Semi-Mechanized Harvesting Solutions for Cultivated Fodder Crops

Chandra Shekhar Sahay
Indian Grassland and Fodder Research Institute, India

P. K. Pathak
Indian Grassland and Fodder Research Institute, India

B. Narsimlu
Indian Grassland and Fodder Research Institute, India

C. R. Mehta
Central Institute of Agricultural Engineering, India

The 23rd International Grassland Congress (Sustainable use of Grassland Resources for Forage Production, Biodiversity and Environmental Protection) took place in New Delhi, India from November 20 through November 24, 2015.

Proceedings Editors: M. M. Roy, D. R. Malaviya, V. K. Yadav, Tejveer Singh, R. P. Sah, D. Vijay, and A. Radhakrishna

Published by Range Management Society of India

Paper ID: 1327
Theme: 2. Grassland production and utilization
Sub-theme: 2.6. Interdependence of grassland and arable lands for sustainable cereal, forage and livestock production

Semi-mechanized harvesting solutions for cultivated fodder crops

Chandra Shekhar Sahay[1*], P.K. Pathak[1], B. Narsimlu[1], C.R. Mehta[2]
[1*]IGFRI, Indian Grassland and Fodder Research Institute, Jhansi, India
[2]ICAR Central Institute of Agricultural Engineering, Bhopal, India
[*]Corresponding author e-mail: sahaycs@yahoo.com

Keywords: Fodder, Harvester self-propelled, Mechanization

Introduction

In case of harvesting and threshing, the level of mechanization in India is 60-70 per cent for wheat and rice and less than five per cent for other crops (Mehta *et al.*, 2014) that include fodder also. Herrmann *et al*.(2011) established that overall area capacities of machine decreased the by 4-24 per cent on taking finer chopping length of 4-6 mm compared to common chopping length of 8-10 mm in the ensiling chain of maize - establishing that finer work in ensiling commands less capacities and higher input costs. Since there is a strong correlation between effective field capacity and both crop yield and field area (Amiama *et al.*, 2008), it is advisable to go for appropriate machine for fodder harvesting depending on the requirement of crop and field. Semi-automatic machines provide comparatively low cost workable solution in such conditions. In semi-mechanized harvesting of fodder, cutting of crop is done by machine and subsequent operations of collection, gathering, feeding to chaffing machines and feeding to animals are done manually. Such machines are discussed here.

Materials and Methods

Two semi-automatic machines taken in this study were i) Tractor operated cutter bar harvester and ii) Engine operated riding type cutter bar harvester. Tractor operated fodder harvester used a reciprocating cutter bar that harvested and left the crop in the field without making rows. Gathering of harvested crop and collection were done manually after harvesting with this machine. Engine operated riding type fodder harvester consisted of a reciprocating cutter bar fitted on the body of moving vehicle operated by an engine while maintaining forward motion on three wheels. This machine harvested crop and left it in a row. Collection of harvested crop was easier in this case.

Tractor operated fodder harvester was operated at 2.2 and 3.3 km/h forward speed and engine operated harvester was operated at 2.5 and 7.0 km/h. Field capacity, harvesting efficiency and fuel consumption were measured and economics of operation was analyzed. All the harvesting was done for cultivated fodder only.

Results and Discussion

Table 1 and Table 2 show parameter of operation with tractor operated fodder harvester and engine operated riding type fodder harvester, respectively.

Table 1: Parameters of operation with tractor operated fodder harvester

Attribute	**Fodder Crop**			
	Berseem	**Natural grass**	**Guinea in horti-pasture system**	**Sorghum**
Height of cut, mm	102±18	143±40	167±22	225±38
Field capacity, ha/h	0.63	0.63	0.42	0.63
Field efficiency, per cent	60-64	52-60	50-58	56-60
Ability to cope up with bunds/trenches of height, mm	150	150-200	150-200	150
Fuel consumption, l/h	2.8	2.9	3.1	2.8
Harvesting efficiency, per cent	94.2-98.1	88.6-95.3	86.4-92.8	96.0-100.0
Green fodder yield, q/ha	184.2-222.6 (2^{nd} harvest)	236.3-278.5 (1^{st} harvest)	230.4-267.5 (1^{st} harvest)	386.4-471.2 (One harvest)

Table 2: Parameters of operation with engine operated riding type fodder harvester

Attribute	Fodder crop		
	Berseem	**Natural grass**	**Green multi-cut oats**
Height of cut, mm	67±32	112±37	67±31
Field capacity, ha/h	0.84	0.3	0.84
Field efficiency, per cent	62-70	60-67	64-70
Ability to cope up with bunds of height, mm	100±50	100±50	100±50
Fuel consumption, l/h	1.0	1.1	1.0
Harvesting efficiency, per cent	94.1-98.6	82.3-93.4	91.1-97.5
Green fodder yield, q/ha	186.4-208.6 (2^{nd} harvest)	238.2-240.4 (1^{st} harvest)	242.1-286.7 (1^{st} harvest)

Field capacity: In case of berseem harvesting with tractor operated fodder harvester, plain and cultivated field allowed the machine to operate in low 2^{nd} gear up to the forward speed of 3.3 km/h however, in staggered trenched and silvi-pasture system, operation was possible only in low 1^{st} gear of tractor providing the forward speed of 2.2 km/h. The field capacity of this machine was 0.42 to 0.63 ha/h in harvesting berseem. However, in staggered trenches and natural grass fields, it was in the range of 0.21 to 0.38 ha/h. With engine operated riding type fodder harvester, the actual field capacity was up to 0.54 ha/h in harvesting green and succulent crop like berseem and oat. However, in case of grasses, the field capacity obtained was less up to 0.18 ha/h.

Fodder yield: The fodder yield with tractor operated cutter bar varied from 184.2 to 471.2 q/ha in different crops. In case of harvesting with riding type reaper, fodder yield was 186.4 to 286.7 q/ha for different types of crops. There was no significant difference of yield when compared to the same with manual harvesting. There was insignificant loss of fodder on account of crushing etc. due to operation of machinery in the field.

Harvesting efficiency: Harvesting efficiency of tractor operated cutter bar in the field having staggered trenched was 86.4 to 92.8 per cent. In berseem, harvesting efficiency was 94.2 to 98.1 percent. However, in sorghum it was 96.0 to 100.0 per cent due to smooth operation of cutter bar.

Engine operated riding type reaper had harvesting efficiency of 94.1 to 98.6 per cent in berseem field. In case of multi-cut green oats also, this machine had harvesting efficiency of 91.1 to 97.5 per cent. However, in case of natural grasses in plain fields, the harvesting efficiency was less in the range of 82.3 to 93.4 per cent.

Height of cut: Tractor operated cutter bar type fodder harvester harvested the crop up to 5 cm height from the ground in level field. Engine operated riding type fodder harvester was able to harvest crop at 5, 7,9, and 11 cm height from the ground level. Berseem and oats were harvested at a height of 5 cm above ground level while grasses were harvested at 11 cm above ground level.

Fuel consumption: Fuel consumption of tractor with cutter bar type fodder harvester varied in the range of 2.8 to 3.1 l/h. Less fuel consumption was in the fields where smooth operation of machine was there. More fuel consumption was due to frequent breaking and accelerating of engine to meet trenches, bushes, impediments etc. In case of engine operated riding type fodder harvester fuel consumption was in the range of 1.0 to 1.1 l/h.

Cost of operation: Cost of harvesting one hectare fodder using tractor operated fodder harvester was Rs.3571. whereas, it was Rs.2510 with engine operated riding type fodder harvester. The profit with tractor operated fodder harvester was Rs.1629 per hectare and in case of engine operated riding type fodder harvester it was Rs.2690 per hectare; as compared to manual harvesting.

Conclusion

Tractor operated fodder harvester was suitable for harvesting both small (<1m height) and tall (>1m height) fodder crops whereas engine operated riding type fodder harvester was useful for small height fodder crops only. Effective field capacity was 0.38 ha/h with tractor driven machine and 0.52 ha/h with engine operated machine for harvesting berseem. This semi-mechanized approach of harvesting also reduced the dependability on scarcely available human labour.

References

Amiama, C., J. Bueno and C. J. Alvarez. 2008. Influence of physical parameters of fields and of crop yield on the effective field capacity of a self propelled forage harvester. *Biosystems Engineering*. 100: 198-205.

Herrmann, C., A.Prochnow and M. Heiermann. 2011. Influence of chopping length on capacities, labour time requirement and costs in the harvest and ensiling chain of maize. *Biosystems Engineering*. 110: 310-320.

Mehta, C. R., N. S. Chandel, T. Senthilkumar and K. K. Singh. 2014. *Trends of Agricultural Mechanization in India. Policy brief*. United Nations Economic and Social Commission for Asia and the Pacific (UNEESCAP) centre for Sustainable Agricultural Mechanization (CSAM). Chaoyang. China. www.un-csam.org.