RETROSPECTIVE EVALUATION OF DIFFERENT FODDER REGIMENS AND CLIMATE ON PREGNANCY RATE IN JERSEY CROSSBRED COWS OF SUBTEMPERATE REGION

PANKAJ SOOD [1], Y. P. THAKUR [2], MADHUMEET SINGH [3], DESY RANI [4], POORBI BURMAN [5], ANOOP RUTHWAL [6], RAJESH SHARMA [7] AND NAVEEN KUMAR [8]

Department of Veterinary Gynaecology and Obstetrics

College of Veterinary and Animal Sciences, CSK HPAU. Palampur 176 062 India

Received : 22.11.11

ABSTRACT

Accepted : 15.12.14

The present study compared separately a retrospective assessment of association of 17 different fodder regimens and three different classes of temperature – humidity index (THI) with per cent pregnancy rates (PRs), following 3,264 artificial inseminations (year 1998 to 2008) in Jersey crossbred cows. The similar fodder combinations and THI were separately clubbed on monthly basis for their association with PR. The green fodder(s) offered to the cows comprised of maize, oats and other green fodders (OGF) namely Seteria, Napier, Kikuyu, Berseem and Sorghum. In addition, silage and wheat straw were also supplemented. The two highest PRs of 41.4% and 40.9% were associated, respectively, with feeding of fodder combinations having 36.3% and 35.4% silage of the total fodder, respectively. Considered together, feeding different fodder combinations of greens having 38.8% to 95.1% maize resulted in a PR of 32.8%, which was less (P=0.10) than 37.5% as recorded with other fodder combinations not having maize. The PR at different THI categories of 50-60, 61-70 and 71-75, respectively, were similar and ranged from 35.0 to 38.0%. In conclusion, pregnancy rates were higher in cows provided silage with green fodder than the others given maize fodder dominated diets. The latter needs to be investigated for the associated mechanism(s) reducing pregnancy rates.

Key words: Cattle, Fodder, Pregnancy, Temperature-humidity index

Crossbreeding was initiated in several tropical countries, including India, to augment the milk production so as to meet the demand of an ever increasing human population. However, the desired expectations have not been met and low productivity of cattle still remains the key issue, which is mainly attributed to below par reproductive performance of the crossbred cows (Deshmukh and Kaikini, 1999). There is a wide variability of agro climatic conditions and farming systems in India (Maurya, 2004). Resultantly, management (especially nutrition) and environmental cues (especially temperature and relative humidity) are the key players strongly influencing the reproductive performance of crossbred cattle in India. In addition, the socio-economic status and lack of liberal fodder resources with Indian farmers, majority of which are small, marginal or landless (Gupta, 2007), prevent uniform feeding practices in cattle. Instead, the cows under herd management as well as marginal farming systems are maintained on diverse nutritional regimens whose effect on conception is unknown. Although cattle are adaptable and can maintain reproductive performance in relatively broad range of environmental conditions, high environmental temperature and relative humidity remains the other risk factor affecting cattle reproduction (Lopez-Gatius *et al.* 2004; Bech-Sabat *et al.* 2008).

[1] Corresponding author and Professor;
[2] Professor, Department of Animal Breeding and Genetics, DGCN COVAS, Palampur;
[3] Professor and Head;
[4] Assistant Professor, Department of Animal Nutrition, DGCN COVAS, Palampur
[5,7] Assistant Professor,
[6] Veterinary Officer, Chango, District Kinnaur, Himachal Pradesh;
[8] Professor, Department of Crop Improvement, College of Agriculture, Palampur 176 062.

In the current investigation a retrospective analysis of the effect of different types of feeding regimens and temperature humidity index were investigated on pregnancy rate in Jersey crossbred cows raised under sub-temperate conditions of Himachal Pradesh.

The period of study was between January 1998 to December 2008 at Palampur, India, situated at a latitude 32°6' N longitude 76°3' E.

The cows belonged to a herd of 190 to 210 cows raised in the Dairy Farm of Himachal Pradesh Agricultural University. The cows were crosses between Jersey and local cattle with an exotic inheritance of 50.0 to 75.0%. The cows were in first to eighth lactation. The average milk production (l) per month of the herd ranged from 19,068 to 24,479. The calves were weaned at birth and the cows were hand milked twice. The cows had round the clock access to clean drinking water. The cows were routinely vaccinated against Foot and Mouth Disease, Rinderpest and Black Quarter using a combined vaccine.

The feeding practice, on total dry matter basis, comprised of concentrate feed (one – third) and seasonally available roughages (two – third) fed to the cows on basis of their reproductive and lactation demands (Ranjan, 1998). The concentrate feed was formulated according to the Bureau of India Standards (1979 reaffirmed 1990). The availability of roughages varied during different months. Maize and oats were the major roughages, whereas berseem, sorghum, setaria, hybrid napier and kikyu grass were available in relatively less quantity and categorized collectively as other green fodders (OGF). Silage was also offered to the cows in the months of green fodder scarcity. It was prepared from maize (70% of total green roughages), napier and setaria during July and from oats in January as per the method of Thomas (2003) and had molasses at a rate of 3.5 per cent. Wheat straw was another component offered to the cows as an adjunct to the other fodders for major part of the year. The animals of similar production performance were fed in groups and therefore the individual data of feed – fodder intake could not be recorded. However, it was strongly presumed that the feed – fodder intake under the organized farm conditions satisfied their nutritional requirements.

As the quantity of concentrates was fixed by demands of cattle, it was the roughage availability that accounted for a major variation and was therefore evaluated in face of the associated pregnancy rate (PR). Oats, maize, wheat straw and silage constituting the greatest bulk were categorized individually, whereas the other green fodders (OGF) were considered as a single/separate category. The quantity of each fodder was considered as per cent of total roughage offered. In all 17 different fodder combinations were provided to the cows (Table 1).

The day time temperature (T) and relative humidity (RH) were recorded every morning and evening. The daily average morning and evening values of both T and RH were considered for calculating temperature – humidity – index (THI) on monthly basis (Thom, 1959) using the following equation: THI = 0.8 x mean T + mean RH(%)/100) x (mean T – 14.4) + 46.4). The THI was categorized in three different classes of 50-60, 61-70 and 71-75, respectively.

The PRs in different months were evaluated against the corresponding fodder combination and THI, respectively.

Cows detected in estrus by visual observations after 70 days of voluntary waiting period and free of uterine infections were inseminated using 0.25 ml of frozen - thawed semen from certified bulls. A total of 3,264 inseminations were performed during the study period. Pregnancy diagnosis was performed 90 d after A.I using transrectal palpation of genitalia. The PR (%) was calculated on monthly basis considering the total number of pregnant cows and total number of inseminations every month.

The PR in relation to different fodder combinations and THI categories were compared

using Chi-square analysis. For statistical significance, a difference of $P<0.05$ was considered significant, whereas $P=0.10$ was considered to have a tendency for difference. The entire statistical analysis was performed using Statistical Package, SPSS (12.0 for Windows).

For economic milk production, the feeding of dairy animals is primarily fodder based (Gupta, 2007). With a wide array of fodders that can be cultivated coupled with their seasonal availability underscores the importance of area specific recommendations of fodder cultivation. Moreover, variation in climatic conditions is also an important variable affecting reproductive performance of cattle (Bitman *et al.* 1984). The present study, therefore, evaluated the reproductive performance of Jersey crossbred cows under varying fodder feeding regimes and environmental situations. To our knowledge, this report is the first comprehensive description of the on-farm effects of different fodder regimes and climatic conditions on pregnancy rates in Jersey crossbred cows raised in subtemperate conditions.

During the study period a total of 17 different fodder combinations were offered to the cows. The PRs after feeding of different quantities of fodder are presented in Table 1.

The fodder combinations associated with highest pregnancy rates of 41.4% and 40.9% had 36.3% and 35.4% silage, respectively. Also evident was that the cows receiving silage alongwith OGF exhibited higher PRs than those receiving only OGF. In three out of four instances, OGF (ranging from 32.9 to 71.3% of total fodder) alongwith silage (ranging from 28.7% to 36.3% of total fodder) resulted in PRs higher than 40%, whereas PRs in four out of five different combinations of OGF (range of 35.6% to 64.4% of total fodder) not having silage resulted in comparatively lower PR of 36.4, 30.2, 34.2 and 30.5%, respectively. Higher conceptions rates upon feeding of silage in combination with OGF could be attributed to the higher availability of energy and minerals because molasses was added in the fodder at the time of ensiling. Moreover, ensiled fodder is rich in lactic acid, amounting to more than 50% of total organic acids (Thomas, 2003), which is transported to the liver for synthesis of glycogen to be used as a source of energy (Banerjee, 2010). The green fodder is considered to be the best feeding commodity in having the advantage of micronutrients (minerals and vitamins) availability. Hence, mixing of silage (32.9 to 71.3%) with OGF may have ensured a balanced feeding mixture to the cows in terms of availability of macro and micronutrients. Mixed feeding is always more beneficial as the nutrients availability from such a combination becomes complementary (Banerjee, 2010).

The only OGF-silage combination resulting in relatively lower PR of 30.8% had 38.8% maize as the third constituent. Although the total number of inseminations in the later group were less, but presence of maize fodder and its inverse relationship to pregnancy was speculated, which was also evinced by a low PR of 31.1% in the cows exclusively fed maize fodder as green roughage (Table 1). The same was affirmed after comparison of PRs between the groups offered roughages with or without maize. Considered collectively, the cows offered roughage having 38.8% to 95.1% maize fodder had average PRs of 32.8%, which tended to be lower ($P=0.10$) than the average PR of 37.5% achieved in groups fed roughages lacking in maize fodder as a component.

The cause effect relationship between feeding of maize rich fodder and reduced pregnancy rates needs to be ascertained. However, as per the available literature, lower PR in cows receiving large quantity of maize fodder in the present investigation could be attributed to natrophobic (sodium hating) properties of maize leading to extremely low sodium content in its stubble, stalks and leaves (Anonymous, 2011), thereby possibly lowering the total sodium intake in the cows. Relationship of PR to sodium deprivation for dairy cows has been suggested (Harris *et al.* 1986). As sodium is actively involved in nerve functions (Banerjee, 2010), low sodium may perturb the neuro-endocrine regulation of the

hypothalamo-pituitary-gonadal axis coordinating towards the establishment of pregnancy in cattle. Low sodium disturbs reproduction in rats and reduces egg production in hens. Further, amino acid and glucose uptake is dependent on sodium (Underwood and Suttle, 1999). So on low sodium diets, the animals are in poor energy and protein status, and protein intake is directly related with the pregnancy rate (Journet and Remond, 1981).

The concentrate feed offered to the cows contained 2% mineral mixture and provided 8.58 g sodium per day to cows consuming 5 kg concentrate per day, which is lower than the recommendations by National Research Council (1981). Hence, lower PRs associated with feeding of maize fodder alone or maize fodder dominated feeds might be incriminated to overall poor sodium status in the cows. It is therefore implied that an increase in provision of sodium chloride during the period of fodder consumption high in maize may improve the PRs. In a previous study (Bais, 2009) on the cows from the same cattle farm where the current investigation was undertaken, marginal deficiency of sodium was recorded in the blood plasma of 16.6% of growing and mature heifers. In these cows the plasma sodium concentration ranged from 133.86±1.31 to 138.31±2.23 mEq/L, which was lower than the standard sodium concentration of 150 mEq/L as recommended by National Research Council (2001). Accordingly increased sodium chloride supplementation was suggested in the later cows (Bais, 2009). Apart from sodium, maize is also not a very good source of calcium and magnesium (Anonymous 2011) both of which also have vital roles in reproductive functioning (Hurley and Doane, 1987). However, unlike sodium, the blood calcium and magnesium levels of the heifers were reported to be within normal range (Bais, 2009).

The temperature and relative humidity during the period of investigation ranged from 8.8°C to 26.5°C and 29% to 86%, respectively. Accordingly, the THI during the study period ranged from 50 to 74. The PRs in the three different THI categories is presented in Table 2. Similar PRs in all the three categories did not suffice an apparent effect of the climatic conditions on reproductive performance of Jersey crossbred cows. It has been suggested that heat stress in cows commences at temperatures of 25°C (Bitman *et al.* 1984) and THI values of 72 (Johnson *et al.* 1962), and the thermal neutral zone ranges from 5 to 20°C (NRC 1981). However, these studies pertain to the exotic germplasm that are high yielders and consume more concentrate feed thereby adding up the metabolic heat load (Banerjee, 2010). Hence, lack of any apparent effect of THI category of 71-75 when compared to the other two lower categories on pregnancy in the present study indicates a better adaptation of the crossbreds that were moderate milk producers. Moreover, lack of any effect of the existing THI range on pregnancy rates in cows under study substantiates a logical relationship between different fodder combinations and conception in cows in the present study.

In conclusion, the findings of present study highlight the selection of different fodders to achieve higher pregnancy rates in Jersey crossbred cows. Incorporation of silage in the seasonal green fodder will increase pregnancy rates. Hence, the Indian farming community should be encouraged to adopt the silage making practices. Extra supplementation of sodium during the period of feeding maize rich fodder may be a viable solution to prevent reproduction losses in cows. The subtemperate conditions seem to suit the Jersey crossbreds.

Table 1. List of different fodder combinations and the respective pregnancy rates (PR) as in Jersey crossbred cows

S.No.	Combinations	No. of inseminations	Pregnancy rate (%)
1	Oats (73.6) - wheat straw (26.4)	745	38.5[a]
2	Silage (44.1) - oats (33.3) - wheat straw (22.6)	560	36.6
3	Maize (95.1) - wheat straw (4.9)	328	34.5
4	OGF (64.4) - wheat straw (35.6)	233	36.4
5	OGF (100)	228	37.7
6	OGF (39.0) - oats (31.6) - wheat straw (29.4)	205	30.2[b]
7	Maize (64.4) - OGF (35.6)	210	34.2
8	Silage (36.3) - OGF (32.9) - wheat straw (18.6) - oats (12.2)	186	41.4[a,d]
9	Maize (56.8) - OGF (38.4) - wheat straw (4.8)	144	30.5[c]
10	OGF (42.8) - silage (35.4) - wheat straw (21.8)	144	40.9[a,d]
11	Maize (100)	106	31.1[b]
12	OGF (71.3) - silage (28.7)	56	42.9
13	Maize (83.4) - wheat straw (9.0) - silage (7.6)	37	40.5
14	OGF (83.5) - oats (16.5)	26	42.3
15	Oats (100)	23	43.3
16	Silage (57.7) - wheat straw (42.3)	20	55.0
17	OGF (48.3) - maize (38.8) - silage (12.9)	13	30.8

Figures in parenthesis indicates the quantity of different fodders, expressed as the percentage of total fodder
OGF – Other green fodder
[a,b] differ at ($P<0.05$); [c,d] differ at ($P=0.10$)

Table 2. Effect of varying temperature humidity index (THI) on pregnancy rate (PR) in dairy cows.

S.No.	THI category	PR (%)
1.	50-60 (n = 49)	38.0
2.	61-70 (n = 44)	35.0
3.	71-75 (n = 39)	36.4

REFERENCES

Anonymous. (2011). Sodium and amaize. http://www.dominionsalt.co.nz/acatalog/sodiumamaize.pdf

Bais, I. S. (2009). 'Strategic nutritional supplementation studies in the performance of heifers.' M.V.Sc. Thesis. CSK HPKV, Palampur, Himachal Pradesh, India.

Banerjee, G. C. (2010). Animal Nutrition. In: A Textbook of Animal Husbandry. 8th edn. Oxford and IBH Publishing Co., New Delhi.

Bech-Sabat, G., Lopez-Gatius, F., Yaniz, J. L., Garcia-Ispierto, I., Santolaria, P., Serrano, B., Sulon, J., De Sousa, N. M. and Beckers, J F. (2008). Factors affecting plasma progesterone in the early fetal period in high producing dairy cows. Theriogenology, **69:** 426-432.

Bitman, J., Lefcourt, A., Wood, D. L. and Stroud, B. (1984). Circadian and ultradian temperature rhythm of lactating dairy cows. J. Dairy Sci., **67:** 1014-23.

BIS: 2052 (1979, reaffirmed 1990). Indian Standards Nutrient Requirements for Bovines. Bureau of Indian Standards, Manak Bhawan, 9 Bahadurshah Jafar Marg, New Delhi, 110 002, India.

Deshmukh, A. W. and Kaikini, A. S. (1999). Incidence of reproductive disorders in Jersey x Sahiwal crossbred cows. Indian Vet. J., **76:** 249-250.

Gupta, P. R. (2007). Dairy India 2007. 6th edn. Thompson Press India Limited.

Harris, J., Caple, I. W. and Moate, P. J. (1986). Relationship between mineral homeostasis and fertility of dairy cows grazing improved pastures. 6th International Conference on "Production Diseases of Farm Animals," Belfast Veterinary Research Laboratory, Stormont. pp 315-318.

Hurley, W. L. and Doane, R. M. (1987). Recent development in the roles of vitamins and minerals in reproduction. J.Dairy Sci., **72:** 784-804.

Johnson, H. A., Ragsdale, A. C., Beary, I. L. and Shankein, M. D. (1962). Effect of various temperature – humidity combinations on milk production of Holstein cattle. M. Agric. Exp. Stn. Res. Bull., **791:** 1-39.

Journet, M. and Remond, B. (1981). Response of dairy cows to protein level in early lactation. Livest. Prod. Sci., **8:** 21-35.

Lopez-Gatius, F., Santolaria, P., Yaniz J. L., Garbayo, J. M. and Hunter, R. H. F. (2004). Timing of early foetal loss for single and twin pregnancy in dairy cattle. Reprod. Domest. Anim., **39:** 429-433.

Maurya, S .N. (2004). Augmenting fertility in cattle under Indian conditions. Proceeding of "9th International Congress on Biotechnology." Chennai. pp 112-124.

National Research Council. (1981). Effect of environment on nutrient requirements of domestic animals. National Academy of Science, Washington, DC.

National Research Council. (2001). Nutrient requirements of dairy cattle. National Academy of Science, Washington, DC.

Ranjan, S. K. (1998). Nutrient requirements of livestock and poultry. Indian Council of Agricultural Research.

Thom, E. C. (1959). The discomfort index. Weatherwise, **12:** 57-60.

Thomas, C. G. (2003). Forage Preservation. *Forage Crop Production in the Tropics.* 1st edn. Kalyani Publishers, New Delhi.

Underwood, E. J. and Suttle, N. F. (1999). The mineral nutrition of livestock. 3rd edn. CAB International, Wallingford, U.K. pp 194.