% -- very good and CV less than 5% -- excellent.

2.6. Statistical Analysis

Data were analyzed using GenStat 16th edition statistical software by least significant difference (LSD) at 5% level of significance.

3. Results and Discussion

This chapter deals with the results of experiments in order to full fill the objectives of the activity. The experiments were conducted for five row animal drawn wheat row planter at station as well as in the field. The performance of this machine was evaluated at selected sites of farmers, considering seed rate, effective field capacity and field efficiency.

3.1. Thousand grain mass of the seed

The thousand grain mass (TGM) of different wheat variety was found as ranges from 29.15 to 34.82 gm. The thousand grain weight is an important parameter which affects the seed rate, so it is very necessary to calculate the thousand grain weight for row sowing. The mean thousand grain weight of wheat was observed as 32.41g, which is a similar result was observed with (Navneet, 2016 and Solomon, 2017).

Table: 2. Average of Thousand Grain Mass

S/N	Wheat Variety	TGW, gm.
1	Shorima	29.15 ± 0.64
2	Hidase	34.82 ± 0.73
3	Ogolicho	32.25± 0.65

3.2. Calibration and Selection of metering roller

From pre assessment and looking to the observed values of seed size and cup size of metering roller, roller no.5 was selected for calibration of the row planter for wheat. Table 3 shows the calibration result of wheat seed with metering roller 5 and different metering exposure scale from 7 to 1. Data revealed that with metering roller no.5 and scale exposure of 4 gave nearest values of seed rate in the range of 113 - 118 kg/ha. Average value of 116.18 kg/ha was obtained which is closer to seed rate of 111.4 kg/ha obtained by (Tamrat *et al*, 2017) and similar seed rate of 115.68 kg/ha was obtained by (Dhruwe *et al*, 2018). Therefore, the calibrated seed rate of evaluated animal drawn wheat seeder was lies in the recommended range.

Table 3: Calibration seed rate (kg/ha) of planter for selection of metering roller for sowing of wheat seeds for different furrow openers

Scale exposure No	Seed rate kg/ha							
	Metering roller 5							
	F1	F2	F3	F4	F5	Mean	SD	CV
1	96.6	99.88	98.24	95.70	97.64	97.61	1.6	1.64
2	100.38	101.08	102.04	98.65	99.22	100.27	1.37	1.37
3	108.65	112	111.28	110.56	107.62	110.02	1.83	1.66
4	118.62	117.49	116.51	114.62	113.68	116.18	2.03	1.75
5	121.26	123.40	122.68	119.95	124.26	122.31	1.72	1.41
6	131.28	129.61	134.61	132.76	130.29	131.71	2.01	1.53
7	142.83	143.68	140.25	139.97	144.71	132.29	2.10	1.59

3.3. Effect of hopper filling capacity on seed rate

Table 4 indicates the seed rate of wheat for different exposure scale varied with the hopper filling (Full, 3/4th and half). It was observed that the entire sample collected for same exposure scale were nearly same and there was very little deviation among the sample i.e. (<2.0). The CV was also very less about in range of 0.96 - 1.71 on average.

Table 4:- Effect of hopper filling on seed rate (kg/ha) of wheat crop with different exposure scale at selected roller no. 5

Scale exposure no.	Seed rate kg/ha					
	full	3/4th	Half	Mean	SD	CV
7	99.74	98.91	102.20	100.28	1.71	1.71
6	102.30	101.39	99.90	101.20	1.21	1.19
5	106.88	107.89	108.99	107.92	1.06	0.98
4	114.79	115.25	113.05	114.36	1.16	1.01
3	122.68	121.95	124.26	122.96	1.18	0.96
2	134.61	132.76	131.98	133.12	1.35	1.01
1	140.25	139.97	142.71	140.98	1.51	1.07

The planting machine was calibrated in the laboratory for the desired seed rate by adjusting the exposed length of the opening. Wide ranges of quantity of seeds dropped through the opening exposure were collected during the calibration of the planter. The data presented in Table 4 shows that, the highest seed rate of 142.71 kg/ha was found with 1 opening exposure length and half-filled hopper whereas, the minimum seed rate 98.91 kg/ha was observed with 7 opening exposures scale and three-fourth hopper filled.

The optimum seed rate close to the mean of recommended seed rate was found 113.05 kg/ha (for line sowing) when the planter was half filled and opening exposure scale were 4. From Figure 3 it was also revealed that, for all the capacities of hopper, half, three fourth and full with 4 opening exposure scale of the seed rate was close to the mean value of recommended seed rate. The observed seed rates for 4 opening exposure scale were 114.79 kg/ha, 115.25 kg/ha and 113.05 kg/ha, for full, three fourth and half hopper capacity respectively.

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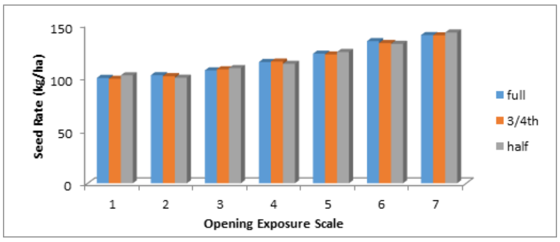

Figure 3: Effect of variation of opening exposure scale on seed rate of wheat

3.4. Mechanical damage to seed by metering mechanism

Visual observations for mechanical damage due to metering mechanism were recorded and it was found that there was no visual damage to the seeds of wheat.

3.5. Calibration and selection of metering unit for fertilizer

The planter was calibrated with 3 available fertilizer metering rollers and the optimum application rate (99.38 kg/ha) was found with roller number 3 at exposure scale 5. Table 5 indicates the observed fertilizer application rate of seeds among the rows (Furrow openers). It was observed that the entire samples collected for same exposure scale were nearly same and there was little deviation among the rows i.e. (0.29 - 1.44). The CV was about in the range of (0.27-1.31). (Exposure scale 5 is best suited for the recommended fertilizer application rate of DAP for wheat 100 kg/ha (EIAR, 2007)).

Table 5: Fertilizer application rate (kg/ha) for wheat crops for different furrow openers

Scale exposure No	Fertilizer rate (kg/ha)							
	Roller no. 3							
	F1	F2	F3	F4	F5	Mean	SD	CV
7	81.05	82	80.97	79.67	80.73	80.88	0.83	1.03
6	91.08	90.75	89.81	90.57	91.03	90.65	0.51	0.56
5	100.07	98.92	100.19	99.74	97.99	99.38	0.92	0.93
4	106.48	108.01	105.82	107.08	107.84	107.05	0.92	0.86
3	109.14	108.51	109.01	109.05	108.59	108.86	0.29	0.27
2	110.07	111.89	109.19	110.83	108.15	110.03	1.44	1.31
1	116.98	118.92	119.78	118.52	120.01	118.84	1.21	1.02

3.6. Effect of hopper filling on fertilization application rate

Table 6 indicates the fertilizer application rate of DAP for different exposure scale varied with the hopper filling (Full, 3/4th and half). It was observed that the entire sample collected for same exposure scale were nearly same and there was very little deviation among the sample i.e. (<2.0). The CV was also very less about in range of 0.50 - 1.29 on average.

Table 6: Effect of hopper filling on fertilization application rate (kg/ha) of DAP with different exposure scale at selected roller no. 5

Scale exposure no.	Fertilizer application rate kg/ha					
	full	3/4th	Half	Mean	SD	CV
7	84.74	86.91	86.20	85.95	1.11	1.29
6	96.30	97.39	96.90	96.86	0.55	0.57
5	102.88	103.89	103.19	103.32	0.52	0.50

The planting machine was calibrated in the laboratory for the desired fertilizer application rate by adjusting the exposed length of the opening. Wide ranges of quantity of fertilizer dropped through the opening exposure were collected during the calibration of the planter. The optimum fertilizer application rate close to the recommended rate was found 103.89 kg/ha (for line sowing) when the planter was three fourth filled and opening exposure scale were 5.

From Figure 4 it was also revealed that, for all the capacities of hopper, half, three fourth and full with 5 opening exposure scale of the fertilizer application rate was close to the recommended application rate of fertilizer. The observed fertilizer application rates for 5 opening exposure scale were 102.88 kg/ha, 103.89 kg/ha and 103.19 kg/ha, for full, three fourth and half hopper capacity respectively.

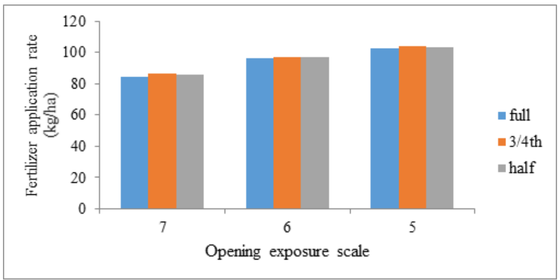

Figure 4: Effect of variation of opening exposure scale on application rate of fertilizer.

3.7. Field performance evaluation result

The planter was evaluated on field for its mechanical and functional performances in farmers' field area of 40 x 20 m^2 at Gonde fincama and Huruba walkite kebeles during rainy season. The soil texture was sandy loam and clay loam at Gonde fincama and Huruba walkite respectively. The sowing of crops in field was done with 20 cm row to row spacing.

3.7.1. Depth of seed placement

The average depth of seed placement achieved in the field was 4.73 cm. The depth of placement of seeds was adjusted by angle of supporting wheel of five row animal drawn row crop planters.

Table 7: Depth of seed placement

S/N	Depth of seed placement				
	F1	F2	F3	F4	F5
1	5.2	4.5	4.8	4.7	4.4
2	4.8	4.3	5.3	4.9	4.6
3	4.6	4.7	4.4	4.3	4.7
4	4.7	4.9	4.8	4.5	4.8
5	4.5	5.1	4.6	5.2	4.9
Mean value	4.76	4.7	4.78	4.72	4.68
SD	0.27	0.32	0.33	0.35	0.19
CV	5.67	6.81	6.90	7.42	4.06

3.7.2. Speed of operation

The speed of operation was found to vary from 1.71 to 1.77 km/h (Table 9).The average speed of operation of the planter for sowing of wheat seeds was found to be 1.75 km/h, for a distance of 40m. The planter takes 5.75 hr/ha to complete a hectare of land. Similar findings (5.88 hr/ha) was obtained by (Ayalew, 2017)

Table 8: Speed of operation

S. No.	Distance (m)	Time (s)	Speed (km/h)
1	40	81	1.77
2	40	82	1.75
3	40	84	1.71
4	40	82	1.75
5	40	83	1.73
6	40	81	1.77
Average			1.75

3.7.3. Field efficiency

The field capacity and field efficiency was calculated for planter using standard procedure described earlier and results are presented in Table 10. The theoretical field capacity was determined as 0.18 ha/h, whereas the actual field capacity of planter was found to be 0.15 ha/h. From the actual and theoretical field capacity the field efficiency of the light weight animal drawn multi crop planter was found to be 82.08%.

Table 9: Field efficiency of five row animal drawn row planters

Operating speed (km/h)	TFC (ha/h)	AFC (ha/h)	Field efficiency (%)
1.75	0.18	0.15	82.08

3.7.4. Germination count and distribution uniformity Analysis

The number of germination count per meter square at random places were counted and the mean value was determined to represent the average germination in all test sites figure 5.

Figure 5. Germination counting

3.7.4.1. Germination Count

The analysis of variance (ANOVA) revealed that the planting method had significant effect ($p < 0.05$) on germination count, as well as test site and the interaction of planting method and test site had significant effect ($p < 0.05$) on germination count. Table 10 show the effect of planting methods, test site and the combined effect of planting methods and test sites on mean percent of germination count. The highest germination count was recorded for BC (491) and the lowest was recorded for LRP (370).

Table 10 showing Effects of Test site and Planting methods on Germination Count (GC)

Parameter	Source of variation				Measure of differences	
	Test Site	Planting Methods				
		RP	LRP	BC	LSD (5%)	SE(M)
Germination Count	Site 1	458^{a}	370^{b}	491^{a}	112.4	35.7
	Site 2	424^{ab}	439^{a}	390^{b}		

Means followed by the same letter (or letters) do not have significant difference at 5% level of probability.

3.7.4.2. Distribution Uniformity

Distribution uniformity indicates variation in delivery between openers. The standard deviation and coefficient of variation for Dharti row planter was shown in table below.

Table 11 Coefficient of variation (CV) for six sites

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
StDEV	4.04	8.25	2.9	4.04	7.11	5.77
Sample mean	54.6	58.8	60.2	54.6	59	53.4
CV (%)	7.4	14.03	4.82	7.4	12.05	10.81

From the table above, the CV of dharti row planter according to PAMI (CV less than 15%) distribution uniformity of the planter is in the range of accepted uniformity.

3.7.5. Potential yield

The analysis of variance (ANOVA) revealed that the planting method had significant effect ($p < 0.05$) on potential yield, whereas test site and the interaction of planting method and test site had no significant effect ($p > 0.05$) on potential yield. Table 12, show the effect of planting methods, test site and the combined effect of planting methods and test sites on mean percent of potential yield. The highest potential yield was recorded for RP (79.1 qunt/ha) and the lowest was recorded for BC (67.5 qunt/ha).

Table12, Effects of Test site and Planting methods on Potential Yield (PY)

Parameter	Source of variation				Measure of differences	
	Test Site	Planting Methods				
		RP	LRP	BC	LSD (5%)	SE(M)
Potential Yield (qunt/ha)	Site 1	79.1[a]	74.1[b]	73.5[b]	9.34	2.96
	Site 2	77.1[a]	75.4[ab]	67.5[c]		

Means followed by the same letter (or letters) do not have significant difference at 5% level of probability.

3.8. Cost Analysis

The total cost of planting was obtained from all planter operation and labor cost for planting whereas in Local row planting and broadcasting, the total cost of operation is just related to labor cost. Annually coverage area was determined by multiplication of the effective field capacity and annual hours of operation. Table 13 shows that only operational cost of planting in wheat crop for one hectare. The lowest planting method cost was associated with Row Planter (162.50 Birr/ha). The planting cost of planter was reduced by 87.4 and 80.6 %, respectively as compared to Local row planting and broadcast methods. These studies showed that selection of a method for planting has significant role in the reduction of cost. The Local row planting method is not economical, because of costly planting, difficulty of performance and limitation of labour.

Table 13, Planting cost in different planting methods

Planting methods	Labour input (Man-h/ha)	Total operational cost(birr /ha)	Saving in cost of Planting (%)
Broadcast	67	837.50	80.6
Local Row Plant	69	862.50	87.4
Row Plant	13	162.50	-

4. Conclusion and Recommendation

As per concerned of the objectives of the present study and results obtained, the following conclusion and recommendation could be drawn.

The developed five row animal drawn multi crop planter worked satisfactory in actual field condition for planting of wheat seeds. Desired seed rate of wheat was obtained as 116.18 kg/ha with exposure scale 4 and roller no 5. Required fertilizer rate was obtained as 99.38 kg/ha with exposure scale 5 and roller no. 3. The speed of operation, actual field capacity and field efficiency were recorded as 1.75 km/h, 0.15ha/h and 82.08% for the evaluated seeder machine with five furrow openers at 20cm row spacing.

The dharti seed cum fertilizer of five row animal drawn row seeder suggested to redesigned and modified in order to reduce the weight of the planter and increasing comfort level of both operator and animal.

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