

Original Research Article

<https://doi.org/10.20546/ijcmas.2019.803.076>

Field Performance of Indigenous and Various Farm Implements at High Altitudes of Ladakh

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ABSTRACT

Keywords

Actual field capacity,
Indigenous plow,
Seedcum fertilizer drill, Seedrate and benefit cost ratio

Article Info

Accepted:
07 February 2019
Available Online:
10 March 2019

In Leh district farming is becoming very costly due to scarce population, high cost of labor and lack of well equipped farm machinery. Thus a study was conducted to check the field performance of various tractor operated equipments under Ladakh condition. It was found that indigenous plow has lowest actual field capacity of 0.021 ha/hr. In addition, a comparative study was conducted between traditional method of sowing and tractor operated seed cum fertilizer drill at HMAARI, Leh, SUAST (K). It was found that the traditional method of sowing has an average seed rate of 360 kg/hac which is double the seed rate (180 kg/hac) in case of seed cum fertilizer drill. However, there was non-significant difference in their yield and biomass between two methods of sowing despite significant difference in their seed rate. Also cost analysis between two methods of sowing reveals a benefit cost of ratio of 5.3 in case of seedrill and 2.4 in case of traditional method of sowing with indigenous plow. Thus, it is recommended to farmers of Ladakh region to adopt modern and well designed seeding equipment like seed cum fertilizer drill to achieve higher productivity and field capacity.

Introduction

The main crop of Ladakh is wheat and barley but yield has not achieved to its potential because the farmers of this region still using indigenous implements. In Ladakh the farmers are still using indigenous plow for sowing with *dzo* (the hybrid of yak and cow), yak and horse as draft animal (Fig. 1, 2 and 3). The traditional method of farm activities is robust and time consuming. Now a days,

keeping draft animal for only sowing purpose is costly affair as fodder is already a big constraint in this cold arid region. The region is still using traditional sickle (*zora*) for harvesting. Due to lack of man power and high labor cost (Rs 350/day) the harvesting goes very expensive. The region has only one cropping season from May – September due to cold desert condition. Therefore, farmers are not getting enough profit from agriculture especially in Leh district. The region is not so

familiar with scientific and mechanized method of seedbed preparation, seeding, leveling and harvesting equipments. As the region has varied soil type i.e. sandy, sandy loam, clay, clay loam etc. the type of implements to be used shall be different accordingly. Also there is need of more efficient farm equipment and system of handling materials in the field which have considerable potential for increasing field efficiency. The high field efficiency means less time consumed by an implement to perform its operation (Kepner, 1978).

Although, various researchers attempted to give an overview of previous work on animal drawn tillage tools and to identify the areas having most potential for future development. From the review, it can be concluded that previous developments in animal traction tillage implements relied on cultural, trial and human experience (Gebregziabher *et al.*, 2006). Field capacity of the bullock-drawn cotton ridger was 0.108 to 0.14 ha/h as compared to 0.031 to 0.0325 ha/h in case of *desi* plough and 0.012 to 0.0125 ha/h in *phowrah* (Mohanty *et al.*, 2009). On the other hand various works have been carried out on different tractor operated farm implements (Hettiaratchi, 1993; Perdok *et al.*, 1994). Despite field performance of seed drill cum fertilizer, Darmora *et al.*, (1995) developed a performance index for the furrow openers of combined seed and fertiliser drills on the basis of output, quality of work and energy input. In specific soil conditions present in Southern Portuguese agriculture, the effect of work rate, fuel consumption per hectare and distribution of dry soil aggregates were evaluated by reducing gang angle of a disc harrow and at higher forward speed (Serrano *et al.*, 2003). Such work on performance of indigenous and modern farm implements have not been carried out in high altitude of Ladakh region. Therefore an experiment has been carried out at HMAARI, Leh, SKUAST

(K) to evaluate the field performance of indigenous plow and various tractor operated farm implements. The study aimed to introduce and demonstrate the importance of modern tractor operated sowing, primary and secondary tillage implements for this region. After this study the improved technology shall be disseminated for the farmers of the region to reduce the human drudgery and to overcome the rising labor cost.

Materials and Methods

The experiment was conducted in cropping season of 2016 at High Mountain Arid Agriculture Research Institute, Leh, SKUAST-K. In this study, modern tractor operated farm implements at. i.e. nine tye cultivator, offset disc harrow, raised bed planter, MB plow, disc plow and seed cum fertilizer drill were evaluated to determine its field efficiency. Field efficiency of the implement is the ratio of actual field capacity and theoretical field capacity of the implement expressed¹. The Actual field capacity of the implement is the area covered in field operation per unit time (ha/hr). The theoretical field capacity of the implement was calculated from the forward operating speed and width or width of cut of the implement. The field operation of each farm implement was carried in an area of 500 m² and repeated for three consecutive years. On the other hand two sowing methods i.e tractor operated seed cum fertilizer drill and traditional method with indigenous plow were compared for yield, yield attributes, field capacity, seed rate, depth of sowing and benefit cost ratio. The experiment was conducted in an area of 250 m² each and repeated for three consecutive years.

Results and Discussion

The field efficiency of primary and secondary tillage implements. i.e. cultivator, disc harrow, MB plow and disc plow ranges (72-

74) % (Table 1), which is lower than desired ranges (75-90) % at plain areas (Anon 1963). This is due to the fact that agricultural land is not straight and consolidated. Most the fields are terraced and irregular which drastically reduces the efficiency of the farm implements. Though disc harrow has highest field efficiency of 74 %, the cultivator is generally use in this high altitude region of Ladakh.

Among sowing implements, indigenous plow has very lowest actual field capacity of 0.021 ha/hr. But, the field efficiency of ingenious plow is higher (65 %) than seed drill (57%) because unlike seed drill, conventional system of plowing performs seedbed preparation and sowing in one operation. Thus, it is recommended to farmers of this region to use disc harrow for secondary tillage operation (i.e. seedbed preparation) and disc plow for primary tillage operation as disc has good soil pulverizing capacity and high actual field capacity (0.109 ha/hr). But, disc plow and MB plow can be use for land development or secondary tillage operation if the soil is clayey or clay loam.

In an same area when sowing was carried out with indigenous plow with the help of two *dzo*, the seed rate was 377.7 kg/ha, which is double the seed rate of seed drill cum fertilizer (183 kg/ha).

The seed rate of seed drill is higher than recommended (100 kh/ha) because of 2-3 effective tiller in wheat and barley under cold desert condition of Ladakh (Sharma 2002). Also, in traditional method of sowing has wide range of depth of sowing (5.2-13 cm) compared to uniform depth of sowing of 5 cm in case of seed drill (Table 2).

Table 2 shows that the biomass and grain yield of barley (sindhu) were found 93.1 q/ha & 27 q/ha, respectively when sown by tractor

operated seed drill cum fertilizer. It was found that there is non significant difference of yield (28.7 q/ha) in traditional method of sowing because very high seed rate. On the other hand there is non significant difference of biomass (114 q/ha) in traditional method of sowing because of high depth of sowing.

The economics were also compared between indigenous method of sowing and tractor operated seed drill cum fertilizer. The benefit cost ratio was found to be 2.4 in case of traditional method and 5.3 in case of seed drill cum fertilizer (Table 3).

The cost of cultivation was taken as Rs 420/hr in seedbed preparation with cultivator and sowing with seed drill. And cost of cultivation was taken as Rs 800/day basis for two draft animal (*dzo*) and two labor in case of traditional method of sowing with indigenous plow.

Cost analysis was carried out on the basis of cost of cultivation between two method of sowing as input and on the basis of yield as output. Cost after sowing till harvesting was kept constant. Therefore, it is recommended to use modern and well equipped tractor operated seeddrill cum fertilizer for sowing of wheat/barley as it has high benefit cost ratio of 5.3.

In conclusion, after evaluating the performance of various tractor operated equipment, it is suggested to use disc plow as primary tillage and disc harrow as secondary tillage for seedbed preparation. Also it is recommended to use raised bed planter to increase water use efficiency through cultivation of different combination of crop like potato and other tuber crop. The low yield and biomass in case of traditional method is due to high depth of sowing (5-13 cm).

Table.1 Field Performance of various farms implements used in cold arid region of Ladakh

Farm implements		Width/width of cut implement (cm)	Forward speed (km/hr)	Theoretical field capacity (ha/hr)	Actual field capacity (ha/hr)				Field efficiency (%)
					1 st year	2 nd year	3 rd year	Average	
Sowing implements	Seeddrill cum fertilizer	150	5	0.75	0.44	0.42	0.43	0.430	57
	Raisedbed planter	240	5	1.2	0.695	0.705	0.69	0.697	58
Primary and secondary tillage implements	Cultivator	178	6.5	1.157	0.830	0.820	0.850	0.833	72
	Disc harrow	123	6.5	0.800	0.590	0.610	0.580	0.593	74
	MB plow	20	4.5	0.090	0.067	0.066	0.065	0.066	73
	Disc plow	33	4.5	0.149	0.110	0.098	0.120	0.109	74
Indigenous plow		11	3	0.033	0.021	0.023	0.02	0.021	65

Table.2 Comparison of indigenous and tractor operated seed cum fertilizer drill on biomass and yield of barley (Sindhu)

Method of sowing	Depth of sowing				Seed rate (kg/ha)				Biomass (q/ha)				Yield (q/ha)			
	1 st year	2 nd year	3 rd year	Avg	1 st year	2 nd year	3 rd year	Avg	1 st year	2 nd year	3 rd year	Avg	1 st year	2 nd year	3 rd year	Avg
Indigenous method	5-13	5.5-12	5-14	5.2-13	380	378	375	377.7	114.6	113.8	113.6	114.0	28.6	28.9	28.6	28.7
Tractor operated seeddrill cum fertilizer	5	5	5	5	180	185	184	183	92.6	93.5	93.3	93.1	26.9	27.1	27.0	27.0

Table.3 Cost analysis for two methods of sowing on one hectare basis

Method of sowing	Inputs (Rs)				Outputs (Rs)				Net profit (Rs)				Benefit cost ratio			
	1 st year	2 nd year	3 rd year	Avg	1 st year	2 nd year	3 rd year	Avg	1 st year	2 nd year	3 rd year	Avg	1 st year	2 nd year	3 rd year	Avg
Indigenous method	6578.3	6664	6500	6580.8	22848	22610	22900	22786.0	16269.7	15946	16400	16205.2	2.4	2.4	2.5	2.4
Tractor operated seeddrill cum fertilizer	3381.9	3446.2	3350	3392.7	21515.2	21658	21100	21424.4	18133.3	18211.7	17750	18031.7	5.3	5.3	5.3	5.3

Fig.1 Traditional method of sowing with *dzo* as draft animal in high altitudes of Ladakh



Fig.2 The indigenous plow of Ladakh



Fig.3 The share of indigenous plow used in Ladakh



Despite more labors involved in indigenous method of sowing, it has very low actual field capacity than sown with seed drill cum fertilizer, where only one labour is required. When sowing was carried out with indigenous plow with the help of two *dzo*, it was found that the seed rate was 377.7 kg/ha, which is double the seed rate of seed drill cum fertilizer (183 kg/ha). So, it is suggested to farmers of this region to adopt modern and well equip seeding like seed cum fertilizer drill for higher productivity and hence to achieve high benefit cost ratio.

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How to cite this article:

Deldan Namgial, O.C. Sharma and Dorji Namgyal. 2019. Field Performance of Indigenous and Various Farm Implements at High Altitudes of Ladakh. *Int.J.Curr.Microbiol.App.Sci*. 8(03): 621-626. doi: <https://doi.org/10.20546/ijcmas.2019.803.076>