

Approximation of work stress of ploughing and planking on carting load scale in working bullocks

M R GADARIYA¹, A M PATEL² and A J DHAMI³

Gujarat Agricultural University, Anand, Gujarat 388 001 India

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Most of the past studies on draftability of bullocks involved either carting (Upadhyay and Madan 1985, Agarwal and Agarwal 1992) or agricultural operations (Bhosrekar and Mangurkar 1988, Gattewar *et al.* 1989). There are probably no reports wherein bullocks were subjected and compared for both carting as well as various agricultural operations at a time in a single study. Therefore, a composite study involving different carting loads and ploughing and planking operations was undertaken to estimate the work stress of ploughing and planking on carting load scale in working bullocks. The pull exerted, horse-power generated, increase in physiological responses after onset of work stress as reflected by initiation and intensification of salivation and changes in certain blood constituents were considered for comparison of work stress to the bullocks due to various types of work.

A total of 192 carting trials and 48 trials each of ploughing and planking were conducted using 12 (6 Kankrej and 6 Jersey×Kankrej) bullocks. The bullocks were subjected to carting loads: total cart-load (pay-load) equivalent to 150 (340 kg), 200 (620 kg), 250 (900 kg) and 300 (1180 kg) per cent of body weight of individual bullock for 3 hours in each session. The carting trials were carried out on kutchra farm road using modified single animal pneumatic-tyred cart having a telescopic arrangement to fit strain-gauge type dynamometer to record pull exerted by the bullock while carting.

The bullocks under study were also subjected to three hours of ploughing in sandy-loam soil at 'vapsa' condition

followed by 11;2 hours of double planking in both the sessions. The pull values while ploughing were recorded on the dynamometer fit on modified plough having a telescopic arrangement and load cell was also attached to 6 feet long wooden plank for the purpose. The speed of travel by the bullocks was recorded as km per hour to arrive at hp production by the bullocks during different works.

Respiration rates (RR/min) of bullocks were measured 5-10 min prior to work, as initial and then after at the end of 1st, 2nd and 3rd hour (± 10 min) of continuous carting. Stress symptoms of the bullock viz., salivation, frothing etc were recorded at every 10-15 min interval during carting and ploughing trials to compare degree of stress to the bullocks subjected to different types of work.

To study the changes in certain blood constituents due to work stress in bullocks, haemoglobin (Hb), blood glucose, plasma creatinine and blood lactic acid were estimated 10 to 15 min prior to work and after 3 hours of continuous work of carting and ploughing by employing the standard procedure.

The work production traits, changes in respiration rate, the time taken (min) after onset of work for first appearance and full mouth frothing and changes in certain blood constituents following different type of work have been given in Table 1.

The pull exerted by the bullock (single) at cart loads L1, L2, L3 and L4 (pay-load 320, 620, 900 and 1180 kg) and ploughing and planking operations averaged 23.56, 36.64, 47.08, 56.72, 44.47 and 21.72 kg, respectively. For corresponding work, the hp output was 0.35, 0.53, 0.67, 0.80, 0.54 and 0.26. The findings on hp values indicated that ploughing could approximately be equated to total carting load L2 i.e. 200% of body weight of the bullock (pay load, 620 kg), while planking was lighter work than total carting load L1 i.e. 150% of body weight of the bullock (pay load being, 320 kg).

Comparison of values of work production traits on a line chart revealed that ploughing was equivalent to total carting

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Present address: ¹Assitant Research Scientist, Cattle Breeding Farm, Junagadh Agricultural University, Junagadh 362 001, Gujarat.

²Professor and Head, Department of Livestock Production,

³Research Scientist and Head, Livestock Research Station, College of Veterinary Science and Animal Husbandry, Anand 388 001. Gujarat.

Table 1. Work production traits, the time taken after onset of work for appearance of distress symptoms (salivation), and changes in respiration rate and blood constituents of the working bullocks subjected to different work

Details of Carting loads and agricultural operations	Work production traits			Respiration rate/min of work, for			Minutes post-onset		% Change after 3 hour over initial level in blood constituents			
	Pull (kg)	Speed (km/hr)	hp	Total rise over initial	Change in first hour	Change in 2nd hr	First appearance of salivation	Full-mouth frothing	Glucose	Lactic acid	Plasma creatinine	Hb
Total cart load % bullock's body weight (pay load kg)												
L1-150% (320)	23.56	4.13	0.35	23.79	15.20	4.34	51.67	150.00	-3.59	11.28	5.71	0.53
L2-200% (620)	36.64	3.96	0.53	23.96	17.90	6.39	39.55	146.25	-3.88	33.29	4.50	0.17
L3-250% (900)	47.08	3.95	0.67	20.98	13.56	7.67	35.45	71.25	-13.94	38.55	12.05	1.76
L4-300% (1180)	56.72	3.91	0.80	19.58	12.81	8.90	25.00	56.25	-19.76	58.91	18.85	2.91
Ploughing	44.77	3.64	0.54	23.71	15.83	7.46	45.00	105.00	-9.96	37.00	7.27	1.23
Planking	21.72	3.51	0.26	20.95	10.79	6.83						
Approximation of work stress on total cart load basis, i.e. % bullocks weight at												
Ploughing	220.0	210.0	187.5	240.0	187.5	242.5	227.5	215.0	205.0	229.0		
Planking	130.0	—	117.5									

load 210% (on pull exerted basis) to 220% (on hp output basis) body weight of the bullock, whereas planking leveled at total carting load 117.5 to 130% body weight of the bullock.

The speed of walking while ploughing (3.64 kmph) at 'vapsa' condition of sandy-loam soil and planking (3.51 kmph) were in-between carting load L1 (4.13) and L2-L4 (3.91-3.96 kmph), and hence indicated the stress level of the agricultural operations in-between total cart load 150 and 200% body weight of the bullock.

With regards to physiological response, the total increase in respiration rate (RR) during 3 hours of work did not reveal any definite trend in magnitude of work stress for different types of work considered in the present study (Table 1). However, when increase in RR during first hour of work was considered, the ploughing (+15.83) operation could be positioned between L1 (+15.20) and L2 (+17.90) and the planking operation (+10.79) as lighter than L1. The increase in RR during second hour of work indicated the ploughing (+7.46) operation to be between L2 and L3. The study of changes in these responses of the bullocks at different work indicated that ploughing was equivalent to total carting load 187.5 to 240 % of body weight of the bullock, on increase in RR during first hour and second hour basis.

The time after onset of work for first appearance of salivation while ploughing (45.00 min) was intermediate between those for cart-loads L2 (51.67 min) and L3 (39.55 min), whereas for excessive/ full mouth frothing (105.00 min), the time taken was in-between L2 (146.25 min) and L3 (71.25 min) [Table 1]. Comparison of the same on a line chart indicated that the ploughing, on work stress wise, could be estimated from time after onset of work for first appearance and full mouth frothing, as total cart-load 187.5 and 242.5% of body weight of the bullock.

As regards to blood biochemical reactions of bullocks

while ploughing, the per cent increase in blood lactic acid (37.00 %) was comparable to that for cart load L3 (38.55 %) whereas the changes in glucose level (reduction), plasma creatinine (increase) and haemoglobin (increase) for ploughing were intermediate between total cart load L2 (200%) and L3 (250%). The graphical plotting of changes in blood biochemical constituents revealed that the ploughing operation, on work stress basis, could be same to the total cart-load between 205 to 229% of body weight of the bullock.

In absence of comparable published report, the present study is perhaps the first of its kind to provoke researchers to take up further work on similar lines. The findings of the study tended to reveal that, under the conditions stated in the investigation, the ploughing and planking as work type and stress point of view, could on an average be equated, respectively, as total cart load 216.40 and 123.8% of bullock's weight (Table 1). The present results may be useful to simulate the ploughing and planking operations where fields for agricultural operations do not exist or bullocks in pairs are not available for such studies.

SUMMARY

A total of 192 carting trials with different cart loads and 48 trials each of ploughing and planking were conducted using 12 (6 Kankrej and 6 Jersey×Kankrej) bullocks. The pull exerted, horse-power generated, the time taken after onset of work for appearance of distress symptoms (salivation), and changes in respiration rate and blood constituents of bullocks subjected to different work were studied. The ploughing and planking as work type and stress point of view could on an average be equated, respectively, as total cart load 216.40 and 123.8% of bullock's weight.

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