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FATIGUE ENDURANCE OF CAMEL IN DIFFERENT MODES OF OPERATION

G.S. Tiwari, Rajeev Garg, Lokesh Gupta and J.L. Chaudhary

AICRP on Increased Utilisation of Animal Energy with Enhanced System Efficiency, Department of Farm Machinery and Power Engineering, College of Technology and Engineering, Udaipur, Rajasthan, India

ABSTRACT

Comparative fatigue endurance of Bikaneri camels was assessed in tillage and transportation. Six camels of almost similar age and body weight were selected for the experiment. Camels were operated at 3 draught levels (16, 18 and 20 per cent of body weight) with a work rest cycle: 2 h (Work)-1 h (Rest) - 2 h (Work) - 4 h (Rest) - 2 h (Work) – 1 h (Rest) – 2 h (Work). A 4 wheel cart was used as a loading device in transportation whereas a multipurpose tool frame with cultivator tynes was used to vary the draught in tillage operation. A fatigue score card based on physiological responses and physical symptoms of camel was used to assess the fatigue endurance. Fatigue score increased with increase in draught and duration of work in both the operations. Fatigue endurance was higer in tillage operations as compared to transportation at all levels of draught which indicated that camel can work more comfortably in transportation as compared to tillage operation.

Key words: Camel, draught, fatigue endurance, tillage operation, transportation

Indian economy is based on agriculture and about 60 per cent of its population depends on agriculture and allied activities for its livelihood. Most of the farmers, comprising about 80 per cent of total land holding, are small and marginal. These farmers have to depend on the draught animals for agricultural operations and transportation. Despite tractorisation and mechanisation of agriculture, the contribution of the draught animal can not be ignored.

Rajasthan is the largest state of country with the area of 3.42 million ha and about 0.7 million camels. (Singh and Maliwal, 2003).

Camel is the major source of power for goods and passenger transport in Rajasthan. Camels are used for very limited period for farm operations. During the idle period they are extensively used for transportation enabling the cart owners to earn revenue through hiring. Farmers employ the camels for different farm operations according to their need and seasons and some times the camels are either under-worked or over-worked. The operation of camels beyond their draught capacity adversely affects their health and may result in shortened life span. Though the camels have been used as a draught animal for the years but very little information is available regarding the fatigue endurance limit of camel with various combination of draught, duration of work and work-rest cycle (Anonymous, 1999 and Bhatt *et al*, 2002). Appropriate combination of draught and work-rest cycle will help in proper use of camel without undue fatigue.

In the present study attempts have been made to compare the fatigue endurance of camel in transportation and tillage operation by assessing the physical symptoms and physiological responses at different levels of draught.

Materials and Methods

Six Bikaneri camels of almost similar age and body weight were selected for experimental purpose. Details of camels and draught levels for transportation and tillage operation are given in Table 1. Experiments were conducted on tar macadam test track and on farmer's field for transportation and tillage operations, respectively. On the basis of previous research findings (Verma and Mathur, 2002 and Bhatt *et al,* 2002) and conventional practices

Table 1. Detail of experimental camels.

Parameters \ Camel	C_1	C_2	C_3	C_4	C_5	C_6
Weight of camel (kg)	520	570	600	515	560	495
Age of camel (Year)	8	8	9	6	7	6
Draught (N) level in terms of body weight (%)						
16 Per cent of body weight	832	912	960	824	896	792
18 Per cent of body weight	936	1026	1080	927	1008	891
20 Per cent of body weight	1040	1140	1200	1030	1120	990

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followed by the farmers, 3 levels of draught and one work-rest cycle were selected for the study. Experimental plan for the study is given in Table 2. All the experiments were repeated 3 times at every load for avoiding error.

Four wheel camel carts are completely balanced and do not impose any vertical load on the camel and thereby utilising the pulling power efficiently for hauling the cart. Thus it was used as a loading device for transportation experiments. Bags filled with concrete and sand weres used to vary the pay load on the cart according to the desired draught levels (Fig 1). A pneumatic wheeled multipurpose tool frame with cultivator tynes was used as a loading device for tillage experiments (Fig 2). The load was varied by adjusting the depth of operation and increasing / decreasing the number of tynes.

A hydraulic dynamometer was attached between cart and crossbar telescopic beam (Fig 3). A harness was mounted on the camel to attach the pull beam of cart with hooks and angle of pull was measured for calculating the draught. The relationship between payload and draught in transportation was obtained. The desired level of draught was achieved by varying pay load on the cart. Similarly a hydraulic dynamometer of 300 N capacity was connected between the swingletree (cross bar linkage) placed under the tail of animal and the beam of the multipurpose tool frame (Fig 4).

Table 2. Experimental plan.

Variables	Levels
Independent	
(a) Camel	6 (No)
(b) Draught (N)	3 (No)
	D_1 = Draught equal to 16 % of body weight
	D_2 = Draught equal to 18 % of body weight
	D_3 = Draught equal to 20 % of body weight
(c) Work rest cycle	1 (No) [2h(W)–1h(R)–2h(W)–4h(R) 2h(W)–1h(R) – 2h(W)]
(d) Mode of operation	2 (No)
	T_1 = Transportation
	T_2 = Tillage operation
Dependent variables	
1. Respiration rate, breaths/ min.	
2. Pulse rate, beats/min	
3. Body temperature, °C	
4. Speed, km/h	
5. Fatigue score	

W= Work; R= Rest

The physiological responses i.e. pulse rate, respiration rate, body temperature and speed of operation were recorded at the beginning of the experiment and at an hourly interval. These parameters were also measured during rest period to assess the recovery.

The pulse rate of camel was measured by placing the second finger on the coccygeal artery under the tail of the camel and counting the number of beats per minute. The respiration rate was measured by counting the number of hot gushes of exhaled air per minute blowing against of the back of the palm kept near the nostrils of the animal. The body temperature of the camel was measured by inserting the digital thermometer probe in the rectum of camel for about 2 minutes.

Two poles were placed at a distance of 50 meter in the middle of the field. The speed of operation was calculated from the time taken by the animal to travel 50-meter distance. Time was recorded by a stop watch and speed was calculated accordingly. During transportation, time taken to cover 5 round of test track was recorded and speed was calculated. Each observation was repeated 3 times and average was taken for the analysis.

In addition to physiological parameters, some physical symptoms such as leg in coordination, watering from nostrils, tears from eyes, frothing from mouth, tongue protrusion and refusal to move forward were also observed visually, to assess the fatigue level of camel. Furthermore, environmental condition such as ambient temperature, wind velocity relative humidity and sunshine were also recorded.

A fatigue score card developed at College of Technology and Engineering, Udaipur (Anonymous 2000) was used for assessment of fatigue level of camel (Table 3). This score card is based on total 7 parameters (physical and physiological) on 4 point scale. Fatigue score limit of 14 point score has been considered as a safer limit for working of camels at different draught levels. Further this score card has been divided in 4 zones i.e. less tired, tired, more tired and excessive tired zone with their respective fatigue score of 7, 14, 21 and 28 points. Fatigue level of camels in different mode of operations and working hours was assessed according to the score card.

Results and Discussion

Fatigue score obtained during transportation and field operations at different levels of draught is shown in Fig 5. In general fatigue score was found to increase

Fig 1. Four wheel cart with sand/ concrete bags.

Fig 3. Dynamometer attachment in four wheel cart.

Fig 2. Pneumatic wheeled multipurpose tool frame with cultivator arrangement.

Fig 4. Measurement of pull during field operation.

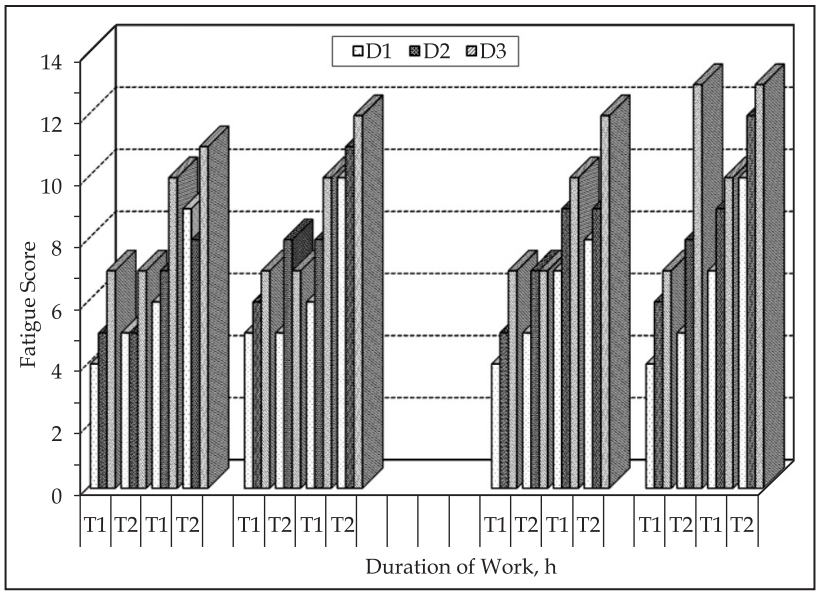

Fig 5. Fatigue score at different levels of draught in transportation and tillage operation.

Table 3. Fatigue score card for camel.

S N	Score	Less tired	Tired	More tired	Excessive tired
	Parameter	1	2	3	4
1	PR (beats/min)	P_0 + 5	P_0 +10	P_0 + 14	P_0 +17
2	RR (breaths/min)	R_0 + 2	R_0 + 4	R_0 + 5	R_0 + 6
3	BT (^{0}C)	T_0 +0.5	T_0 + 1.0	T_0 + 1.3	T_0 + 1.5
4	Speed (kmph)	S_0 - 0.1	S_0 - 0.2	S_0 - 0.3	S_0 - 0.4
5	Frothing	First appearing of frothing	Occasional falling of froth	Continuous falling from froth	Heavy frothing from mouth
6	Water from eyes and nostrils	Appearance of water from nostrils	Occasional watering from nostrils and appearance of tears	Frequently appearance of water from nostrils and tears from eyes	Continuous flow of water from nostrils and tear from eyes
7	Leg incoordination	Occasional dragging of feet	Frequent dragging of feet	No coordination between fore and hind legs	Staggered walking

P_0 = Pulse rate in zeroth hour of operation. R_0 = Respiration rate in zeroth hour of operation.
T_0 = Body temperature in zeroth hour of operation. S_0 = Initial speed.

with increase in draught and duration of work in both the operations. This might be due to the increase of physiological responses and appearance of physical symptoms with increase draught and duration of work which confirms the findings of Anonymous (2000), Bhatt *et al* (2002) and Verma and Mathur (2002).

It could be seen from figure that the fatigue score was low in transportation as compared to tillage operation at different draught levels. This might be due to irregular terrain, more exposure to open environmental conditions, variation of draught due to soil conditions and harnessing systems which imparted more stresses in camel during tillage operation as compared to transportation. On the other hand in transportation the camel has to pull a constant load on level surface with little variations.

Fatigue score was found to vary in the range of 4-6 and 5-9 during first session of 2 hours work at draught D_1. After one hour of rest, fatigue score reached up to 10 points in field operations. Figure also indicates that in both the sessions the fatigue score reached up to tired range in tillage operation and did not cross the less tired range in transportation. Further increase in draught resulted higher score and maximum value of 12 points was obtained at draught D_2 during first 2 sessions of work. Though the fatigue score in transportation was less in similar conditions but it touched the tired limit.

After 4 hours of rest no change in fatigue score was observed with draught D_1 during third session of work but it was higher at draught D_2 and D_3. During fourth session of work minimum score was observed with draught D_1 while it was highest with draught D_2 and D_3.

Results also indicate that in no conditions the fatigue score did cross the tired limits in both the operations which suggest that up to draught level of 20 per cent of body weight with the selected work rest cycle the camel can work without showing fatigue.

Conclusions

At draught levels up to 20 per cent of body weight with the work rest cycle, WR: 2 h (W)-1 h (R) - 2 h (W) - 4 h (R) - 2 h (W) – 1 h(R) – 2 h (R), camel can work for 8 hours a day without overstraining.

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