Effect of pour-on alphacypermethrin on feed intake, body condition score, milk yield, pregnancy rates, and calving-to-conception interval in buffaloes1,2

G. Bifulco,* V. Veneziano,* R. Cimmino,† L. Esposito,* L. Auletta,* E. Varricchio,† A. Balestrieri,* S. Claps,‡ G. Campanile,* and G. Neglia*3

*Department of Veterinary Medicine and Animal Production (DMVPA), Federico II University, V. Delpino 1, 80137, Naples, Italy; †Department of Sciences and Technologies, University of Sannio, Via Port’Arsa 11, 82100 Benevento, Italy; and ‡Consiglio per la Ricerca e la Sperimentazione in Agricoltura – Unità di Ricerca per la Zootecnia Estensiva, Bella Muro, Potenza, Italy

ABSTRACT: The aims of this study were to assess the efficacy of alphacypermethrin (ACYP) on pediculosis due to Haematopinus tuberculatus and to evaluate the influence of the treatment on productive and reproductive performance in buffaloes (Bubalus bubalis) reared in an intensive system. The trial was performed on 56 pluriparous buffaloes at 86.8 ± 8.1 d in milk. The animals underwent individual louse count and were divided into 2 homogenous groups according to louse count, age, number of lactations, days in milk, live BW, BCS, pregnancy status, and milk yield. Group A (n = 28) was treated by a pour-on formulation of ACYP, and Group S (n = 28) was treated by pour-on saline solution. Individual louse counts were performed weekly on 10 buffaloes in each group. Feed intake was recorded daily and the total mixed ration, individual ingredients, and orts were analyzed to calculate DM ingestion. Individual milk yield was recorded daily and milk samples were analyzed at the beginning of the trial, after 4 wk, and at the end of the trial to assess milk composition. Individual BCS was also evaluated simultaneously. Finally, the animals underwent synchronization of ovulation starting 4 wk after treatment and the pregnancy rate and the calving–conception interval were evaluated. Data were analyzed by the Mann–Whitney test and ANOVA for repeated measures. The infestation was constant in Group S, whereas no lice were present in Group A throughout the study. Daily DMI was similar in the 2 groups (16.7 ± 0.4 vs. 16.3 ± 0.3 kg/d in Group A vs. Group S, respectively), although buffaloes in Group A showed higher (P < 0.05) BCS score at the end of the trial (7.39 ± 0.1 vs. 7.14 ± 0.1 in Group A vs. Group S, respectively). The average milk yield/buffalo was higher (P < 0.05) in Group A compared to Group S (10.58 ± 0.1 vs. 10.39 ± 0.1 kg in Group A vs. Group S, respectively) and this was mainly due to the higher milk production recorded in buffaloes at less than 75 d in milk (11.81 ± 0.1 vs. 11.45 ± 0.1 kg in Group A vs. Group S, respectively). Despite of a similar fertility rate (90.5 vs. 80.9% in Group A vs. Group S, respectively), a lower (P < 0.05) calving–conception interval was recorded in Group A compared to Group S (118 ± 16 vs. 177 ± 16 d in Group A vs. Group S, respectively). In addition to the pour-on treatment against pediculosis, productive and reproductive performance were also improved. This represents a significant improvement in dairy buffalo herd management.

Key words: alphacypermethrin, buffalo, negative energy balance, pediculosis


1Work supported by POR CAMPANIA FSE 2007/2013. Sviluppo di Reti di Eccellenza tra Università – Centri di Ricerca – Imprese. PROGETTO CARINA “Sicurezza, sostenibilità e competitività nelle produzioni agroalimentari della Campania” – CUP B25B09000080007. The authors gratefully acknowledge Andrea Bassini and Luca Miotto, Zoetis, Italy, for technical support. 2The authors report that there are no conflicts of interest relevant to this publication. 3Corresponding author: neglia@unina.it

Received August 1, 2014. Accepted February 10, 2015.
INTRODUCTION

Buffalo breeding in Italy has reached high productive standards and a high grade of innovation, similar to that performed in dairy cattle. Few available spaces and the resultant overcrowding of buffalo can cause chronic stress that is responsible for both reduced animal welfare (Napolitano, 2001) and reduced immune response (Borghetti et al., 2009), together with a higher incidence of infectious and parasitic diseases. Pediculosis due to Haematopinus tuberculatus (Burmeister, 1839) is the main parasitic disease that can be found on buffalo in Italy (Veneziano et al., 2003, 2004), although it has been reported worldwide (Meleney and Kim, 1974; Veneziano et al., 2003). Cattle, camels, and American bison are also susceptible to infection (Chaudhuri and Kumar, 1961). Louse infestation leads to skin irritation, anemia, anorexia, restlessness, and loss of body condition (Veneziano et al., 2003), causing a negative impact on the general health status (Ahmed et al., 2009).

Therapeutics, such as antiparasitic compounds, are often administered to buffaloes based on dosage and intervals recommended for cattle, because very few drugs have buffalo-specific label indications (Veneziano et al., 2004). Alphacypermethrin (ACYP) is a synthetic pyrethroid insecticide containing more than 90% of the most active enantiomer pair of the 4 cis isomers of cypermethrin as a racemic mixture. This molecule can be applied as a pour-on, facilitating animal management and handling, and it is marketed with zero milk-withdrawal time. In a recent study, ACYP was demonstrated to be a highly effective compound for pediculosis treatment in buffalo (Veneziano et al., 2013), although the influence of the treatment on productive and reproductive performance in buffalo intensive breeding was not evaluated. Therefore, the aims of this study were 1) to confirm the efficacy of ACYP on buffalo pediculosis and 2) to evaluate the effect of treatment on productive and reproductive performance.

MATERIALS AND METHODS

Farm

The investigation was approved by the Animal Ethics Committee of the University of Naples, Federico II (Naples, Italy). The trial was performed from April to June 2013 in a commercial buffalo farm located in South Italy (Caserta Province), between 40.5° N and 41.5° N. Within the farm, the buffaloes were divided in groups according to age and physiological stage: 5 groups were in lactation, 2 in dry period, and 6 were constituted by growing calves of different age. All groups were maintained on cement pads that allowed 15 m² for each animal and 80 cm manger space.

Because of the reproductive seasonality of the species, the out-of-breeding-season mating technique (Campanile et al., 2010a) was applied to meet milk production with market requirements for mozzarella cheese production. It consists of the interruption of sexual promiscuity from October to February; for this reason, deliveries were concentrated from the end of December to the beginning of August. Furthermore, AI was routinely applied, to guarantee the genetic improvement of the herd.

Lactating buffaloes were milked twice daily and were fed a total mixed ration (TMR) based on corn silage, wheat straw, soybean meal, barley meal, wheat bran, beet pulp, hydrogenate vegetable fat, and vitamin and mineral supplement. The diet was characterized by 50 to 55% forage and 45 to 50% concentrate and contained 0.90 milk forage units (MFU)/kg of DM and 15% CP/DM in a group pen situation. Water was provided ad libitum throughout the course of the study.

Farm Parasitological Status

The buffaloes naturally acquired the infestation and no pharmacological treatments for pediculosis were performed in the last 3 yr. For taxonomic identification, a significant number of lice (about 50) were collected 7 d before the beginning of the trial from 5 randomly chosen adult buffaloes. Louse specimens were fixed in 70% ethanol, treated by KOH 4% for 7 to 8 h, further fixed in 70% ethanol and glycerol, and mounted on slides. The examination of the slides was performed under optical (Leica DM 750 HD; Leica Microsystems Srl, Milan, Italy) and dissection microscopes (Leica EZ4 HD; Leica Microsystems Srl, Milan, Italy). Species determination was based on the morphological keys proposed by Chaudhuri and Kumar (1961), Meleney and Kim (1974), and Veneziano et al. (2003).

Animals and Groups

A total of 56 pluriparous buffaloes at 86.8 ± 8.1 d in milk (mean ± SE) were selected. All animals were double ear-tagged for identification and individual daily milk yield was recorded for 1 wk before the beginning of the trial. On the day before treatment (d −1), louse counts were performed according to the procedures described below (Veneziano et al., 2013). Body condition score was also individually evaluated according to the Wagner scale modified for buffalo species (Wagner et al., 1988).

On d 0 (day of treatment), the buffaloes were divided into 2 homogenous groups (Group A and
Group S) according to louse count, age, number of lactations, days in milk, live BW, BCS, pregnancy status, and milk yield recorded during both the previous 7 d and the previous lactation (as both real milk production and mature equivalent buffalo):

- Group A ($n = 28; 85.9 \pm 11.9$ d in milk) was treated by a pour-on formulation of ACYP (Renegade 1.5%, Pour-on Long Acting; Fort Dodge – Zoetis, Rome, Italy) at the manufacturer recommended dose (0.02 mg/buffalo) for cattle. The solution was applied topically with a syringe along the midline of the back from the withers to the tail.

- Group S (saline; $n = 28; 87.7 \pm 11.3$ d in milk) was treated by pour-on saline solution (0.9% NaCl) applied topically as described for Group A.

Groups A and S were allocated into 2 separated paddocks and were maintained in these conditions throughout the experimental period to avoid physical contact and received the same TMR. Feed intake was determined from orts (refusals) collected daily in the morning before the next feed administration. The amount and the composition of orts were used to calculate daily DMI per group and the composition of the ingested diet. Single ingredients, TMR, and orts were sampled weekly, at the same time as louse counts. The analyses of single ingredients, TMR, and orts were performed as per Association of Official Analytical Chemists methods (AOAC, 1980) and energy values (MFU = 1,700 kcal of net energy for lactation – NEI) were calculated according to INRA equations (Jarrige, 1988).

**Louse Counting Procedures**

Louse counts were performed on each buffalo in Groups A and S by recording the individual number of lice at 8 louse predilection sites (Fig. 1), which were determined on the basis of louse distribution studies on buffaloes (Veneziano et al., 2013). The predilection sites were as follows: right and left cheek (5 by 10 cm area), right and left ear (5 by 10 cm area), right and left neck and dewlap (10 by 20 cm area), right and left withers (10 by 10 cm area), right and left foreleg (axilla; 10 by 10 cm area), right and left back (10 by 10 cm area), right and left hind leg (inguin; 10 by 10 cm area), and tailhead and perineum (10 by 10 cm area). If no lice were found at any of the predilection sites, a search of the whole body of the animals was performed. Counting was performed with the naked eye by the same persons throughout the study aided by a head-mounted, high-intensity focused light source and by magnifying lens (10x magnification).
Parasitological, Productive, and Reproductive Investigations

Parasitological investigations were performed weekly (d −1, 7, 14, 21, 28, 35, 42, 49, 56, and 63) by adding up all predilection site counts for each animal in a group. The efficacy (%) of ACYP was determined each day, in terms of percentage of louse reduction, using the Abbott's formula (Abbott, 1925) as proposed by Holdsworth et al. (2006): efficacy = 100 × [(C − T)/C] in which T is the louse count on treated buffaloes and C is the louse count on control buffaloes.

Individual milk yield was recorded daily using a computerized system located in the milking parlor. Milk samples from each buffalo were collected during the morning and afternoon milking at the beginning of the trial, after 4 wk, and at the end of the trial to evaluate milk composition (fat and protein) using infrared spectroscopy (Milkoscan 139; Foss Electric, Hillerød, Denmark) calibrated with the appropriate buffalo standard. In these cases, energy-corrected milk (ECM; 740 kcal) was calculated using the formula for buffalo cows: \((\{[\text{fat (g/kg)} – 40 + \text{protein (g/kg)} – 31] \times 0.01155\} +1) \times \text{milk yield}\) (Campanile et al., 2003).

Feed intake and differences (Δ) between nutritive intake and relative requirements were estimated as suggested by Campanile et al. (1998): DMI = 91 g × metabolic weight + 0.27 kg × kg ECM, CP = g CP intake − (80 g CP × 100 kg live weight + 2.7 g CP × g milk protein yield), and MFU = MFU intake − [(1.4 + 0.6 × 100 kg live weight) \times 1.1 + 0.44 MFU × kg ECM] (Jarrige, 1988).

Average milk production per group was compared from d 0 until d 63. Data regarding individual BCS were evaluated at the beginning of the trial, after 4 wk, and at the end of the trial, at the same time as with milk sampling, by using a scale of 1 to 9 (Wagner et al., 1988) modified for the buffalo.

Finally, the effect of treatment on fertility rate was assessed in each group. Buffaloes already pregnant on d 0 (n = 7 in each group) were excluded from the trial. Nonpregnant buffaloes were treated with a modified Ovsynch protocol, 4 wk after louse treatment, to facilitate timed AI (TAI). The protocol was developed for cattle (Pursley et al., 1995) and previously applied in buffaloes (Neglia et al., 2008). Briefly, a GnRH agonist (lecirelin acetate, 50 μg; Ovucon; Zoetics, Rome, Italy) was administered on d 0, a PGF \(_{2α}\) analog dose on the same day and another GnRH dose 2 d later. A further TAI was performed on d 30. This protocol was performed continuously until pregnancy was recorded (Rossi et al., 2014). Pregnancy diagnosis was confirmed 70 d after the first TAI that was followed by pregnancy.

Artificial inseminations were performed until September 20 because of the out-of-breeding-season mating technique (Campanile et al., 2010a) and the pregnancy rate and the number of Al/buffalo were calculated. The calving–conception interval was calculated for each subject as the number of days from calving until the day of AI followed by a pregnancy.

Statistical Analysis

Differences in louse count were analyzed weekly between Groups A and S using a Mann–Whitney test. Significant differences were considered if P-values were lower than 0.05. Productive data were analyzed by a multivariate analysis of variance (MANOVA) for repeated measures, with the daily average milk yield as dependent variable (SAS Inst. Inc., Cary, NC). The normal distribution of the variables was assessed by the Kolmogorov–Smirnov test. The Sidak’s multiple comparisons test was applied post hoc. On the basis of the negative energy balance that buffaloes encounter during the first phase of lactation, a further statistical analysis was performed by dividing the buffaloes in each group according to their days in milk (less or more than 75 d in milk at the beginning of the trial), in particular,

- subgroup A1 (n = 18; 46.3 ± 4.9 d in milk),
- subgroup S1 (n = 18; 48.9 ± 4.5 d in milk),
- subgroup A2 (n = 10; 157.1 ± 15.3 d in milk), and
- subgroup S2 (n = 10; 157.5 ± 12.8 d in milk).
Daily milk yield in animals with less (subgroups A1 and S1) and more (subgroups A2 and S2) than 75 d in milk was compared weekly. The final model included the daily milk yield and considered group, days in milk, and the interaction between group, days in milk, and time.

Both daily DMI and BCS were analyzed as dependent variable in a MANOVA analysis with treatment as effect of the model.

Finally, a general linear model (GLM; SAS Inst. Inc.) was applied to evaluate the effects of days in milk, treatment, BCS, DMI, and their interaction over the daily milk yield (dependent variable).

The pregnancy rate between the 2 groups was analyzed by a χ² test and the calving–conception interval and, consequently, the intercalving period were analyzed by ANOVA (SAS Inst. Inc.).

**RESULTS**

**Parasitological Results and Dermal Examination**

The lice collected at d −7 were identified as *H. tuberculatus*, according to the morphological data reported by several authors (Chaudhuri and Kumar, 1961; Melaney and Kim, 1974; Veneziano et al., 2003). The study lasted 63 d and the number of lice in predilection sites in Groups A and S at d −1 was, respectively, 88.7 and 80.0 lice/buffalo. The infestation was constant throughout the experimental period in Group S, ranging from 52.2 to 83.0 lice/buffalo, whereas no lice were counted at the inspection sites or during whole body inspections in Group A on all posttreatment days, indicating an efficacy of 100% for d 7 to 63.

**Dry Matter Intake and BCS**

Daily DMI/group was similar in the 2 experimental groups (16.7 ± 0.1 vs. 16.3 ± 0.1 kg/d in Group A vs. Group S, respectively). Group A ingested a slightly higher total amount of MFU/day (15.1 vs. 14.7 in Group A vs. Group S, respectively). Body condition score values recorded in the 2 groups were in the physiologically range for buffalo species. Although similar values were recorded on d −1 (6.96 ± 0.02 and 6.91 ± 0.03 in Group A vs. Group S, respectively), a higher ($P < 0.05$) BCS score was recorded in Group A compared to Group S at the end of the trial (7.39 ± 0.06 vs. 7.14 ± 0.09 in Group A vs. Group S, respectively). Interestingly, no differences were found between buffaloes with more than 75 d in milk (7.57 ± 0.14 vs. 7.59 ± 0.12 in Group A vs. Group S, respectively; $P > 0.1$), whereas a higher BCS score was recorded in animals at less than 75 d in milk (7.28 ± 0.02 vs. 6.86 ± 0.04 in Group A vs. Group S, respectively; $P < 0.01$).

**Productive and Reproductive Performance**

Although no differences were observed in daily milk yield within each week between the 2 groups, the average milk yield/buffalo throughout the experimental period was higher ($P < 0.05$) in Group A compared to Group S (10.58 ± 0.1 vs. 10.39 ± 0.1 kg/d in Group A vs. Group S, respectively). Similar results were found in terms of ECM (17.77 ± 0.1 vs. 17.45 ± 0.1 kg/d in Group A vs. Group S, respectively), as no differences were found in terms of milk protein (4.62 ± 0.1 vs. 4.65 ± 0.1 in Group A vs. Group S, respectively) and milk fat (8.28 ± 0.1 vs. 8.45 ± 0.1 in Group A vs. Group S, respectively) percentage. Differences in milk yield (Fig. 2) were mainly observed from the first to the fifth week (11.11 ± 0.1 vs. 10.75 ± 0.1 kg/d in Group A vs. Group S, respectively).

When the animals were divided according to their days in milk, buffaloes in Group A with less than 75 d in milk (Table 1) showed a significantly higher ($P < 0.01$) milk production compared to their Group S counterparts throughout the experimental period (11.81 ± 0.1 vs. 11.45 ± 0.1 kg/d in Group A vs. Group S, respectively). Milk production was significantly higher ($P < 0.01$) in Group A compared to Group S from the first until the fourth week (12.50 ± 0.1 vs. 11.80 ± 0.1 kg/d in Group A vs. Group S, respectively), whereas no differences were observed subsequently. Milk yield recorded in buffaloes with more than 75 d milk was similar ($P = 0.34$) between the 2 groups (Table 2).

A significant influence of the time on milk yield was observed in both groups ($P < 0.01$). The time × group interaction was not significant both considering the total of animals ($P = 0.30$) and the buffaloes at less or more than 75 d in milk ($P = 0.28$). On the contrary, a significant interaction of time × days in milk was recorded ($P < 0.01$) when all buffaloes were consid-
Influence of pediculosis in buffalo

ACYP, a synthetic pyrethroid insecticide, on buffalo (Neglia et al., 2013). In the past, the animals were worth pointing out that the overcrowding, a typical health and production (Veneziano et al., 2004, 2013; Campanile and Neglia, 1985; Ahmed et al., 2009). On the contrary, Veneziano et al. (2004) found that eprinomectin pour-on, a macrocyclic lactone with zero milk-withdrawal time, at cattle dose (500 μg/kg BW) was completely effective on water buffaloes naturally infested by H. tuberculatus with a total control of the lice 63 d after treatment.

DISCUSSION

The present study aimed to assess the efficacy of ACYP, a synthetic pyrethroid insecticide, on buffalo pediculosis and to evaluate the effect of the treatment on productive and reproductive performance in intensive breeding. The pediculosis due to H. tuberculatus is the main parasitic disease that can influence buffalo health and production (Veneziano et al., 2004, 2013; Neglia et al., 2013). In the past, the animals were maintained on pastures and were able to defend themselves and reduce the parasitic load using mud pools, which are characteristic of the marginal zones where buffaloes were confined. Nowadays, the new intensive breeding techniques and different management that is applied in Italy reduced helminth infections but, simultaneously, do not allow the animals to naturally counteract infestations from ectoparasites. Furthermore, it is worth pointing out that the overcrowding, a typical scenario in intensive breeding, favors the diffusion of ectoparasites, such as H. tuberculatus.

Alphacypermethrin is effective against a wide range of pests relevant to public health and animal husbandry and it is used in veterinary medicine to control ectoparasites, such as ticks, lice, and blowflies. Alphacypermethrin acts on insects’ axons in the peripheral and central nervous systems by interacting with sodium channels. The efficacy of ACYP recorded in our study (100%) is similar to that reported in previous trials performed in both buffaloes bred in intensive breeding in Italy (Veneziano et al., 2013) and donkeys naturally infested by the chewing louse Werneckiella equi (Veneziano et al., 2012) by using the same molecule. Furthermore, it was more effective than ivermectin, which showed an efficacy ranging from 80 to 90% at a dose of 200 or 400 μg/kg in previous studies (Lau and Singh, 1985; Ahmed et al., 2009). On the contrary, Veneziano et al. (2004) found that eprinomectin pour-on, a macrocyclic lactone with zero milk-withdrawal time, at cattle dose (500 μg/kg BW) was completely effective on water buffaloes naturally infested by H. tuberculatus with a total control of the lice 63 d after treatment.

Milk yield recorded in Group A was significantly higher than that recorded in Group S. This was mainly influenced by the milk production recorded in buffaloes with less than 75 d in milk, because no differences were observed in those with more than 75 d in milk between the 2 groups. Interestingly, a higher milk yield was observed in Group A from the first until the fifth week, which corresponds to the condition of negative energy balance. It is known that ruminants enter a state of negative energy balance during early lactation when the energy demand for maintenance and lactation exceeds that of dietary energy intake (Bauman and Currie 1980). This condition causes mobilization of body reserves and changes in BCS and live weight (Le Blanc, 2010). In buffalo species, it has been observed that the high milk production together with the low DMI that occurs at the beginning of lactation cause a 2 to 4% BW loss in primiparous and multiparous cows, respectively (Campanile and Neglia, 2004). In our study, buffaloes in Group A also showed

Table 1. Milk production (kg – mean ± SE) recorded in buffaloes at less than 75 d in milk treated by alphacypermethrin (Group A) or by saline (Group S) from the first (W0) to the ninth week (W9)

<table>
<thead>
<tr>
<th>Group</th>
<th>W0</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
<th>W8</th>
<th>W9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (n = 18)</td>
<td>12.31 ± 0.2</td>
<td>12.58 ± 0.2</td>
<td>12.45 ± 0.2</td>
<td>12.50 ± 0.2</td>
<td>12.41 ± 0.2</td>
<td>12.11 ± 0.2</td>
<td>11.36 ± 0.2</td>
<td>11.18 ± 0.2</td>
<td>10.88 ± 0.2</td>
<td>10.58 ± 0.2</td>
</tr>
<tr>
<td>Group S (n = 10)</td>
<td>9.81 ± 0.3</td>
<td>9.27 ± 0.2</td>
<td>8.76 ± 0.2</td>
<td>8.77 ± 0.2</td>
<td>8.72 ± 0.1</td>
<td>8.69 ± 0.1</td>
<td>8.31 ± 0.2</td>
<td>8.18 ± 0.2</td>
<td>8.03 ± 0.2</td>
<td>7.63 ± 0.2</td>
</tr>
</tbody>
</table>

Values within a column with different superscripts differ significantly at *P* < 0.05.

Table 2. Milk production (kg – mean ± SE) recorded in buffaloes at more than 75 d in milk treated by alphacypermethrin (Group A) or by saline (Group S) from the first (W0) to the ninth week (W9)

<table>
<thead>
<tr>
<th>Group</th>
<th>W0</th>
<th>W1</th>
<th>W2</th>
<th>W3</th>
<th>W4</th>
<th>W5</th>
<th>W6</th>
<th>W7</th>
<th>W8</th>
<th>W9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A (n = 10)</td>
<td>9.70 ± 0.2</td>
<td>9.13 ± 0.3</td>
<td>8.72 ± 0.2</td>
<td>8.65 ± 0.2</td>
<td>8.72 ± 0.2</td>
<td>8.67 ± 0.2</td>
<td>8.29 ± 0.2</td>
<td>8.13 ± 0.2</td>
<td>7.87 ± 0.2</td>
<td>7.63 ± 0.2</td>
</tr>
<tr>
<td>Group S (n = 10)</td>
<td>12.35 ± 0.2</td>
<td>12.03 ± 0.2</td>
<td>11.83 ± 0.2</td>
<td>11.79 ± 0.2</td>
<td>11.69 ± 0.2</td>
<td>11.74 ± 0.2</td>
<td>11.40 ± 0.2</td>
<td>11.13 ± 0.2</td>
<td>10.79 ± 0.2</td>
<td>10.39 ± 0.2</td>
</tr>
</tbody>
</table>

Values within a column with different superscripts differ significantly at *P* < 0.05.
higher BCS scores at the end of the trial compared to their Group S counterparts and this phenomenon was mainly observed in animals at less than 75 d in milk. It is known that *H. tuberculatus* causes irritation, rubbing, scratching, and loss of BCS because the animals are distracted from feeding (Veneziano et al., 2003). In a study performed on Egyptian buffaloes (Ahmed et al., 2009), subjects infested by *H. tuberculatus* showed lower BCS compared to healthy animals. Furthermore, it was demonstrated that treatment for skin parasites allowed 0.25 kg additional daily weight gain in Hereford calves (Kamyszew and Tratwal, 1977). In our trial, buffaloes in Group A ingested about 28 kg of DM (and hence 25.2 MFU) more compared to buffaloes in Group S throughout the experimental period, although this difference was not significant. This MFU surplus may be accounted for the higher milk production recorded in Group A. Furthermore, in a recent trial performed on Murrah buffalo heifers, the energy requirement for increasing 1 kg of live BW was around 4.5 MFU (Campanile et al., 2010b). Taking into account daily energy requirements for maintenance and milk production, a surplus of 1.12 MFU/buffalo (which corresponds to 70.6 MFU throughout the experimental period) was recorded in Group A compared to group B. Because each point of BCS seems to be equivalent to an increase and/or a loss of about 50 kg of live weight (Gasparrini et al., 2007), it is likely that this energy surplus may have been used to increase 0.3 BCS points (about 16 kg). Interestingly, the BCS score increase was not observed in Group S, where the presence of ectoparasites may even worsen the negative energy balance, increasing reserves mobilization and reducing the BCS.

In a previous study (Veneziano et al., 2004), a treatment with eprinomectin pour-on was performed in lactating buffaloes and milk yield was recorded throughout the lactation. A higher average milk production during the whole lactation (about 70 kg) was observed, although significant differences were assessed only in the second half of lactation. These conflicting results may be explained by both the different productive level of the buffaloes used in the 2 trials and the different experimental conditions. In fact, in our study, the average milk production of the animals was about 2,900 kg of milk/lactation (on the basis of the data obtained by the Italian Breeders Association [Rome, Italy] in the previous lactation and as prediction current lactation), whereas in the study performed by Veneziano et al. (2013), the average production was about 2,300 kg of milk/lactation. It is known that highly producing cows show more severe negative energy balance than low producing animals (Le Blanc, 2010). Furthermore, the number of lice recorded in our study was higher than that observed previously (about 50 lice in the same predilection sites compared to about 80 in our trial).

It is likely that the improvement of both the general health status of the animals and the BCS had also positive effects on reproductive performance. Although no differences were found between the 2 groups in terms of pregnancy rate, probably because of the low number of subjects included in the study, buffaloes in Group A showed a significantly lower calving–conception interval compared to Group S. A relationship between BCS and fertility has been recorded in both dairy buffaloes (Campanile et al., 2006) and dairy cattle (Le Blanc, 2010). In particular, animals characterized by low BCS score showed also a decline in fertility. Furthermore, embryo quality is also reduced in high producing dairy cows compared to heifers or beef cows (Leroy et al., 2005). The application of the out-of-breeding-season mating technique (Campanile et al., 2010a) inevitably causes an extension of the intercalving period, because the sexual promiscuity is avoided for at least 5 mo, which are the most favorable for the reproductive activity of the species. Pregnancy lasts 305 d in buffalo; therefore, it is clear that an optimal intercalving period of 400 d can hardly be achieved in this species. As in dairy cattle, the key point to improve the reproductive efficiency is to ensure optimal conditions of the animals during the first stages of lactation. In this sense, the treatment against pediculosis may represent a further improvement in herd management.

In conclusion, this study demonstrates that the treatment of pediculosis in dairy buffaloes in intensive breeding improves productive and reproductive performance,

<table>
<thead>
<tr>
<th>Buffaloes</th>
<th>Fixed TAI number ACYP</th>
<th>SAL</th>
<th>ACYP</th>
<th>SAL</th>
<th>ACYP</th>
<th>SAL</th>
<th>ACYP</th>
<th>SAL</th>
<th>ACYP</th>
<th>SAL</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant, n</td>
<td>11</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Pregnant, %</td>
<td>52.4</td>
<td>23.8</td>
<td>40.0</td>
<td>6.3</td>
<td>33.3</td>
<td>40.0</td>
<td>50.0</td>
<td>44.4</td>
<td>0.0</td>
<td>20.0</td>
<td>90.5</td>
</tr>
<tr>
<td>Percentage of total pregnant</td>
<td>57.9</td>
<td>29.4</td>
<td>21.1</td>
<td>5.9</td>
<td>10.5</td>
<td>35.3</td>
<td>10.5</td>
<td>23.5</td>
<td>0.00</td>
<td>5.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>
in particular when it is performed during the first phase of lactation. Furthermore, it is worth pointing out that in Italy, alphacypermethrin is the only molecule, together with eprinomectin, that is marketed as a pour-on formulation for use on cattle and buffalo with zero milk-withdrawal time to treat louse infestations. This allows its use also in lactating animals and, according to these results, in particular during the first phase of lactation.

LITERATURE CITED


