# A STUDY ON THE BREEDING PERFORMANCE OF ROMNEY AND BORDER LEICESTER CROSS ROMNEY EWE LAMBS AFTER CIDR TREATMENT

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Palmerston North

New Zealand

BAE SEOK CHUN

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ABSTRACT

The reproductive performance of 117 Border-Leicester X Romney (BLX) and 91 Romney ewe hoggets in 1984 and 108 BLX and 101 Romney in 1985, was studied after treatment with controlled internal drug releasers (CIDRs) containing progesterone or with polyurethane sponges containing medroxyprogesterone acetate (MAP). To induce and synchronise oestrus at the beginning of the breeding season, progestagens were administered for 11-12 days. The animals were joined with teaser rams or with entire rams and data collected on the occurrence and synchronization of oestrus, conception and lambing performance.

In 1986, 36 lambs of each of the Romney or BLX genotypes were used in a study to determine the time of ovulation after treatment with CIDRs either with or without 200 i.u. PMSG injected at CIDR withdrawal. Laparoscopies were carried out one or more times at 54,60,66,72 hours and one week after CIDR withdrawal to determine the occurrence of ovulation. The release of progesterone from the CIDR was monitored in blood samples from entire animals and from ovariectomised animals during treatment and after withdrawal of the CIDRs.

Following progestagen withdrawal, 69% and 42% of sponge- treated hoggets and 45% and 40% of CIDR-treated animals were in oestrus over 5 days in the two years,respectively. In 1986, following progestagen withdrawal, 61% and 83% of animals came into oestrus within 3 days in CIDR- and CIDR + PMSG- treated ewe lambs.

The mean time of ovulation was 67 h and 65 h in CIDR and CIDR + PMSG treated animals, respectively. The incidence of multiple ovulation was similar in CIDR- (15%) and Sponge-treated (20%) ewe lambs. Although the injection of a small amount of PMSG caused a higher incidence of multiple ovulation than in CIDR-treated ewe lambs, the difference was not significant. The conception rate was higher in animals treated in 1984 than in the next year (69% v 49%). Treatment

or breed differences in conception were not significant but in 1985 the BLX animals had a reduced conception rate of only 38%; the Breed X Year interaction was significant ($P < 0.05$). There were only a few multiple births recorded and the gestation length was not affected by treatment. Significant birth weight effects due to year and breed were apparent, but only a difference due to year occurred in the weaning weights. The fleece weights recorded at one year age were not influenced by the treatments, but year effects were important.

Progesterone levels in blood plasma of ovariectomised ewe lambs reached a maximum by 24 h after CIDR insertion, then declined gradually and an abrupt fall resulted soon after CIDR withdrawal. In the entire lambs with CIDRs the levels of progesterone remained high until withdrawal and then fell to basal levels consistent with ovulation. After this the levels rose and were similar to that in animals with a corpus luteum of a natural oestrous cycle.

It was concluded that CIDR treatment can induce earlier breeding among ewe lambs and that the induced ovulation resulted in a normal corpus luteum. The pregnancy rate after CIDR treatment was influenced by year effects and this was probably associated with differences in liveweight among the ewe lambs.

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# CHAPTER ONE
# INTRODUCTION

In New Zealand mating of ewe lambs is not common and ewes are normally bred first at about eighteen months of age.Methods to increase the efficiency of sheep production are sought if the New Zealand sheep industry is to remain competitive.Breeding the ewe as early as possible would be one method to increase efficiency during the breeding ewe's productive lifetime. Overseas, early breeding of ewe lambs is frequently the normal practice where good feed conditions prevail. Because of the good conception rates and lambing percentages achieved it is relevent to study early breeding in relation to increased efficiency of lamb production in New Zealand.

Breeding young animals to give birth at about a year has several advantages.These include a saleable meat production at one year old rather than two years,reduction maintenance costs before the start of reproduction,reduction in the generation interval which could result in more rapid genetic gains from selection, and early prediction of subsequent years reproductive performance. However,the success rate in breeding ewe lambs is generally lower than that expected from two-year-old ewes. In ewe lambs the behavioural signs of oestrus are usually weak and less intense than in two-tooth and in adult ewes and this with the shorter oestrus may lower mating efficiency. Furthermore,it might be anticipated that early breeding would detrimentally lower later reproductive performance owing to the pregnancy in the immature animal. Furthermore,the spread in the onset of puberty may lead to a delayed and possibly prolonged mating season and hence to a lengthy and very late lambing period. Unless a restricted lactation occurred then performance at the two year age would be reduced.

The benefits of using various hormonal treatments, involving gonadotrophic and gonadal hormones and prostaglandins to control

breeding in the ewe have been well established,but very few studies have been conducted in lambs. Controlled breeding could be applied to ewe lambs to synchronize oestrus in those that have already reached puberty and also to induce oestrus in lambs that would not have mated at all during their first year of life. Suitable methods of controlled breeding would be required if multiple ovulation of young ewes and ebryo transfer (probably into mature ewes) was developed to increase the rates of genetic improvement theoretically possible (Smith,1986) as compared with normal reproduction and conventional selection schemes.

# CHAPTER TWO

# REVIEW OF LITERATURE

## 2.1. ASPECTS OF PUBERTY

### 2.1.1. Definition

Puberty is often defined as the time at which reproduction first becomes possible,characterised by the release of germ cells in the female, whereas sexual maturity is the time when the animal expresses its full reproductive power (Asdell,1946).

Puberty in ewe lambs is determined by most observers in terms of age at first behavioural oestrus (Joubert,1963; Dyrmundsson, 1973). Allen and Lamming (1961) studied the formation of ovarian follicles and the development of the reproductive tract after slaughter. Ovulation has been determined by laparotomy (Southam et al.,1971) and disadvantages associated with the technique (Oldham et al.,1976) have been overcome by the development of endoscopic procedures (Roberts,1968; Kelly and Allison,1976). Blood hormone levels have been monitored as the young animal approaches puberty (Foster, et al.,1975a). Although it is normally assumed that ovulation accompanies first oestrus, ovulation without oestrus (Foote, et al.,1970) or oestrus without ovulation can occur in ewe lambs (Chu and Edey, 1978). Edey et al.(1978) have suggested that puberty would be more adequately defined by including both the requirement to ovulate and to allow insemination by the ram. The first appearance of tupping marks on the rumps of ewe lambs joined with harnessed rams appears to be an acceptable working definition of puberty in the ewe.

### 2.1.2. Endocrinology of puberty

A) During foetal development

Gonadotrophic hormones are evident in both the foetal pituitary and embryonic circulations by 55 days of gestation (Foster et al.,1972a). The temporal changes in circulating luteinizing hormone (LH) increases to a maximum at about midgestation and declines

thereafter while follicle stimulating hormone (FSH) continues to increase through the third quarter of gestation before eventual decline independent of sex or twinning status (Foster et al.,1972a; Sklar et al.,1978; Sklar et al.,1981). Levasseur (1979) has reported that the secretion of gonadotrophins from the foetal pituitary is aumented during the same temporal frame in which oogenesis and initial stages of folliculogenesis occur and has presumed that gonadotrophic hormone of foetal origin could be a critical role in the functional development of the ovary. Mueller et al. (1978) has identified the gonadotrophin releasing hormone (Gn-RH) in the hypothalamus of the foetal lamb by the 58th day of gestation. Furthermore, hypothalamic extract or synthetic Gn-RH will induce gonadotrophin secretion from the pituitary glands of the foetal lambs (Foster et al.,1972c; Mueller et al.,1981).

B) During early postnatal period

The tonic level of FSH secretion increases about two-fold during the first ten weeks of life and then remains relatively constant and their levels comparable with those in the adult female (Foster et al., 1975b).

LH secretion is low for 2-5 weeks after birth (Foster et al., 1972b). After this the number of LH pulses increases and this extends over a period of 25-30 weeks (Foster,et al. 1975b) and the pulsatile patterns of circulating LH reflect the tonic rather than the surge mode of LH secretion. Foster and Ryan (1979a, 1981) have concluded that this increase in pulsatility is the result of a decrease in the sensitivity of the hypothalamic-pituitary axis to oestradiol. During the prepubertal period, the pulsatile pattern of LH secretion increases both in the frequency and amplitude of the LH (Ryan and Foster,1978). Quirke et al. (1983) suggested this hourly pulse frequency might be the threshold which permits continuation of the maturational development of the follicles leading to the first ovulation. Ryan and Foster (1980) have induced ovulation in the prepubertal lamb by the hourly administration of exogenous LH, however administration at three hourly intervals was ineffective. Some evidence has been obtained for a marked increase in LH pulse frequency, but not amplitude shortly before first ovulation (Huffman and Goodman, 1985).

A positive LH response following injection of oestradiol is observed before puberty as early as 5-7 weeks of age (Squires et al., 1972; Foster and Karsch,1975). The positive feedback mechanism gradually matures during the prepubertal period because the magnitude of oestradiol-induced gonadotrophin release increases progressively through this period (Foster and Karsch, 1975). By 12-20 weeks of age, the magnitude of the LH surge was in the range of that capable of producing ovulation.Moreover, when the response to oestradiol positive feedback was determined at 20 weeks of age (i.e. 10 weeks before expected puberty) the sensitivity was equal to that of the adult,and as little as a 2ng/ml increment in circulating oestradiol produced an LH surge (Foster, 1984). Gluckman et al. (1979) have noted the negative feedback effects of oestradiol on the hypothalamic- hypophyseal axis in utero. The negative feedback effects of oestradiol begin to be suppressed fully after the fifth week of neonatal life (Foster et al., 1972a; Foster et al., 1975b).

In lambs which have been ovariectomised increased gonadotrophin secretion indicates the repressive effect of oestradiol. Furthermore, Foster and Ryan (1979b) have reported that the potency of oestradiol as a negative regulator of the hypothalamic-hypophyseal axis is markedly reduced in the ovariectomised lamb at 28-32 weeks of postnatal development. The marked reduction in response to the inhibitory effect of oestradiol on tonic LH (Legan et al., 1977) has suggested that hypersensitivity to oestradiol feedback on LH secretion was the final common mechanism in both the prepubertal ewe lamb and the anoestrous ewe (Ryan and Foster,1980).

C) During pubertal period

The transition into adulthood occurs when sensitivity to oestradiol feedback inhibition decreases sufficiently to allow the expression of the requisite high-frequency LH pulses.In concert with the reduction in sensitivity to negative feedback,oestradiol becomes able to accelerate LH pulse to frequencies beyond those possible in the absence of steroids (Foster and Olster, 1985; Foster et al., 1985). These high-frequency LH pulses then develop the ovarian follicle to the preovulatory stage ,and induce the sustained rise in oestradiol production. The dormant gonadotrophin surge system is activated, and the first ovulation occurs.

Steroid feedback control of LH secretion shifts from oestradiol to progesterone during the pubertal transition after the inibition of ovulation. Progesterone serves as a potent inhibitor of LH secretion in the lamb (Foster and Karsch, 1976) and the LH pulses slow in response to this steroid emanating from the newly formed corpus luteum (Foster et al.,1975a). During the luteal phase of the cycle, such infrequent pulses do not provide a sufficient stimulus to drive the follicle to the preovulatory stage, and hence for its secretion of oestradiol to levels that trigger the gonadotrophin surge mechanism. Following luteal regression and the decline in progesterone secretion, high frequency LH pulses once again occur to initiate the next 2-3 day follicular phase, and another postpubertal reproductive cycle begins (Karsh et al.,1984; Martin,1984).

## 2.2. FACTORS AFFECTING FIRST OESTRUS

In most studies of puberty, the age at first oestrus has been recorded to determine the influence of factors such as breed,time of birth,growth rate, photoperiod and liveweight (Joubert,1963;Dyrmundsson, 1973; Quirke, 1978a, 1979a; Foster and Ryan,1981; Foster et al.,1984).

### 2.2.1. Breed

Breed and strains within breed differences in the incidence, and in the age and body weight at first oestrus have been reported (Hafez,1952; Dyrmundsson,1973). Land (1978) has emphasised that sexual development is affected by both genetic and environmental factors and the interaction between these. A higher proportion of Border Leicester-Romney crossbreed, particularly F1 and F2 animals compared to straight-bred Romney ewe lambs showed first oestrus during the first but not the second half of the breeding season (Hight et al.,1973). Laster et al. (1972) conducted a study involving 19 genetic groups and recorded that Finnish-Landrace crossbreeding in particular can markedly increase the incidence of first oestrus.

Quirke et al. (1985) reported Rambouillets were older at first oestrus than Finnsh Landrace and Finn-Dorsets, but differences in age at first ovulation were not significant. The Finnish Landrace and Finn-Dorset ewes continued to cycle much longer than the other groups. Vesely and Swierstra (1986) have reported that lambs sired by Romanov rams conceived at an earlier age than Finnish- or Dorset-sired lambs,however the litter sizes were similar for Romanov- and Finn-sired lambs but smaller for Dorset-sired lambs.

### 2.2.2. Age and body weight

There is variation, both between and within breeds, in the age and body weight at puberty (Hafez,1952, 1953; Southam et al.,1971). Dyrmundsson (1973) has summarized ages at puberty within the range of 6-18 months. The season of birth can influence the age at puberty and cause it to occur earlier (Robinson and Orskov, 1975) or later (Foster,1980) than the mean. Keane (1975b),on the other hand,found that time of birth, within the range January to April had no influence on reproduction in the ewe lambs. In general, first oestrus in ewe lambs is attained at weights varying from 50 to 70% of adult body weight,mainly within the range of 30-50 kg. (Hafez,1952; Dyrmundsson, 1973; Bichard et al., 1974; Quirke et al., 1978).

However,Keane (1974b) has reported that in Irish Suffolk-cross lambs, puberty may occur at 44 kg in early October but decline to 33 Kg in late December. Later born lambs tend to be younger at first oestrus (Hafez,1952; Sefidbakht et al., 1966; Dyrmundsson and Lees,1972a; Quirke, 1978a). Twin-born lambs are often older than singles at first oestrus (Southam et al.,1971; Dyrmundsson and Lees,1972a; Hight et al.,1973; Baker et al.,1978). In general,faster growth during rearing will normally favour an earlier onset of oestrus at a lower age than heavier bodyweight lambs growing at slower rates,and normally exhibit oestrus later in the season at higher mean ages (Foster and Ryan,1981; Foster et al.,1984).

### 2.2.3. Nutrition

Many studies have suggested that ewe hoggets on a high plane of nutrition are younger at their first oestrus than those reared on a lower plane of nutrition (Keane, 1984; Moore et al.,1978; Hamra and Bryant,1979; Moore and Smeaton, 1980) and also heavier (Keane, 1974b; Hamra and Bryant,1982).Underfeeding of immature animals may seriously retard pubertal development (Lamming,1969). It has been also reported that the early growth pattern of ewes can affect their reproductive

potential (Gunn,1977; Downing and Lees,1977). At high growth rates the plane of nutrition made little difference, but at low growth rate, differences in nutrition were more important, particularly for hoggets born late in the year.

Fitzgerald et al.,1982 have reported a lower LH pulse frequency and amplitude in lambs on a low energy diet. Foster et al. (1984) also reported a nutritional effect on LH pulse frequency during the pubertal process and demonstrated that low nutrition impairs the neuroendocrine regulation of tonic LH secretion. Foster and Olster (1985) demonstrated that small amounts of exogenous oestradiol exert a potent negative feedback action,and LH remains suppressed during the time when puberty would occur had the lambs not been growth- retarded. When such food-restricted females are fed ad libitum, the sensitivity to oestradiol inhibition is reduced and LH increases, reflecting the production of high frequency pulses.

### 2.2.4. Photoperiod

Ample evidence indicates that seasonality is an important factor in the attainment of puberty in ewe lambs (Dyrmundsson,1973). The onset of oestrous activity in the majority of non-tropical breeds usually occurs during the period of decreasing daylight hours in the autumn and winter (Hafez,1952; Ch'ang and Raeside,1957; Joubert,1962; Burfening et al.,1974; Dyrmundsson,1978; Legan and Karsch,1980). In breeds of tropical origin, however, it would seem that ewe lambs may experience a less well-defined seasonal onset of first oestrus than ewe lambs of higher latitudes,(Mounib et al.,1965; Younis et al., 1978).

Ducker et al. (1973) found that various artificial light treatments modified the occurrence of oestrus in ewe hoggets,while it has been suggested that daylight environment experienced by the lamb during rearing may be a critical factor in regulating breeding activity (Dyrmundsson and Lees,1972a; Legan and Karsch,1980; Foster and Ryan, 1981). Attempts have been made to define the critical light

requirements for normal puberty onset. If ewe lambs are maintained from birth in constant long or constant short day length, puberty is delayed (Yellon and Foster 1985). Furthermore, short daylength is only stimulatory if ewe lambs have been exposed to long daylength between 10-20 weeks of age (Foster et al.,1985).

### 2.2.5 Exteroceptive factors

The presence of the ram suddenly introduced to ewes in the transition from the non-breeding to the breeding season is known as an "exteroceptive" factor leading to a synchronisation of oestrus in adult ewes (Schinckel,1954). The first evidence that the stimulation of the ewe was mediated by ram pheromone was reported by Watson and Radford (1960). The wool and wax from rams contain pheromones which, when applied to anoestrous ewes,will stimulate them to ovulate (Knight and Lynch,1980a; Knight et al.,1983)

Ewes and wethers treated for short periods with high doses of androgens or oestrogens can be as effectives as rams at stimulating ewes to ovulate and exhibit oestrus (Lishman et al.,1969; Fulkerson et al., 1981; Croker et al.,1982.) Most breeds of ewes can be stimulated by the ram (Merino: Schinckel,1954; Romney: Edgar and Bilkey,1963; Awassi: Eyal, 1968; Prealps, Ile-de-France and Berichon: Cognie' et al., 1980; Sarda: Cappai et al.,1984).

Dorset rams were more effective than Merino rams which in turn were more effective than Romney rams at stimulating oestrus in ewes (Tervit et al., 1977; Knight et al., 1980). The minimum period of isolation is unknown but isolation from the sight and smell of rams for 17 and 34 days is a general recommendation (Oldham,1980). Knight,1980) found that while 24 h teasing increased the percentage of ewes exhibiting oestrus 17 to 24 days later, 48 h teasing was required to give a response equivalent to teasing for 17 days. Oldham and Gray (1984) have induced puberty with testosterone-primed wethers in 10 month-old Merino ewes irrespective of their season of birth, but their

ovulatory response was relatively poor (Murtagh et al.,1984; Oldham and Gray,1984).

### 2.2.6. Temperature

Little information is available in the literature on the direct effect of temperature on sexual development in ewe lambs. The removal of the fleece towards the end of anoestrus was found to advance the time of first oestrus in adult ewes (Lees,1967). However, after autumn shearing of the ewe lambs in Wales there was no clear effect on the onset of puberty (Dyrmundsson and Lees,1972a).

### 2.2.7. Exogenous hormones

Various gonadal and gonadotrophic hormones have been used to manipulate reproductive function in very young immature ewe lambs (Mansour,1959; Denamur and Mauleon,1963; Land et al., 1970). Progestagens, administered by intramuscular injection or as feed additives have been used in conjunction with Pregnant Mare Serum Gonadotrophin (PMSG) to induce breeding in prepuberal animals (Burfening and Van Horn,1970; Gordon,1967a; Trounson et al., 1977; Wright et al., 1976). Induction of puberty using Human Chorionic Gonadotrophins (HCG) and oestrogen has been examined, but with little benefit (Sefidbakht et al.,1967; Southam et al., 1971; Keane, 1975a; Quirke,1981). Dyrmundsson (1973) concluded that a high degree of variability existed in the proportion of ewe lambs which responded successfully to treatment and these were more effective when applied close to the time of natural onset of breeding activity.

## 2.3. ARTIFICIAL CONTROL OF OESTRUS AND OVULATION

### 2.3.1. Progesterone and its analogues

Ovulation can be blocked by progesterone and therefore such treatment can be useful for synchronising oestrus and ovulation. Progesterone or synthetic progestagens administered by oral, subcutaneous, intramuscular or intravaginal routes simulate the action of the corpus luteum.

In the young lambs, Mansour (1959) induced ovulation at 8-12 weeks of age by treatment with progesterone and PMSG. Ova recovered from such animals after intrauterine insemination were cleaved (Land and McGovern,1968) and when transferred to adult ewes appeared to develop normally (Trounson et al. 1977).

Progesterone treatment has be advanced the breeding season by several weeks when given to lambs at 7-10 months of age, or caused synchronization of breeding in cyclic animals (Quirke et al. 1983;Keane, 1974a). PMSG has been also of value in causing earlier reproduction (Burfening and Van Horn, 1970)

Most pratical methods to induce breeding have used intravaginal sponges or subcutaneus silastic implants (Quirke, 1978b; Colas,1979). Progestagen analogues as well as progesterone have been used. Recently an intravaginal device (CIDR) consisting of a plastic core covered with an elastomer-containing progesterone has been used to induce oestrus in adult ewes (Welch et al., 1984; Ainsworth and Downey, 1986; Boland et al.,1983) and in lamb (McMillan, 1986). In ewes there was a linear increase in fertility when the progesterone content of intravaginal sponges was increased from 500 to 1000 mg. Optimum fertility appeared to be related to adequate absorption of progesterone at rapid initial rate, this being assured at the higher level of progesterone.

Various progestagens including Fluorogestone acetate (FGA) and

Medroxyprogesterone acetate (MAP) have been shown to be efficient in controlling oestrus (Robinson, 1967; Cognie' et al. 1977). In Ireland, comparative trials have shown that sponge containing these compounds are equally effective in inducing and synchronizing oestrus, in both ewes and lambs at doses of 30 and 60 mg, respectively (Gordon, 1975; Quirke,1979b). French researchers favour the higher dose of Cronolone (FGA 40 mg) for ewe lambs and recommended a 14 day treatment duration (Thimonier and Cognie', 1977). A reduction in the duration of progestagen administration from 14 to 10 days did not modify the response to the treatment or the fertility of ewe lambs (Cognie' and Mauleon, 1983).

The retention rate of intravaginal sponge in hoggets may be similar to that in ewe 0.5% (Reed et al.,1977), but loss rates may be high especially where difficulty of insertion is encountered (Ch'ang et al. 1968).

### 2.3.2. Melatonin

The pineal indoleamine, melatonin, has been proposed to be the hormone that mediates the photoperiodic regulation of seasonal breeding. Pinealectomy of prepubertal sheep does not affect growth rate, (Brown and Forbes, 1980), but puberty was significantly delayed; the median pubertal age in pineal-intact ewe lambs was 37 weeks compared to 49 weeks in pinealectomised lambs (Kennaway et al. 1985). It has been demonstrated that melatonin drives the reproductive response of the ewe to inductive photoperiods (Bittman et al.1983).

The rythmic administration of melatonin, by feeding or injection, can substitute for darkness to induce puberty and the breeding season in both ewe lambs and adults (Kennaway et al. 1982a; Nett and Niswender, 1982; Arendt et al.1983; Nowak and Rodway, 1984, 1985). Puberty was unaffected or significantly delayed in lambs treated with melatonin at birth or at 8 weeks of age (Kennaway and Gilmore, 1984; Nowak and Rodway, 1984; while lambs treated at 19 weeks ovulated 45

days earlier or advanced puberty by 2-5 weeks before that in untreated animals (Nowak and Rodway, 1984, 1985). First oestrus was advanced by 2 weeks and 3 weeks when malatonin was given orally or by implant, respectively Moore et al.(1984).

### 2.3.3. Steroid immunization

Follicular growth and ovulation rate is increased in ewes passively immunised against oestradiol (Scaramuzzi,1975). The ovulatory responses to active immunization against oestrone and androstenedione have been tested (Cox et al. 1976; Scaramuzzi et al., 1977). In ewes ranging from 18 months to 7 years of age no effect of age on the number of extra lambs born in response to immunization was reported (Geldard, 1984). McMillan and Smith (1983) immunised against oestrone in Romney hoggets and increased multiple ovulation rates by 50%, Fitzsimons and Hanrahan (1984) also increased first ovulation rate in ewe lambs after immunisation against androstenedione.

O'Shea et al. (1984) immmunised ewe lambs from 3 weeks of age with inhibin, which specifically supresses FSH secretion (Cummins et al. 1983) and obtained advanced puberty and increased ovulation rate; thus ovarian examination of lambs 7 months of age revealed 1 of 9 control lambs to have ovulated, whereas 10 of 15 immunised lambs had up to 8 recent ovulations (mean $\pm$ 2.9).

## 2.4. TIME OF OVULATION

The use of progestagens to control oestrus and ovulation in sheep is closely associated with the application of artificial insemination (Colas,1975). Accurate knowledge of the time of ovulation is crucial to the success of insemination, since introduction of the sperm suspension into the female genital tract must precede release of the egg by a number of hours. The time of ovulation is related to the onset of oestrus, the duration of oestrus is generally 24-42 h,and

ovulation normally occurs 25-30 h after the onset of oestrus. The time of ovulation varies from as early as 11 h before the end of oestrus to 7 h after, but generally it occurs before the end of oestrus and is more closely related to the end than the beginning of oestrus (Robinson,1959; Persons et al.,1967; Holst and Braden,1972).

### 2.4.1. Factors affecting time of ovulation

#### 2.4.1.1. Season

Boschoff et al. (1973) reported the average length of oestrus induced during the non-breeding season (29 h) was significantly shorter than among ewes treated within the breeding season (35 h) Lamond (1962). The interval from sponge withdrawal to the beginning of oestrus was found to be shorter (Cognie' et al., 1970) and the length of oestrus longer in the normal breeding season as compared to the non-breeding season. However once oestrus has started the interval to ovulation did not differ within or without the breeding season (Boschoff et al., 1973).

#### 2.4.1.2. Age

Quirke et al., 1981 reported that the interval between sponge removal and the onset of oestrus was shorter for adults than for ewe lambs, but the interval from the onset of oestrus to the beginning of the LH discarge was longer in adults. In mature ewes the interval between the start of the preovulatory LH discarge and ovulation is relatively constant (21-26 h) and ovulation generally occurs around the end of oestrus (Robinson, 1959; Parson et al.,1967; Holst and Braden,1972; Cumming et al.,1973). Quirke et al., (1981) found a similar relationship in progestagen-PMSG treated Galway ewe lambs.

2.4.1.3. Hormonal treatment effect

In the ewe, ovulation occurs 32 h after onset of oestrus, and is not modified by control with intravaginal fluorogestone acetate (FGA). Injection of PMSG, however, results in earlier onset of oestrus in FGA-treated ewes (30 h v 37 h after sponge withdrawal)(Signoret and Cognie', 1975). The time of ovulation in relation to sponge withdrawal is known to be advanced by treatment with both PMSG (Killen and Moore,1970; Boschoff et al.,1973; Evans and Robinson,1980;) and FSH (Evans and Armstrong, 1984).

2.4.1.4. Ram effect

Signoret and Cognie' (1975) found the presence of the male accelerates the time of LH surge and ovulation by 6-8 h and reduces markedly the duration of sexual receptivity (Parsons and Hunter, 1967; Fletcher and Lindsay, 1971). The mean time of ovulation with respect to sponge removal for ewes joined with vasectomised rams at sponge removal in teased and unteased ewes was 55.8 h and 59.7 h, respectively and with little variation (Maxwell, 1986).

2.4.1.5. Stress

Transport of ewes can alter the incidence of ovulation and even induced it in anoestrous animals (Braden and Moule, 1964). A number of stressful stimuli might well affect the time when ovulation occurs after synchronization treatment. Walker et al. (1986) have reported 12.6% of the ovulations in control ewes occurred later than 72 h after sponge removal whereas no ovulations occurred in this period in ewes that underwent repeated laparoscopy. The stress experienced by the ewes as an inevitable consequence of repeated laparoscopy may have an effect on the time-course of ovulation. However, Walker et al. (1986) concluded its effect was small.

## 2.5. PROGESTERONE IN PERIPHERAL BLOOD

### 2.5.1. Prepubertal period

Several reports indicate that one or more ovulations may occur prior to that recorded at first oestrus (Foote et al. 1970; Foster and Karsch,1975). Foster and Ryan (1979) reported that such ovulations were initiated by an LH surge.

Fitzgerald and Butler (1978) showed a transient elevation of serum progesterone (0.2-0.8 ng/ml) lasting 1-4 days preceded the first ovulatory increment in progesterone (1.5-2.0 ng/ml). This is in agreement with the observations of Ryan and Foster (1978). Berardinelli et al. (1980) reported the first and second rises of progesterone in prepuberal ewes were produced by luteal tissue in the ovary.

### 2.5.2. Oestrous cycle

Allison and McNatty (1972) have measured progesterone concentration in peripheral plasma throughout the oestrous cycle in Romney and Merinos ewes,and showed progesterone levels were low for the first 4 days of the cycle (0 to 0.35 ng/ml) and then rose to levels up to 2.0 ng/ml over the next few days. On day 14 to 16 of the cycle there was a sharp drop, and by the next oestrus progesterone levels were negligible (<0.1 ng/ml). These results were consistent with values reported by many others (Stabenfeldt et al., 1969; Thorburn et al.,1969; Obst and Seamark,1970; Pant et al.,1971). In the ewe lambs the concentration and pattern of progesterone indicates luteal function similar to the adult (Quirke and Gosling, 1976, 1979)

Breed differences in the mean level of plasma progesterone on any day of the oestrous cycle were not significant (Quirke and Gosling, 1979). Allison and McNatty (1972) also found no differences between Romney and Merino ewes. Quirke and Gosling (1979) found no differences

in the mean daily plasma concentration for the animals on the two planes of nutrition throughout the cycle,with the exception of day 11 when those fed at the high plane had an elevated level of progesterone. This is consistent with the results of studies with older ewes (Howland et al., 1966; Shevah et al., 1975).

Hamra et al., (1986) has conducted replicate experiments to evaluate four progesterone-releasing devices in ovariectomised ewes. Progesterone profiles in ewes with 12 and 9% CIDR dispensers increased to near maximum concentrations within 24 h, or within a further 2 days and then declined gradually. Compared to the CIDR dispenser, implants resulted in a more gradual increase in progesterone levels and a rather sharp drop on Day 6. Sponges and CIDR dispenser produced similar progesterone levels through to Day 5, after which levels fell more quickly and were lower in sponge-treated ewes.

## 2.6.REPRODUCTIVE PERFORMANCE

### 2.6.1. Oestrus and ovulation

Failure to display oestrus over the mating period can be a major cause of poor reproductive performance (Godlee, 1968; McGuirk et al., 1968; Allison et al., 1975; Barlow and Hodges,1976; Tyrell, 1976; Quirke, 1978). In New Zealand, studies with several breeds or crosses have shown variable results for the incidence of oestrus (Ch'ang and Raeside,1957; 72%; Hight et al., 1973; 50-64%; Allison and Kelly,1978; 47%; Meyer and French,1979; 25%; Baker et al.,1981; 75%; McMillan and McDonald,1983; 88-92%; Asofi, 1984; 83%).

Ovulation without oestrus (silent heat) occurs frequently in ewe hoggets as it does in mature ewes. Cleverdon and Hart (1981) found that 56% of the ewe hoggets had experienced one and 26% experienced two or more silent heats respectively prior to first oestrus. Quirke (1979) also has reported silent oestrus but at low frequency (3%). The occurrence of oestrus without ovulation is common (6-33%) in ewe lambs (Edey et al., 1977). Quirke (1979a) observed a similar phenomenon in

7% of Galway ewe lambs. Cleverdon (1980) also reported oestrus without ovulation at the end of the first breeding season.

With a combined progestagen-PMSG treatment it is usual for 90% or more lambs to be mated within 2-3 days of progestagen withdrawal (Keane,1974a; Quirke, 1978a; Thimonier et al.,1968).

Although the oestrous response to progestagen-PMSG treatment is often good and fertilisation high, the fertility is variable and usually lower than for adult ewes (Quirke, 1981). Anovulatory oestrus also occurred in progestagen-treated lambs ( Quirke, 1979c).

### 2.6.2. Conception

Fertility is much more variable and usually lower in ewe lambs than for adult sheep and conception rates as low as 16% (Watson and Gamble, 1961) and as high as 82% (Quirke, 1979a) have been recorded. The poor fertility applies to ewe lambs that mate after progestagen-PMSG treatment as it does to those that breed naturally (Bichard et al.,1974; Edey et al., 1978; Dyrmundsson,1981). In a study with several breeds the conception rate at the controlled oestrus ranged from 16 to 82% and overall lambing rate from 23 to 92%, depending on breed (Quirke, 1979a). With adult ewes the lambing rate to insemination at the first oestrus following progestagen-PMSG treatment is normally around 60-70% (Colas, 1979; Gordon,1973; Gordon 1975; Gordon 1977).

Several factors are concerned in the lowered reproductive performance in ewe lambs. Allison et al. (1975) reported that failure of insemination in hoggets marked by harnessed rams is one factor in lowered fertility. Edey et al. (1978) considered failure to be inseminated is largely a consequence of the inferior mating behaviour characteristic of most oestrous lambs. Keane (1974a) found that there was invariably a sizeable percentage af hormone-treated (25-58%) and

control (16-43%) animals which failed to conceive.

Several authors have attempted to estimate the fertilization rate in ewe lambs as part of their investigation into the problem of reduced reproductive performance. The available estimates for unstimulated lambs (Allen and Lamming ,1961; Hamra and Bryant,1979; Keane,1974a) range from 77 to 95% and for hormone-treated animals from 78 to 93% (Bradford et al., 1971; Quirke and Hanrahan,1977; Quirke,1979a). McMillan (1981) reported a 91.4% fertilization rate for ova from ewe lambs and 90.5% for ewes. Gordon (1983) concluded that fertilization failure to be the source of the major difference in conception and pregnancy rates between ewe lambs and adult sheep. In recent studies, McMillan and McDonald (1985) have reported insemination failure and anovular oestrus were minor sources of reproductive wastage.

### 2.6.3. Embryo mortality

With fertilization rates high and lambing rates low, it follows that the level of embryonic mortality must contribute substantially to the problem. Quirke and Hanrahan (1977) compared the survival rates to term of fertilized eggs from Galway ewe lambs and adult ewes when transferred to the uteri of adult recipient ewes and these were 33 and 73%, respectively. There is evidence of a very high wastage rate of fetilized eggs (63%) in ewe lambs of the Galway breed following progestagen-PMSG treatment (Quirke,1979b). McMillan and McDonald (1985) have found the ability of ova to survive to term was less for lamb than ewes(25% v 52%). These ewe lambs were not hormonally treated. Embryo transfer studies have shown that ewe lamb and adult ewe uteri are equally capable of supporting normal adult sheep eggs (Quirke and Hanrahan, 1977).

2.6.4. Lamb mortality.

Lamb mortality is higher in the offspring of ewe lambs than in that of older sheep during the perinatal period (Gordon,1967; Donald et al., 1968; Dyrmundsson,1973; McCall, 1980). Losses may be especially high among the twin-born lambs because of low birthweight and associated lack of vitality (Yalcin and Bichard,1964; Gordon,1967; Donald et al.,1968; Southam et al., 1971; Dyrmundsson,1973). In addition, at the same birthweight the incidence of mortality tends to be greater in lambs born to immature rather than older ewes (Gordon,1967b; McMillan,1983).

The shorter duration of gestation (Gordon,1967b; Southam et al.,1971; Dyrmundsson,1973; Quirke et al., 1978b) and a higher incidence of dystokia (Lewis,1959; Godlee and Scarlett,1968; McMillan,1983) which were associated with various factors such as birth rank, sex, age of dam, year and breed of sire (Dalton et al., 1980) may partially explain the higher mortality rates. Keane (1975c) suggested that the delayed onset of lactation in young as compared to adult ewes, was as a contributing factor to high ewe lamb offspring mortality. Asofi (1984) reported hoggets generally had a low incidence of lambing difficulty. Also their mothering ability was satisfactory and thus this did not appear to be a cause of increased lamb mortality (Apps,1953; Lewis,1959; Dyrmundsson,1973).

## PURPOSE AND SCOPE OF THE INVESTIGATION.

Polyurethane sponges containing progestagen have been used to induce or synchronise oestrus in young and adult ewes. Recently controlled internal drug releases (CIDR) have been developed as a means of controlling oestrus in sheep and goats by intravaginal administration of progesterone. Several types of CIDRs have been successfully used to synchronise oestrus for natural or artificial mating and the induction of early and out-of- season breeding in adult ewes.

The purpose of this study was to examine the ability of CIDRs and Sponges to induce and synchronise oestrus and to achieve a satisfactory lambing performance in Romney and Border Leicester X Romney ewe lambs. As CIDRs might be used to induce breeding when AI is considered it seemed worthwhile also to determine the time when ovulation as well as oestrus was induced.

To assess the absorption of progesterone from the CIDRs blood of animals during and after treatment was examined and progesterone concentrations determined. These levels which were determined using ovariectomised ewes were later compared with those from intact animals during an oestrous cycle.

# CHAPTER THREE
# MATERIALS AND METHODS

## 3.1. ANIMALS

Romney and Border Leicester x Romney (BLX) ewe hoggets from a Massey University flock were used in the experiments. These animals were an unselected group that had been born and reared together. They were derived from a randomly-bred Romney flock mated to Romney or Border Leicester rams. Sheep were identified by serially numbered brass and large plastic ear tags at the commencement of the trial.

A total of 417 ewe hoggets were used for induction of breeding and comprised 117 BLX and 91 Romney animals in 1984 and 108 BLX and 101 Romney in 1985. In 1986, 72 ewe lambs (36 each of BLX and Romney)were used to determined the time of ovulation after CIDR treatment. Ten additional lambs were blood sampled to measure plasma progesterone levels when CIDR treatments were given in 1984 and six additional lambs (3 BLX, 3 Romney) were used for the same purpose in 1986.

## 3.2. EXPERIMENT 1: INDUCTION OF BREEDING

### 3.2.1. Mating records

In each year the animals were run with harnessed vasectomised rams until mid-May prior to being allocated into four treatment groups.

GROUP 1: Control (with vasectomised rams only). A total of 111 ewe hoggets were used (1984: 30 BLX, 28 Romney; 1985: 27 BLX, 26 Romney). In the first year one Perendale vasectomised ram was run with

this group from April 12 until July 5; in the second year two Suffolks were used from April 3 until July 2.

Rams were fitted with "Sire-sine" harnesses and colour marks were checked every week until the rams were removed.

The crayon colours were changed as follows:

| Colour/year | 1984 | 1985 |
|---|---|---|
| Yellow | April 12- May 11 | April 17- May 8 |
| Green | May 11- May 23 | May 8- May 21 |
| Red | May 23- June 1 (except Group2.May15-June1) | May 21- May 28 (except Group2.May8-May28) |
| Blue | June 1- July 5 | May 28- July 2 |

The colour change schedule was the same as above in the remaining groups.

GROUP 2: Joined (run with entire rams)

A total of 102 ewe hoggets were used (1984: 29 BLX, 21 Romney; 1985: 27 BLX, 25 Romney).

In 1984, mating started on May 15. Two entire rams were used until May 23. After this the animals were run together with Groups 3 and 4 ewes and with 5 entire rams until June 14. From June 14 to July 5 a teaser ram replaced the entire rams.

In 1985, ewe hoggets were run with 2 entire rams from May 8 until May 21. From May 21 until June 11, these animals were run together with Groups 3 and 4 and 2 additional entire rams.

Colour marks were ckecked weekly while Group 2 was run separately, but after these sheep joined Groups 3 and 4,marks were checked daily for a one week period in both years.

Group 3: Sponge-Treated;
Group 4: CIDR-Treated.

In both years the number of animals in Groups 3 and 4 was similar to Group 2. Vasectomised rams and Groups 3 and 4 ewes were run with Group 1 until May 23 in 1984 and May 21 in 1985. Groups 3 and 4 were then run with Group 2 as already mentioned.

### 3.2.2. Synchronization of oestrus

The polyurethane intravaginal sponges(Group 3)each contained 40 mg medroxyprogesterone acetate (MAP, Upjohn Ltd); the treatment started on May 11 in 1984,and May 8 in 1985 and sponges were removed after 12 days. The animals in Group 4 were treated as above with controlled internal drug release dispensers (CIDRs) carrying 9% progesterone (0.38g, w/w) inserted for 12 days. At the time of each Sponge or CIDR treatment,antiseptic cream was put on the applicator.

Animals which lost sponges or CIDRs were noted.

### 3.2.3. Blood sampling and progesterone analyses

In 1984, 10 ovariectomised and 10 entire ewe lambs were blood sampled. Ten ewe lambs, 5 from the ovariectomised group and 5 from entire ewe lambs were treated with CIDRs. The remaining 5 entire lambs were treated with sponges and the remaining 5 ovariectomised ewe lambs served as controls.

Blood sampling began one day pretreatment. On the day of the treatment (Day 0) one sample was taken immediately prior to insertion

(8-9 a.m.) and another 8 h later (4-5 p.m.). Samples were collected daily for 3 days (Day 1,2,3) and every two days thereafter (Days 5,7,9,11) until treatment withdrawal on Day 12. Two samples were taken on Day 12, one immediately after withdrawal (8-9 a.m.) and another 8 h later (4-5 p.m.). Samples were taken on the following 2 days (Day 13-14) and lastly,on Day 18.

All samples were taken by venipuncture into 10 ml evacuated tubes containing 150 i.u heparin. Samples were centrifuged about 1 h later. Plasma was pipetted off and stored at -20°C until later analysis.

Plasma progesterone concentrations were estimated using the radioimmunossay procedures described by Kirkwood et al.1984).

3.2.4. Ovarian activity

In 1984, 20 ewe hoggets from each of Groups 2,3 and 4 which were marked between May 23 and June 7,were laparoscoped on June 7 to examine ovarian activity and the frequency distribution of the number of animals classified according to the number of corpora lutea. These animals were within 1-14 days of being marked by the rams.

3.2.5. Fleece weight

Greasy fleece weights were recorded at hogget shearing on September 9, 1984 and September 17, 1985.

### 3.2.6. Lambing management

Real-time ultrasonic scanning was used 4 times during gestation to assess whether or not each ewe was pregnant. Scanning was done on July 8, July 27, August 16, and September 9 in 1984 and July 8, July 29. August 16 and September 9 in 1985.

Pregnant and non pregnant ewes were grazed separately after shearing. New-born lambs were identified with their dams and tagged within 24 h of birth. The date of birth, sex of lamb, birth rank and birth weight were recorded.

### 3.2.7. Weaning

All lambs were weaned on December 24 in 1984 and December 13 in 1985.

## 3.3. EXPERIMENT 2: TIME OF OVULATION

The ewe lambs (72) were allocated to 6 groups, each being divided into two sub-groups, comprising 6 ewe lambs (3 BLX, 3 Romney).

All groups were treated with CIDRs (w/w 0.38 g progesterone) on April 10 for 11 days. At CIDR withdrawal hoggets in six subgroups were injected subcutaneously with 200 i.u. pregnant mare serum gonadotrophin (PMSG) given in 6 ml saline solution.

Laparoscopy was conducted at one or more of 54, 60, 66, 72 h and one week after CIDR withdrawal. The schedule for the six groups was chosen to "straddle" the expected time of ovulation. Animals were starved for 12 hours before laparoscopy and returned to pasture when ovulation was recorded or earlier if a second operation was required . It is doubtful if animals consumed much feed after initial surgery. Observations for mating marks were recorded weekly until treatment then at 8 and 24 h following CIDR withdrawal, at 8 hourly intervals until 56 h and then at 6 hourly intervals until 74 h and subsequently each day until May 26.

Blood samples for progesterone determinations were taken from 12 lambs during the CIDR treatment period on Days -1, 0 (at insertion and 8 h later) 3, 6, 9, 11 (at withdrawal and 8 h later), and 12. Samples were also taken each 2 days for the next 14 days in the CIDR-treated and CIDR + PMSG-treated animals.As well 6 Control hoggets were also sampled over 14 days after having been in oestrus during the preceding 6-21 days. These latter animals were from the same flock as the 72 animals in the experiment.

Collection,storage procedure and progesterone analysis were as described earlier.

## 3.4. ANALYSIS OF DATA

The data were analysed using a Generalized Linear Models Computing package (REG), Gilmour (1983).

The continuous data were analysed using analysis of variance procedures. The model for traits such as gestation length, date of birth, fleece weight was:

$$Y_{ijkl} = u + A_i + B_j + C_k + AB_{ij} + AC_{ik} + BC_{jk} + e_{ijkl}.$$

A = the effect of the $i^{th}$ year i= 1,2
B = the effect of the $j^{th}$ breed j= 1,2
C = the effect of the $k^{th}$ treatment k= 1-3
$(AB)_{ij}$ = the effect of interaction of the $i^{th}$ year and $j^{th}$ breed
$(AC)_{ik}$ = the effect of interaction of the $i^{th}$ year and $k^{th}$ treatment
$(BC)_{jk}$ = the effect of interaction of the $j^{th}$ breed and $k^{th}$ treatment
$e_{ijkl}$ = the random error effect.

Higher order interaction effects were assumed negligible.

The discrete data were analysed using the same general model to construct analyses of deviance.These were generated by applying the method of iterative re-weighted least squares together with the logit transformation which is given by logit (p) = In (p/1 - p) where p is the proportion of individuals responding at one of the two levels of the variate. The ratio (p/1 - p) is commonly referred to as the odds ratio.

In the tables presenting the results the following abbreviations are used to denote the levels of statistical significance calculated:

NS = Not significant or P>0.05
* = P<0.05
** = P<0.01
*** = P<0.001

# CHAPTER FOUR
# RESULTS

## 4.1. EWE LAMB PERFORMANCE

### 4.1.1. Incidence of oestrus

A) Before treatment

Table 4-1 summarises the effect of breed, treatment and year on the incidence of oestrus before hormonal treatment.

More BLX animals exbited oestrus than in Romneys ($P< 0.05$). Interactions were examined but were not fitted in this model owing to the presence of extreme values in the data.

B) After treatment

Table 4-2 shows the effect of breed, treatment and year on the incidence of oestrus during and after progestagen treatment. The year effect was statistically highly significant ($P< 0.001$).

In 1984, 85.1% and in 1985, 57.5% of ewe lambs came into oestrus. No significant breed and treatment effects were found. Year X breed interaction was significant ($P< 0.05$). Thus, proportionately more Romney than BLX ewe lambs came into oestrus in 1984, but the reverse occurred in 1985. The other main interactions were not significant.

Table 4-1 Effect of breed, treatment and year on the incidence of ewe lamb oestrus before treatment period.

| Classification | | No. of lambs | Incidence of oestrus (%) (Mean ± s.e.) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 91 | 11.0 ± 3.30 |
| | '85 | 100 | 7.0 ± 2.56 |
| BLX | '84 | 117 | 16.2 ± 3.42 |
| | '85 | 107 | 16.8 ± 3.63 |
| TREATMENT | | | |
| Control | '84 | 59 | 13.6 ± 4.50 |
| | '85 | 54 | 16.7 ± 5.12 |
| Mating | '84 | 49 | 16.3 ± 5.34 |
| | '85 | 50 | 14.0 ± 4.96 |
| Sponge | '84 | 50 | 14.0 ± 4.96 |
| | '85 | 52 | 3.9 ± 2.69 |
| CIDR | '84 | 50 | 12.0 ± 4.64 |
| | '85 | 51 | 13.7 ± 4.87 |
| YEAR | | | |
| | 1984 | 208 | 13.9 ± 2.41 |
| | 1985 | 207 | 12.1 ± 2.2 |

Analysis of deviance

| Source of variation | d.f | Deviance |
|---|---|---|
| YEAR | 1 | 0.95 NS |
| BREED | 1 | 3.87 * |
| TREATMENT | 3 | 1.99 NS |

Table 4-2 Effect of breed, treatment and year on the incidence of ewe lamb oestrus during and after treatment.

| Classification | | No. of lambs | Incidence of oestrus (%) (Mean ± s.e) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 91 | 87.9 ± 3.44 |
| | '85 | 100 | 50.0 ± 5.03 |
| BLX | '84 | 117 | 82.9 ± 3.50 |
| | '85 | 107 | 64.5 ± 4.65 |
| TREATMENT | | | |
| Control | '84 | 59 | 86.4 ± 4.50 |
| | '85 | 54 | 57.4 ± 6.79 |
| Mating | '84 | 49 | 83.7 ± 5.34 |
| | '85 | 50 | 72.0 ± 6.41 |
| Sponge | '84 | 50 | 92.0 ± 3.88 |
| | '85 | 52 | 50.0 ± 7.00 |
| CIDR | '84 | 50 | 78.0 ± 5.92 |
| | '85 | 51 | 51.0 ± 7.07 |
| YEAR | | | |
| | 1984 | 208 | 85.1 ± 2.48 |
| | 1985 | 207 | 57.5 ± 3.44 |

Analysis of Deviance

| Source of Variation | d.f | Deviance | |
|---|---|---|---|
| YEAR | 1 | 39.89 | ** |
| BREED | 1 | 1.27 | NS |
| TREATMENT | 3 | 4.86 | NS |
| YEAR X BREED | 1 | 4.19 | * |
| YEAR X TREATMENT | 3 | 5.83 | NS |
| BREED X TREATMENT | 3 | 0.46 | NS |

4.1.2. Synchronization of oestrus

The distributions of the onset of oestrus over the 7-day period after progestagen withdrawal for the ewe lambs in each of the years are shown in Table 4-3 and Figure 4-1. The effect of the breed of lamb on distribution of onset of oestrus in 1984 and 1985 is shown in Figure 4.2 a and b, respectively.

In 1984, 69.7% and 44.9% of the ewe lambs were detected in oestrus over a five-day period following Sponge and CIDR withdrawal, respectively. In 1985, 42.2 and 40.8% of the ewe lambs in the Sponge and CIDR groups showed heat during the similar period. Analysis of these data (Table 4-4) revealed no significant effects of breed, treatment and year on the frequency distribution of oestrus. Treatment X Breed interaction was significant ($P< 0.05$), but other main interactions were not evident.

4.1.3. Incidence of multiple ovulation

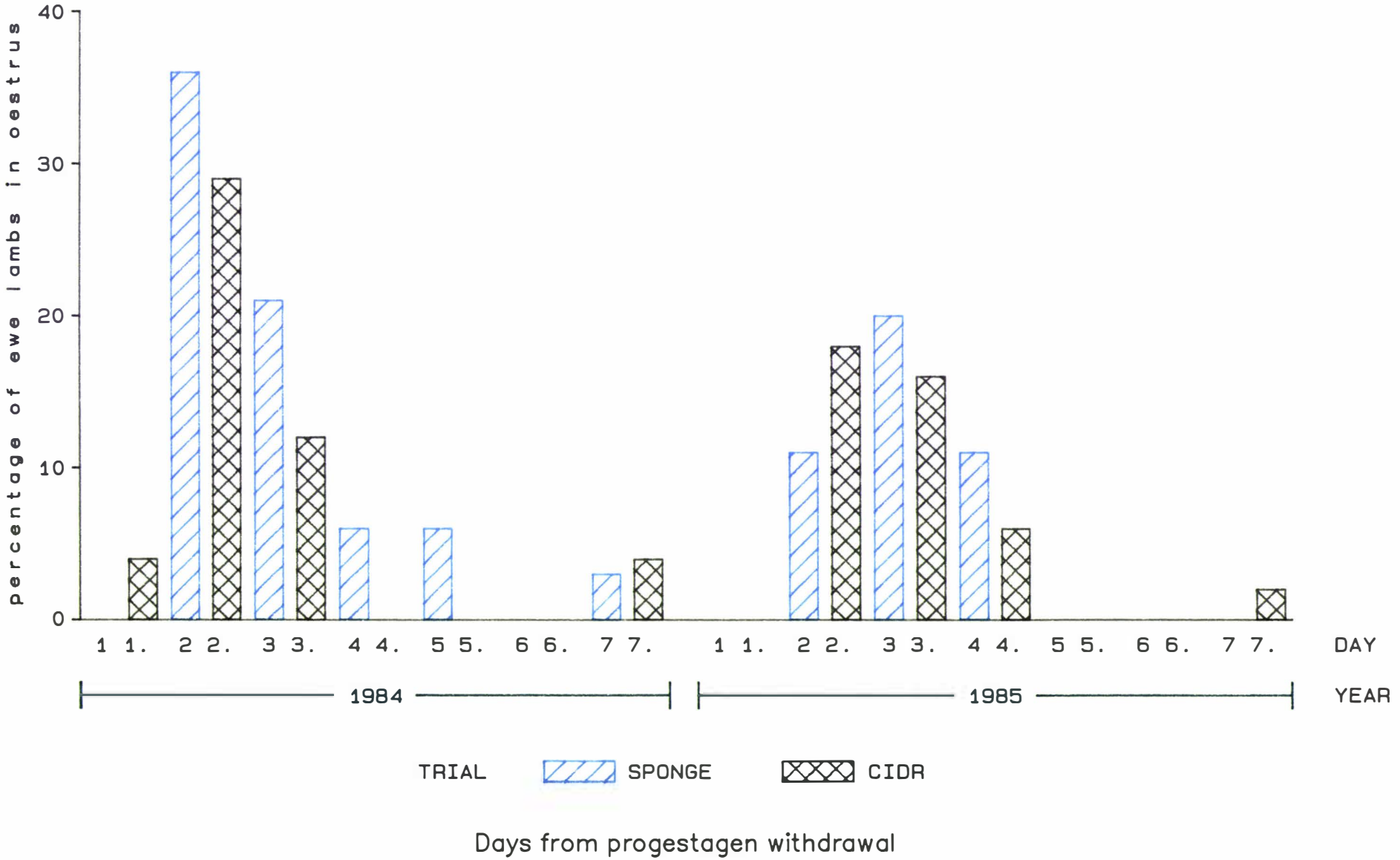
A total of 60 ewe lambs were laparoscoped. All animals had recently formed corpora lutea, and in ten animals (16.7%) twin ovulations were recorded (Table 4-5). No significant effects of breed or treatment or of interaction were found in the data.

Table 4-3 Effect of treatment and year on the interval between Sponge or CIDR removal and the onset of oestrus (h).

| Classification / Treatment | Year/No. treated | No. not lost | Day+ 1 | 2 | 3 | 4 | 5 | 6 | 7 | No.lambs not mated (%) | No.lambs in oestrus but lost Sponge/CIDR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No. (%) lambs in oestrus | | | | | | | | |
| SPONGE | '84 50 | 33 | 12 | 7 | 2 | 2 | | 1 | | 9 | 6 |
| | | (66) | (36) | (21) | (6) | (6) | | (3) | | (27) | (35) |
| | '85 52 | 45 | 5 | 9 | 5 | | | | | 26 | 0 |
| | | (87) | (11) | (20) | (11) | | | | | (58) | 0 |
| CIDR | '84 50 | 49 | 2 | 14 | 6 | | | 2 | | 25 | 0 |
| | | (98) | (4) | (29) | (12) | | | (4) | | (51) | 0 |
| | '85 51 | 49 | 9 | 8 | 3 | | | 1 | | 28 | 0 |
| | | (96) | (18) | (16) | (6) | | | (2) | | (57) | 0 |

+ Days from progestagen withdrawal (1-7)

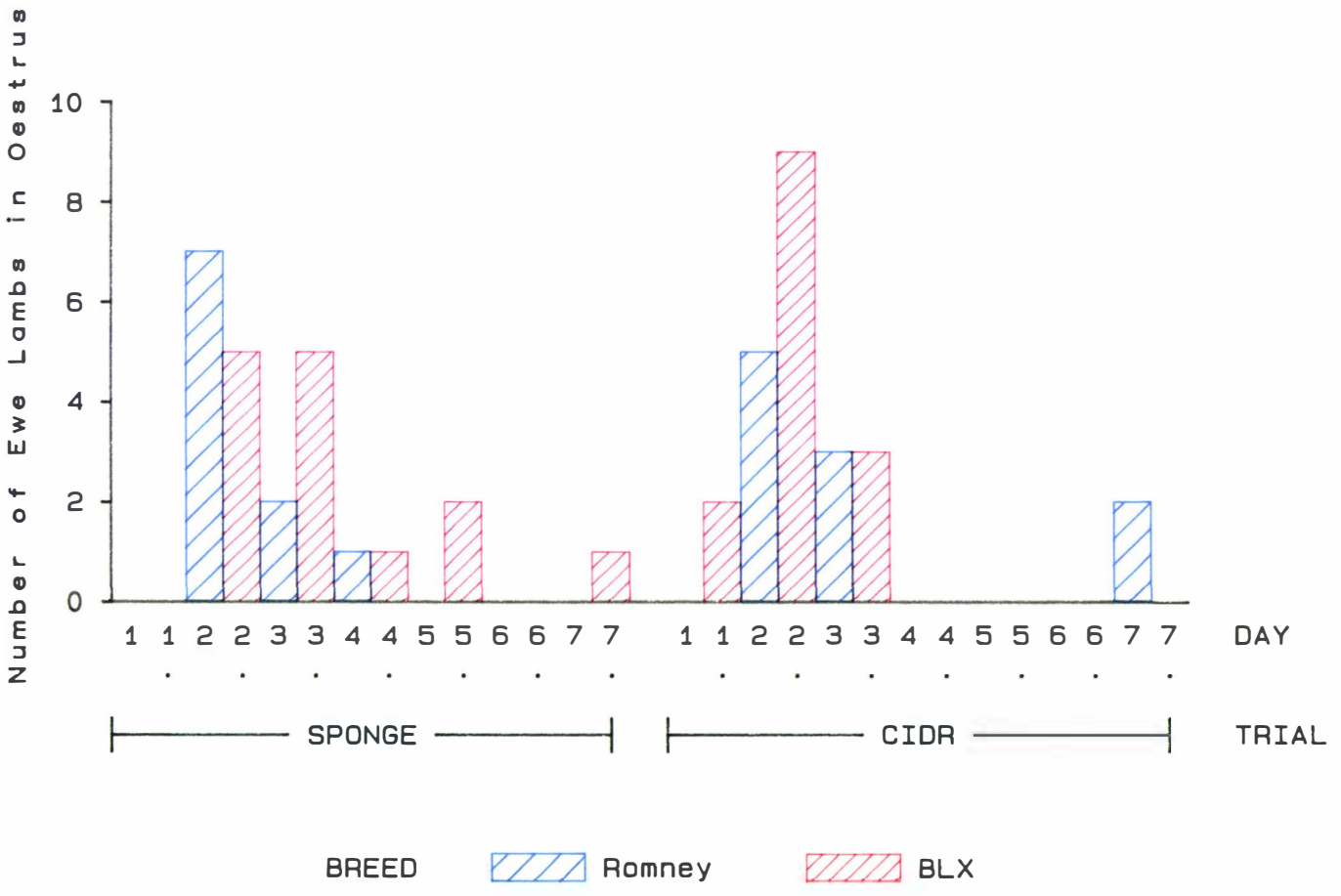
# FIG.4.1 Distribution of the onset of oestrus



# FIG.4.2a Effect of Breed on the

Distribution of onset of oestrus

—YEAR 1984 —

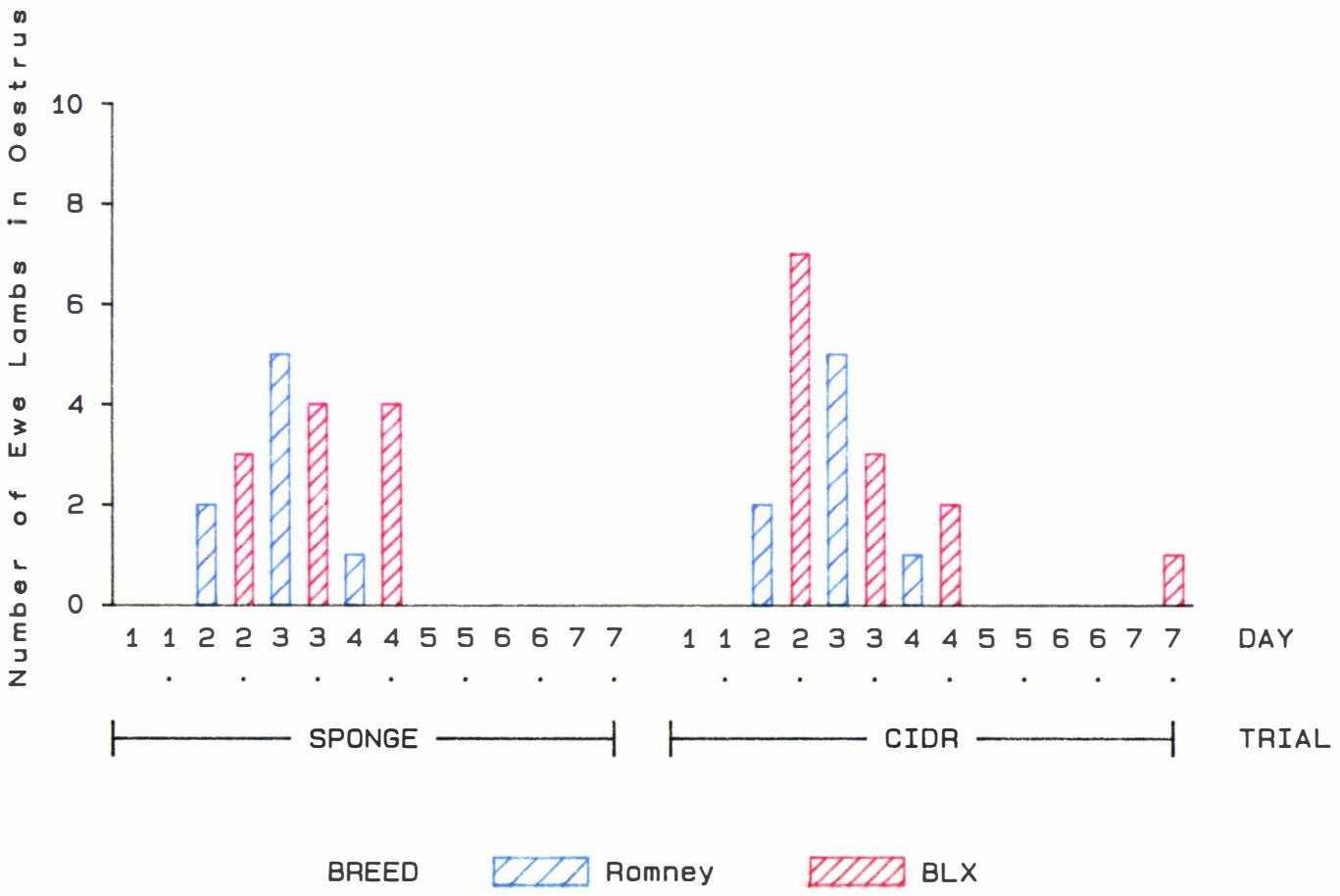



Days from progestagen withdrawal

# FIG.4.2b Effect of Breed on the

Distribution of onset of oestrus

—YEAR 1985 —




Days from progestagen withdrawal

Table 4-4 Analysis of variance of factors influencing the interval to onset of oestrus (h).

| Source of variation | d.f | Mean Square | |
|---|---|---|---|
| YEAR | 1 | 0.025 | NS |
| BREED | 1 | 0.001 | NS |
| TREATMENT | 1 | 0.025 | NS |
| YEAR X BREED | 1 | 0.003 | NS |
| YEAR X TREATMENT | 1 | 0.005 | NS |
| TREATMENT X BREED | 1 | 0.090 | * |

Table 4-5 Effect of breed and treatment on the incidence of multiple ovulation.

| Classification | No. of lambs laparoscoped | Incidence of multiple ovulation (%) |
|---|---|---|
| BREED | | |
| Romney | 24 | 12.5 ± 6.90 |
| BLX | 36 | 19.4 ± 6.69 |
| TREATMENT | | |
| Mating | 20 | 15.0 ± 8.19 |
| Sponge | 20 | 20.0 ± 9.18 |
| CIDR | 20 | 15.0 ± 8.19 |

Analysis of Deviance

| Source of Variation | d.f | Deviance |
|---|---|---|
| BREED | 1 | 0.51 NS |
| TREATMENT | 2 | 0.29 NS |
| BREED X TREATMENT | 2 | 0.34 NS |

4.1.4. Pregnancy

A) Conception rate

Marked ewes - First service

The effects of breed, treatment and year on the incidence of conception in animals which were marked once or on more occasions are presented in Table 4-6.

Significantly more ($P<0.05$) lambs conceived in 1984 (69.3%) than in 1985 (48.2%) following first service. Breed or treatment effects were not significant. Interactions were individually fitted after the main effects, but no first order interactions (i.e. Year X Treatment, Year X Breed and Treatment X Breed) were significant.

Marked ewes - All services

Table 4-6 shows that of the animals that conceived after any of the services, the year effect was significant ($P<0.05$). In 1984 and in 1985 68.9% and 48.8% of marked ewe lambs conceived, respectively. Breed X Treatment interaction also was significant ($P< 0.05$). More Romney than BLX ewe lambs were pregnant among the CIDR- treated animals although more BLX animals had conceived in the Mating- and Sponge-treated groups.

Joined ewes - First service

The effects of breed ,treatment and year on conception rate following First Service and All Services,for all the lambs joined are shown in Table 4-7. There was a significant year effect on conception rate to First Service ($P<0.001$) with 40.9% and 17.6% of the lambs

pregnant in 1984 and 1985 respectively. No other factors were statistically significant nor was an interaction evident in the data. When the data for All Services were analysed, only the effect of year was significant (P< 001) there being a much higher pregnancy rate apparent in 1984 than in the next year.

Table 4-6 Effect of breed, year and treatment on conception rate in marked ewe lambs.

| Classification | | No. | Conception Rate (%) First Service | No. | All Services |
|---|---|---|---|---|---|
| BREED | | | | | |
| Romney | '84 | 35 | 68.6 | 50 | 68.0 |
| | '85 | 27 | 59.3 | 32 | 65.6 |
| BLX | '84 | 53 | 69.8 | 69 | 69.6 |
| | '85 | 29 | 37.9 | 50 | 38.0 |
| TREATMENT | | | | | |
| Mating | '84 | 27 | 74.1 | 38 | 71.1 |
| | '85 | 23 | 47.8 | 33 | 51.5 |
| Sponge | '84 | 34 | 64.7 | 43 | 65.1 |
| | '85 | 17 | 47.1 | 24 | 41.7 |
| CIDR | '84 | 27 | 70.4 | 38 | 71.0 |
| | '85 | 16 | 50.0 | 25 | 52.0 |
| YEAR | | | | | |
| | 1984 | 88 | 69.3 | 119 | 68.9 |
| | 1985 | 56 | 48.2 | 82 | 48.8 |

| Source of Variation | d.f. | Analysis of Deviance Deviance First Service | All Services |
|---|---|---|---|
| YEAR | 1 | 6.39 * | 8.74 * |
| BREED | 1 | 0.93 NS | 2.25 NS |
| TREATMENT | 2 | 0.53 NS | 1.37 NS |
| TREATMENT X BREED | 2 | 4.90 NS | 7.43 * |
| YEAR X BREED | 1 | 1.63 NS | 3.84 NS |
| YEAR X TREATMENT | 2 | 0.33 NS | - |

Table 4-7 Effect of breed, year and treatment on the conception rate in the lambs joined with rams.

| Classification | | No. | Conception Rate (%) First Service | All Services |
|---|---|---|---|---|
| BREED | | | | |
| Romney | '84 | 62 | 38.7 | 56.5 |
| | '85 | 73 | 21.9 | 28.8 |
| BLX | '84 | 87 | 42.5 | 56.3 |
| | '85 | 80 | 13.8 | 23.8 |
| TREATMENT | | | | |
| Mating | '84 | 49 | 40.8 | 57.1 |
| | '85 | 50 | 22.0 | 34.0 |
| Sponge | '84 | 50 | 44.0 | 56.0 |
| | '85 | 52 | 15.4 | 19.2 |
| CIDR | '84 | 50 | 38.0 | 56.0 |
| | '85 | 51 | 15.7 | 25.5 |
| YEAR | 1984 | 149 | 40.9 | 56.4 |
| | 1985 | 153 | 17.6 | 26.1 |

| Source of Variation | d.f | Analysis of Deviance Deviance First Service | All Services |
|---|---|---|---|
| YEAR | 1 | 20.21 *** | 29.01 *** |
| BREED | 1 | 0.21 NS | 0.24 NS |
| TREATMENT | 2 | 0.57 NS | 0.57 NS |
| TREATMENT X BREED | 2 | 1.16 NS | 5.03 NS |
| YEAR X BREED | 1 | 1.78 NS | 0.27 NS |
| YEAR X TREATMENT | 2 | 0.76 NS | 1.41 NS |

B) Gestation length

Table 4-8 shows the mean gestation length for the animals classified according to breed, treatment and year of study. The data for seven ewes were excluded from the analysis owing to them aborting lambs before 135 days of gestation. Such pregnancies were considered to be outside the normal range.

Year and breed effects were not significant. There was a highly significant effect of treatment on the length of pregnancy with the Mating group having a shorter gestation than occurred in the Sponge- or CIDR-treated animals. There were no significant differences between the Sponge- and CIDR-treated groups in gestation length.

The other main factors were without effect on pregnancy length, but significant interaction between year and breed existed ($P<0.05$).

C) Day of birth

Table 4-9 shows the mean day of birth (May 1= Day 1) in ewe lambs and the analysis of the effect of year, breed and treatment.

The distribution of these data are also depicted in Fig 4-3 a, b, c, for the Mating-, Sponge- and CIDR-treated groups, respectively.

The mean dates of birth were 25 and 19 Oct in 1984 and 1985, respectively. The difference in day of birth between years was significant ($P<0.01$). In each year the mating group animals were joined with entire rams several days before the hormone treated animals.This would partly account for the slightly earlier mean day of birth recorded. Further in 1985, the mating group were inadvertently

joined one week earlier than in 1984. However only one animal conceived in this period. Exclusion of this animal did not alter markedly the mean day of birth for the 1985 mating group.

BLX hoggets gave birth five days earlier on average than did Romneys ($P< 0.001$). There was a difference of 3 days in the mean day of birth between the Sponge- and the CIDR-treated groups with the former animals also lambing earlier. This effect was consistent in both years.

D) Incidence of multiple birth

Table 4-10 shows the occurrence of multiple birth among the ewe lambs. As expected the incidence was low and the 3 sets of twins all came from the BLX ewes.

E) Birth weight

Only single-born lambs and those whose gestation lengths were normal were considered in the analysis.Those lambs born dead and of very light weight were also excluded. Table 4-11 shows the effect of year, breed and treatment on mean birth weight.

In 1984, the birth weights were significantly heavier than in 1985 (4.23 v 3.33 kg; $P<0.001$). There was a significant effect of breed on birth weight ($P<0.05$) but the effects of the treatment were not significant.

Table 4-8 Effect of breed, treatment and year on gestation length.(d)

| Classification | | No. of ewes | Gestation length (Mean ± s.e) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 35 | 143.29 ± 0.57 |
| | '85 | 19 | 145.11 ± 0.96 |
| BLX | '84 | 47 | 143.60 ± 0.54 |
| | '85 | 16 | 142.31 ± 1.02 |
| TREATMENT | | | |
| Mating | '84 | 28 | 141.93 ± 0.76 |
| | '85 | 13 | 141.08 ± 0.87 |
| Sponge | '84 | 26 | 144.42 ± 0.65 |
| | '85 | 10 | 144.80 ± 1.20 |
| CIDR | '84 | 28 | 144.11 ± 0.54 |
| | '85 | 12 | 146.00 ± 1.31 |
| YEAR | 1984 | 82 | 143.46 ± 0.39 |
| | 1985 | 35 | 143.83 ± 0.73 |

| Source of Variation | Analysis of Variance d.f | Mean Square |
|---|---|---|
| YEAR | 1 | 3.27 NS |
| BREED | 1 | 11.32 NS |
| TREATMENT | 2 | 112.43 *** |
| YEAR X BREED | 1 | 56.34 * |
| YEAR X TREATMENT | 2 | 16.54 NS |
| BREED X TREATMENT | 2 | 8.44 NS |

Note: Data for animals delivering lambs prior to 135 days gestation were excluded from analysis.

Table 4-9 Effect of breed, treatment and year on the day of birth in ewe lambs.

| Classification | | No. lambed | Day of birth[+] (Mean ± s.e) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 35 | 179.51 ± 1.67 |
| | '85 | 19 | 175.42 ± 1.83 |
| BLX | '84 | 47 | 175.15 ± 1.26 |
| | '85 | 16 | 167.38 ± 1.92 |
| TREATMENT | | | |
| Mating | '84 | 28 | 171.68 ± 1.79 |
| | '85 | 13 | 167.08 ± 2.16 |
| Sponge | '84 | 26 | 178.08 ± 1.62 |
| | '85 | 10 | 173.60 ± 3.00 |
| CIDR | '84 | 28 | 181.36 ± 1.49 |
| | '85 | 12 | 175.25 ± 2.12 |
| YEAR | | | |
| | 1984 | 82 | 177.01 ± 1.04 |
| | 1985 | 35 | 171.74 ± 1.48 |

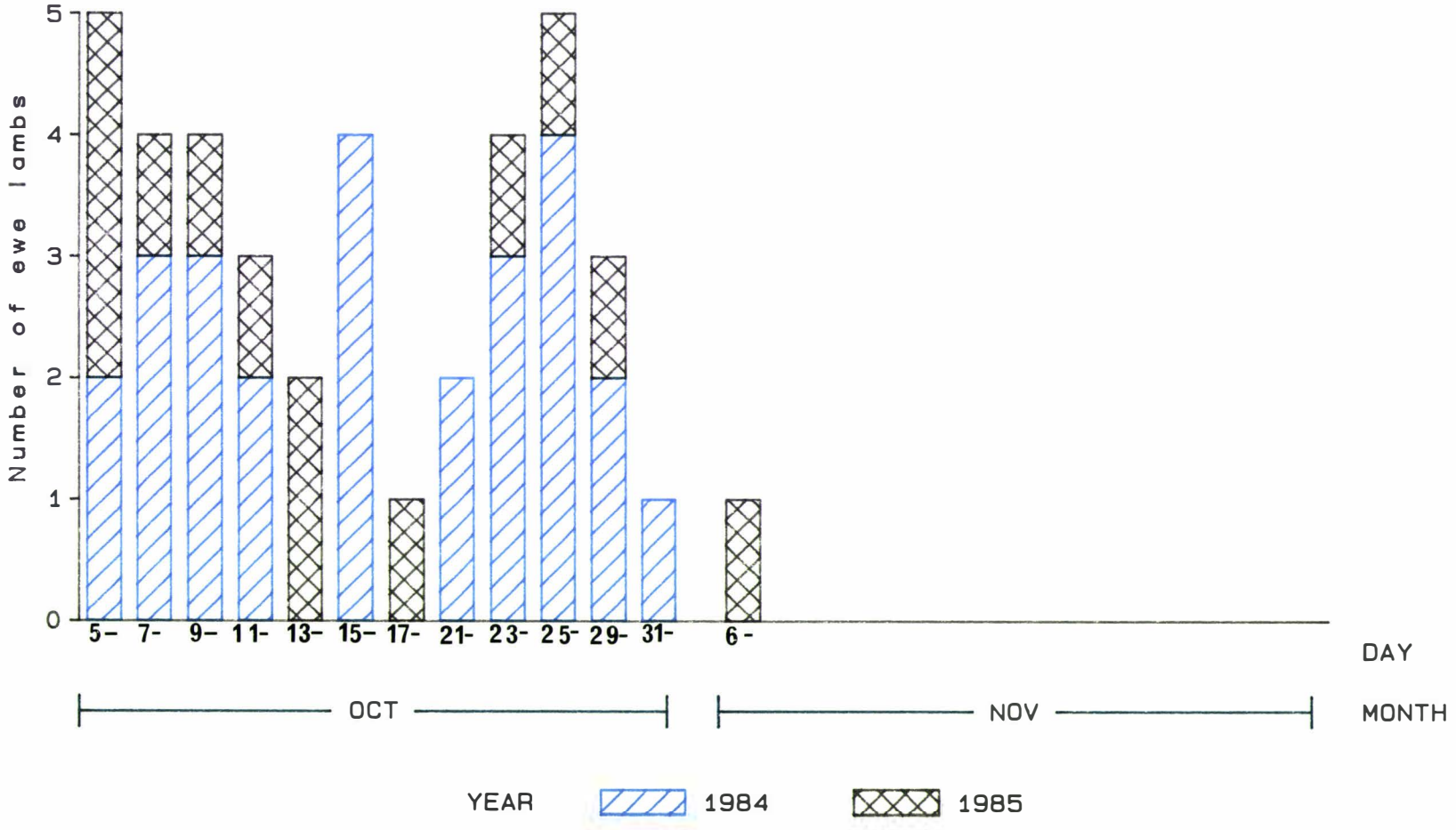
Analysis of Variance

| Source of Variation | d.f | Mean Square |
|---|---|---|
| YEAR | 1 | 681.096 ** |
| BREED | 1 | 862.475 *** |
| TREATMENT | 2 | 763.433 *** |
| YEAR X BREED | 1 | 85.799 NS |
| YEAR X TREATMENT | 2 | 3.492 NS |
| BREED X TREATMENT | 2 | 8.413 NS |

+ May 1st= Day 1.

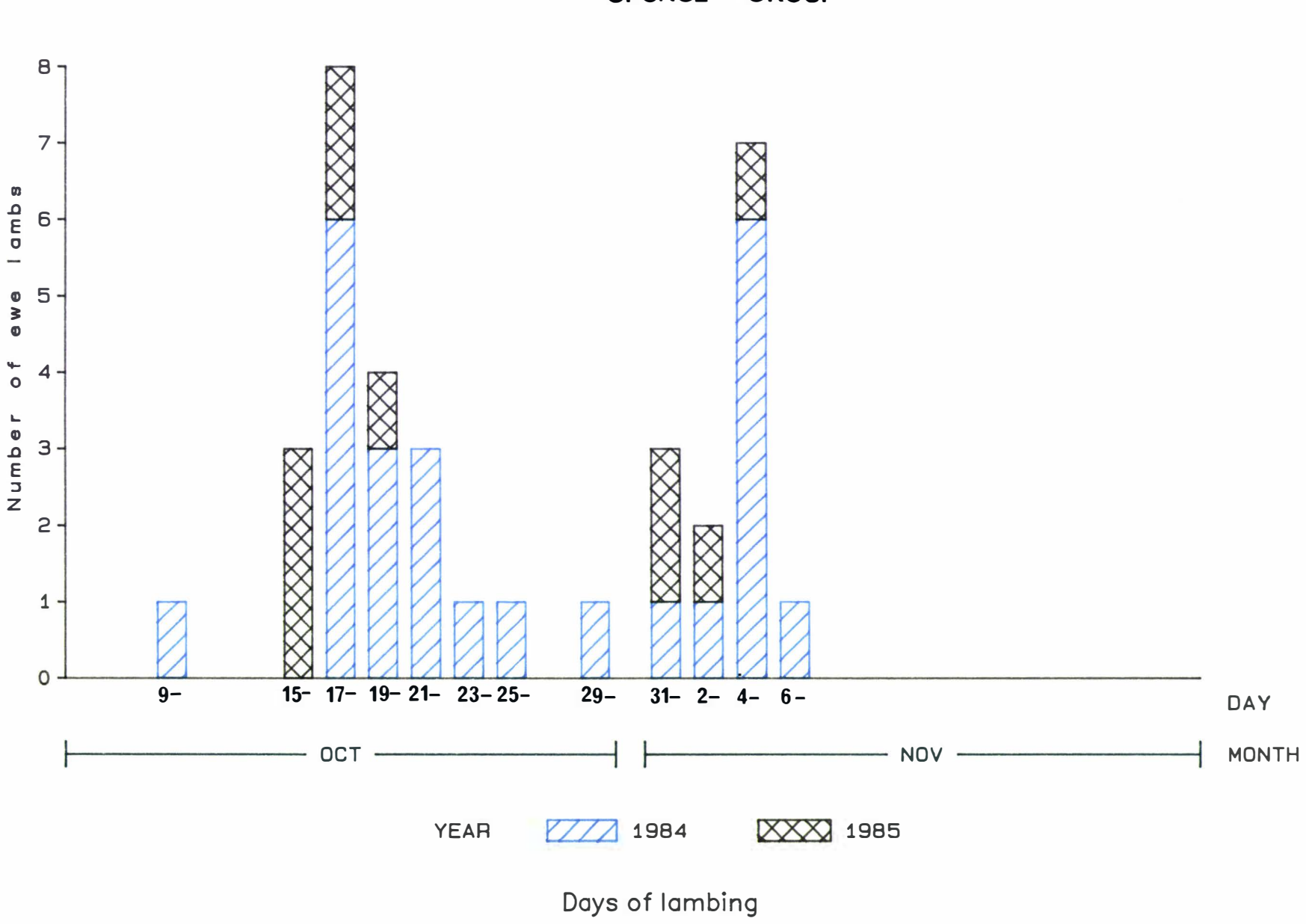
# FIG.4.3a Distribution of day of birth

**MATING GROUP**



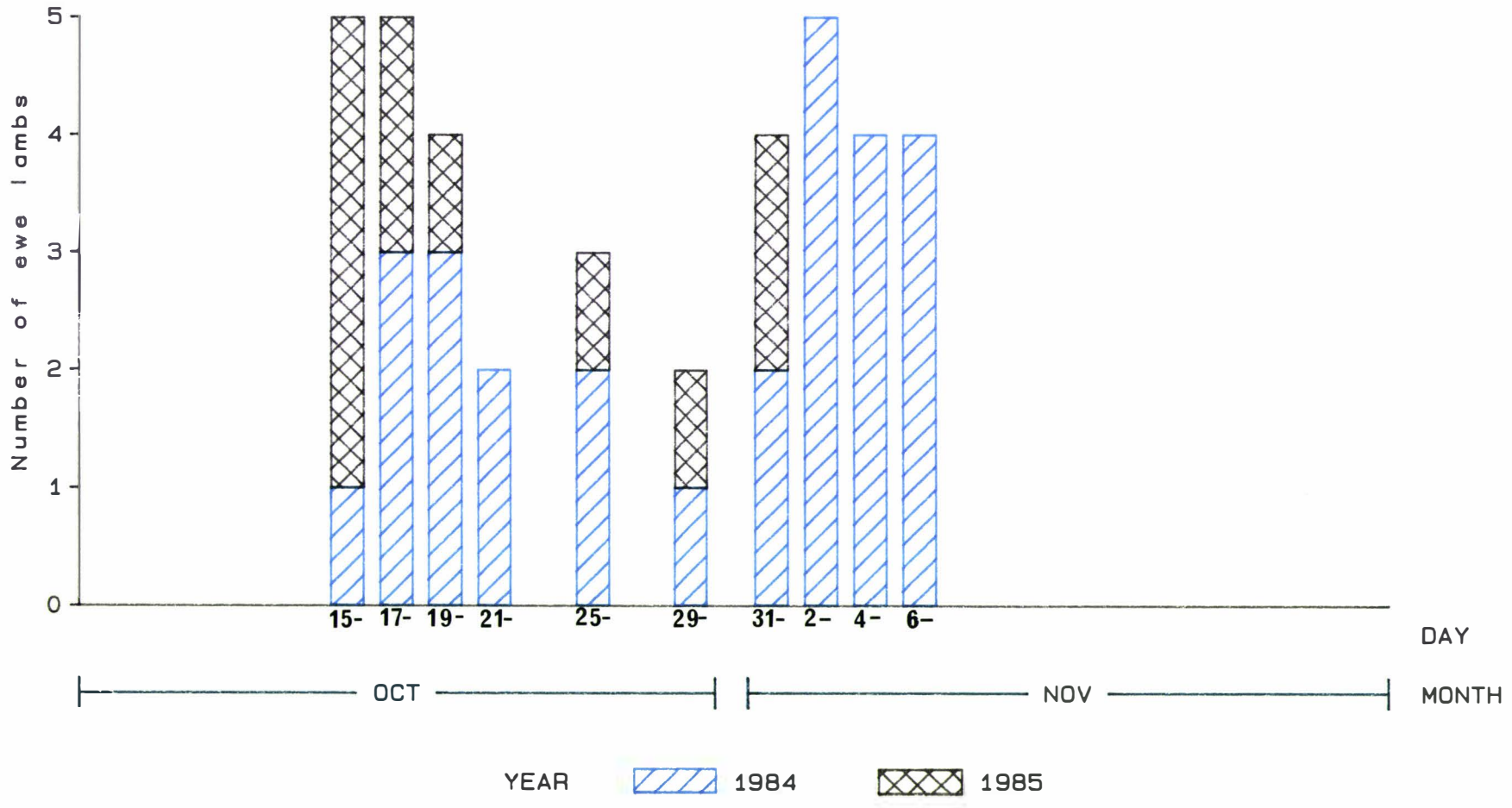

Days of lambing

# FIG.4.3b Distribution of day of birth



# FIG.4.3c Distribution of day of birth

**CIDR GROUP**




Days of lambing

Table 4-10 Incidence of multiple birth in ewe lambs.

| Classification | | No. of lambs | Incidence of twinning (%) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 62 | |
| | '85 | 73 | |
| BLX | '84 | 87 | 2.30 |
| | '85 | 80 | 1.25 |
| TREATMENT | | | |
| Mating | '84 | 49 | 4.08 |
| | '85 | 50 | |
| Sponge | '84 | 50 | |
| | '85 | 52 | 1.92 |
| CIDR | '84 | 50 | |
| | '85 | 51 | |
| YEAR | 1984 | 149 | 1.34 |
| | 1985 | 153 | 0.65 |

Table 4-11 Effect of breed, treatment and year on birth weight.

| Classification | | No. of lambs | Birth weight (kg) (Mean ± s.e) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 35 | 4.49 ± 0.15 |
| | '85 | 19 | 3.39 ± 0.17 |
| BLX | '84 | 43 | 4.03 ± 0.11 |
| | '85 | 14 | 3.25 ± 0.17 |
| TREATMENT | | | |
| Mating | '84 | 26 | 4.35 ± 0.17 |
| | '85 | 12 | 2.83 ± 0.19 |
| Spange | '84 | 24 | 3.94 ± 0.17 |
| | '85 | 9 | 3.67 ± 0.22 |
| CIDR | '84 | 28 | 4.38 ± 0.13 |
| | '85 | 12 | 3.58 ± 0.12 |
| YEAR | | | |
| | 1984 | 78 | 4.23 ± 0.09 |
| | 1985 | 33 | 3.33 ± 0.12 |

Analysis of Variance

| Source of Variation | d.f | Mean Square |
|---|---|---|
| YEAR | 1 | 18.78 *** |
| BREED | 1 | 3.73 * |
| TREATMENT | 2 | 0.79 NS |

### 4.1.5. Lambs weaned

Factors affecting the percentage of lambs weaned per ewe lamb joined are shown in Table 4-12. More lambs were weaned in 1984 than in 1985, being 47.0% and 20.9%, respectively ($P<0.001$). None of the other main effects and interactions were significant.

### 4.1.6. Fleece production

Table 4-13 presents the mean ($\pm$ s.e) for fleece weight and the associated analysis of the effects of breed, treatment and year. There was a highly significant effect ($P<0.001$) of the year on fleece production (3.7 v. 2.6 kg in 1984 and 1985). The animals were shorn at approximately similar times in each year, but the liveweights of the animals at shearing in both years were 41.6 kg and 32.2 kg, respectively. Breed effects and interaction between year and breed were significant ($P<0.05$). Higher fleece weights occurred in Romney than in BLX ewe lambs in 1984, but the reverse occurred in 1985, however the magnitude of the breed effect was much smaller than that due to the year of study. The influence of the treatment on fleece weight and any other main interactions were not significant.

Table 4-12 Effect of breed, treatment and year on the percentage of lambs weaned per ewe lamb joined.

| Classification | | No. lambs | Lambs weaned per ewe lamb joined (%) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 62 | 46.8 |
| | '85 | 73 | 21.9 |
| BLX | '84 | 87 | 47.1 |
| | '85 | 80 | 20.0 |
| TREATMENT | | | |
| Mating | '84 | 49 | 46.9 |
| | '85 | 50 | 18.0 |
| Sponge | '84 | 50 | 46.0 |
| | '85 | 52 | 21.2 |
| CIDR | '84 | 50 | 48.0 |
| | '85 | 51 | 23.5 |
| YEAR | | | |
| | 1984 | 149 | 47.0 |
| | 1985 | 153 | 20.9 |

| Source of Variation | Analysis of Deviance d.f | Deviance |
|---|---|---|
| YEAR | 1 | 23.55 *** |
| BREED | 1 | 0.15 NS |
| TREATMENT | 2 | 0.48 NS |
| YEAR X BREED | 1 | 0.10 NS |
| YEAR X TREATMENT | 2 | 0.13 NS |
| TREATMENT X BREED | 2 | 1.98 NS |

Table 4-13. Effect of breed, treatment and year on hogget fleece weight (kg).

| Classification | | No.lambs | Fleece weight (Mean ± s.e) |
|---|---|---|---|
| BREED | | | |
| Romney | '84 | 89 | 3.75 ± 0.04 |
| | '85 | 97 | 2.52 ± 0.03 |
| BLX | '84 | 117 | 3.68 ± 0.04 |
| | '85 | 107 | 2.66 ± 0.03 |
| Treatment | | | |
| Control | '84 | 59 | 3.75 ± 0.06 |
| | '85 | 53 | 2.68 ± 0.05 |
| Mating | '84 | 49 | 3.72 ± 0.06 |
| | '85 | 50 | 2.53 ± 0.04 |
| Sponge | '84 | 48 | 3.64 ± 0.05 |
| | '85 | 52 | 2.54 ± 0.04 |
| CIDR | '84 | 50 | 3.72 ± 0.06 |
| | '85 | 49 | 2.61 ± 0.04 |
| YEAR | | | |
| | 1984 | 206 | 3.71 ± 0.03 |
| | 1985 | 204 | 2.59 ± 0.02 |

Analysis of variance

| Source of Variation | d.f | Mean Squere |
|---|---|---|
| YEAR | 1 | 129.94 *** |
| BREED | 1 | 1.25 * |
| TREATMENT | 3 | 0.53 NS |
| YEAR X BREED | 1 | 1.07 * |
| YEAR X TREATMENT | 3 | 0.36 NS |
| TREATMENT X BREED | 3 | 0.06 NS |

## 4.2. PLASMA PROGESTERONE LEVELS IN EWE LAMBS TREATED WITH CIDR

### 4.2.1. Experiment 1

Mean plasma progesterone levels during and after CIDR treatment in entire and ovariectomised (OVX) ewe lambs are listed in Table 4-14 and Fig. 4-4.

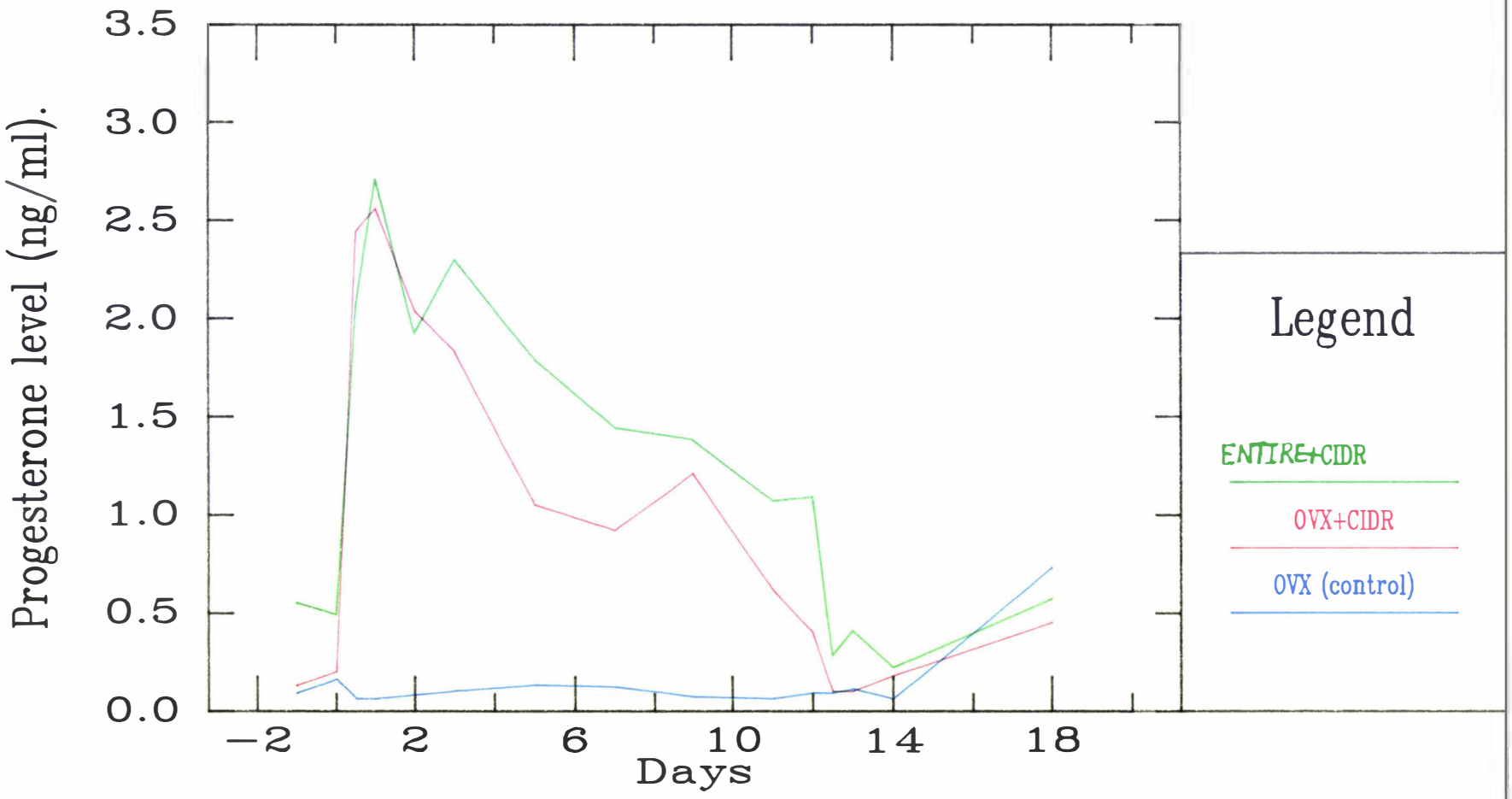
Data were log transformed to stabilize treatment variances. Analyses were made between Day 0 (p.m) and Day 12 (before CIDR withdrawal). The results showed no significant differences between entire + CIDR- and OVX + CIDR-treated animals,but there were significant ($P<0.05$) differences in parallelism of the treatment profiles over time. A separate analysis of variance was made at each of the time-periods. In Day 11 and Day 12 (a.m) the treatment effects were significant ($P<0.05$).

Table 4-14 Progesterone levels (ng/ml plasma) during and after CIDR treatment in entire and ovariectomised (OVX) ewe lambs.

| Day of observation | (Mean ± s.e) Progesterone Entire + CIDR | OVX + CIDR | OVX |
|---|---|---|---|
| -1 a.m | 0.55 ± 0.39 | 0.13 ± 0.02 | 0.09 ± 0.04 |
| 0 a.m | 0.49 ± 0.19 | 0.20 ± 0.04 | 0.16 ± 0.09 |
| p.m | 2.05 ± 0.39 | 2.44 ± 0.36 | 0.06 ± 0.03 |
| 1 | 2.71 ± 0.58 | 2.56 ± 0.48 | 0.06 ± 0.02 |
| 2 | 1.92 ± 0.39 | 2.04 ± 0.43 | 0.08 ± 0.02 |
| 3 | 2.30 ± 0.44 | 1.83 ± 0.37 | 0.10 ± 0.02 |
| 5 | 1.79 ± 0.38 | 1.05 ± 0.28 | 0.13 ± 0.06 |
| 7 | 1.44 ± 0.17 | 0.92 ± 0.24 | 0.12 ± 0.02 |
| 9 | 1.38 ± 0.07 | 1.21 ± 0.25 | 0.07 ± 0.03 |
| 11 | 1.07 ± 0.07 | 0.62 ± 0.16 | 0.06 ± 0.02 |
| 12 a.m | 1.09 ± 0.23 | 0.40 ± 0.09 | 0.09 ± 0.05 |
| p.m | 0.28 ± 0.08 | 0.10 ± 0.03 | 0.09 ± 0.00 |
| 13 | 0.41 ± 0.14 | 0.10 ± 0.03 | 0.11 ± 0.03 |
| 14 | 0.22 ± 0.03 | 0.18 ± 0.08 | 0.06 ± 0.02 + |
| 18 | 0.57 ± 0.03 | 0.45 ± 0.17 | 0.73 ± 0.65 |

Note: + 4 animals only

FIG.4.4 Mean plasma progesterone levels during and after CIDR treatment in ewe lambs (Exp.1).



4.2.2. Experiment 2

A) Progesterone levels during CIDR treatment.

Table 4-15 and Fig. 4-5 shows mean plasma progesterone levels during the CIDR treatment period.

B) Progesterone levels after CIDR treatment.

Table 4-16 and Fig. 4-6 shows mean progesterone levels in three groups of ewe lambs, CIDR-treatment, CIDR + PMSG-treatment and in control animals.

Because oestrus in the Control group animals was not synchronised with that in the hormone treated hoggets the data were adjusted by regarding Day 1-2 in the naturally cyclic animals as equivalent to Day 4 after withdrawal in the CIDR-treated hoggets.

As none of the animals in the control group were monitored over the length of time that the treated animals were, then analyses were only possible between CIDR- and CIDR + PMSG-treated animals. The hypothesis of independence among repeated measures failed to be rejected ($P=0.89$) thus a univariate analysis was used. From this it was found that there was a significant difference ($P< 0.05$) in plasma progesterone levels between the CIDR- and CIDR + PMSG-treated animals at Day 8-14.

Table 4-15 Progesterone levels in entire ewe lambs treated with CIDRs

(Mean ± s.e.; ng/ml plasma)

| GROUP | Day of Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | -1 | 0 a.m. | 0 p.m. | 3 | 6 | 9 | 11 a.m. | p.m. |
| CIDR | 0.17 ±0.03 | 0.23 ±0.06 | 2.39 ±0.21 | 3.06 ±0.40 | 1.40 ±0.21 | 2.12 ±0.24 | 1.08 ±0.10 | 0.17 ±0.05 |

Table 4-16 Progesterone levels in entire ewe lambs after treatment with CIDR

(Mean ± s.e.; ng/ml plasma)

| Group | Days after CIDR withdrawal+ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| CIDR only | 0.09 ±0.04 | 0.41 ±0.07 | 0.72 ±0.19 | 1.27 ±0.21 | 1.65 ±0.20 | 1.35 ±0.24 | 0.84 ±0.22 | 0.24 ±0.13 |
| CIDR+ PMSG | 0.16 ±0.03 | 0.58 ±0.04 | 1.53 ±0.29 | 1.74 ±0.36 | 2.82 ±0.38 | 2.36 ±0.36 | 1.47 ±0.40 | 0.56 ±0.24 |
| Control | 0.07 ±0.04 | 0.39 ±0.08 | 1.32 ±0.26 | 2.54 ±0.32 | 2.17 ±0.47 | 2.64 ±0.23 | 1.75 ±0.51 | 0.06 ±0.04 |

+ Day 0 day of CIDR withdrawal
Ø Day 1-2 in cyclic ewes equivalent to "Day 4 after CIDR withdrawal" (see text)

FIG. 4.5 Mean plasma progesterone levels during CIDR treatment in ewe lambs.(Exp.2).

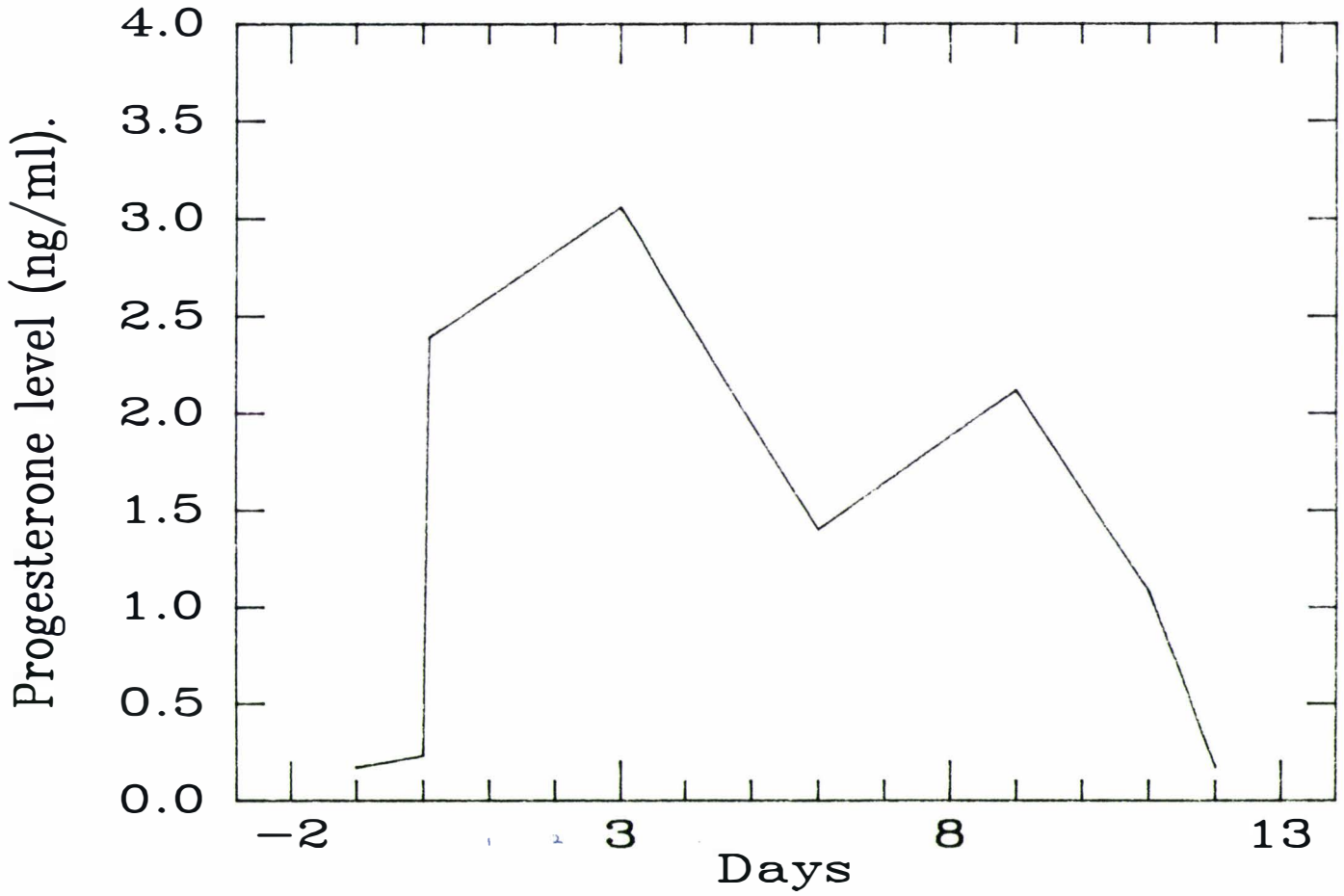


Table 4-15 Progesterone levels in entire ewe lambs treated with CIDRs

(Mean ± s.e.; ng/ml plasma)

| GROUP | Day of Treatment | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | -1 | 0 a.m. | 0 p.m. | 3 | 6 | 9 | 11 a.m. | p.m. |
| CIDR | 0.17 ±0.03 | 0.23 ±0.06 | 2.39 ±0.21 | 3.06 ±0.40 | 1.40 ±0.21 | 2.12 ±0.24 | 1.08 ±0.10 | 0.17 ±0.05 |

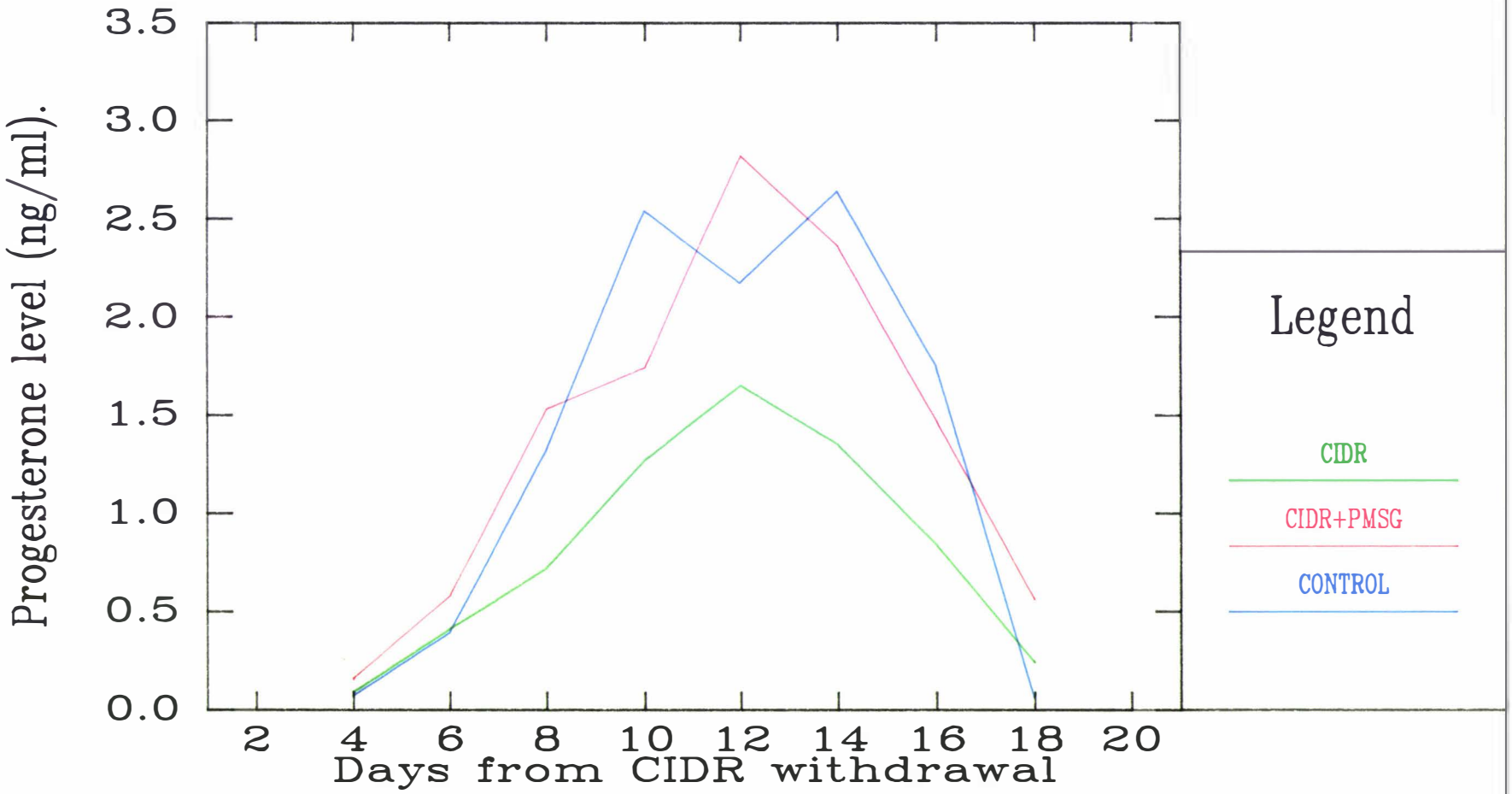
Table 4-16 Progesterone levels in entire ewe lambs after treatment with CIDR

(Mean ± s.e.; ng/ml plasma)

| Group | Days after CIDR withdrawal+ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| CIDR only | 0.09 ±0.04 | 0.41 ±0.07 | 0.72 ±0.19 | 1.27 ±0.21 | 1.65 ±0.20 | 1.35 ±0.24 | 0.84 ±0.22 | 0.24 ±0.13 |
| CIDR+ PMSG | 0.16 ±0.03 | 0.58 ±0.04 | 1.53 ±0.29 | 1.74 ±0.36 | 2.82 ±0.38 | 2.36 ±0.36 | 1.47 ±0.40 | 0.56 ±0.24 |
| Control | 0.07 ±0.04 | 0.39 ±0.08 | 1.32 ±0.26 | 2.54 ±0.32 | 2.17 ±0.47 | 2.64 ±0.23 | 1.75 ±0.51 | 0.06 ±0.04 |

+ Day 0 day of CIDR withdrawal
Ø Day 1-2 in cyclic ewes equivalent to "Day 4 after CIDR withdrawal" (see text)

FIG.4.6 Mean plasma progesterone levels after CIDR treatment in CIDR only, CIDR+PMSG and Control groups (Exp.2).



## 4.3. OVULATORY ACTIVITY AFTER CIDR WITHDRAWAL

### 4.3.1. Incidence of ovulation

Table 4-17 presents the number of animals in which ovulation had occurred in the ovaries when laparoscopies were made at 54,60,66 or 72 h and at one week after CIDR withdrawal. These data were analysed for possible variation owing to breed, treatment and group on the incidence of ovulation (Table 4-18). Main effects were individually fitted in this model owing to the presence of extreme values in the data. More Romney animals ovulated than did BLX but the difference was not significant. More ovulations occurred ($P<0.001$) in animals treated with PMSG (97.1%) than when CIDR treatment alone was given (69.4%). There were no significant effects on the overall incidence of ovulation between groups of hoggets examined at different times.

A total of 72 ewe lambs were laparoscoped but there were only 4 animals (5.56%) in which twin ovulations were recorded. The data were too few for an adequate analysis, but it was noted that all twin ovulations occurred in the BLX hoggets (Table 4-19).

Table 4-17 Proportion of ewe lambs which ovulated by various times after CIDR withdrawal.

| Group | Treatment | Breed | Time after CIDR withdrawal 54h | 60h | 66h | 72h | 1wk | Total hoggets ovulating |
|---|---|---|---|---|---|---|---|---|
| 1 | CIDR | Rom | 0/3 | 0/3 | | 1/3 | 0/3 | 9/12 |
| | | BLX | 0/3 | 0/3 | | 1/3 | 1/3 | |
| | CIDR +PMSG | Rom | 1/3 | 2/3 | | 0/3 | 0/3 | |
| | | BLX | 0/3 | 1/3 | | 2/3 | 0/3 | |
| 2 | CIDR | Rom | | 0/3 | | 1/3 | 2/3 | 10/12 |
| | | BLX | | 2/3 | | 0/3 | 0/3 | |
| | CIDR +PMSG | Rom | | 2/3 | | 0/3 | 1/3 | |
| | | BLX | | 2/3 | | 0/3 | 0/3 | |
| 3 | CIDR | Rom | | | 1/3 | 0/3 | 1/3 | 8/11 |
| | | BLX | | | 0/3 | 1/3 | 0/3 | |
| | CIDR +PMSG | Rom | | | 0/2 | 1/2 | 1/2 | |
| | | BLX | | | 2/3 | 1/3 | 0/3 | |
| 4 | CIDR | Rom | 1/3 | | 1/3 | 0/3 | | 11/12 |
| | | BLX | 1/3 | | 1/3 | 1/3 | | |
| | CIDR +PMSG | Rom | 1/3 | | 2/3 | 0/3 | | |
| | | BLX | 1/3 | | 2/3 | 0/3 | | |
| 5 | CIDR | Rom | | 0/3 | 2/3 | | 1/3 | 11/12 |
| | | BLX | | 0/3 | 0/3 | | 2/3 | |
| | CIDR +PMSG | Rom | | 1/3 | 2/3 | | 0/3 | |
| | | BLX | | 2/3 | 1/3 | | 0/3 | |
| 6 | CIDR | Rom | | | | 1/3 | 1/3 | 10/12 |
| | | BLX | | | | 2/3 | 0/3 | |
| | CIDR +PMSG | Rom | | | | 3/3 | | |
| | | BLX | | | | 2/3 | 1/3 | |

Table 4-18 Effect of breed of hogget, treatment and laparoscopy group on the incidence of ovulation by 1 week after CIDR withdrawal.

| Classification | No. of hoggets | Incidence of ovulation (%) |
|---|---|---|
| BREED | | |
| Romney | 35 | 85.7 ± 0.60 |
| BLX | 36 | 80.6 ± 0.67 |
| TREATMENT | | |
| CIDR | 36 | 69.4 ± 0.78 |
| CIDR + PMSG | 35 | 97.1 ± 0.29 |
| GROUP | | |
| 1 | 12 | 75.0 ± 1.30 |
| 2 | 12 | 83.3 ± 1.52 |
| 3 | 11 | 72.7 ± 1.41 |
| 4 | 12 | 91.7 ± 0.83 |
| 5 | 12 | 91.7 ± 0.83 |
| 6 | 12 | 83.3 ± 1.12 |

Analysis of Deviance

| Source of Variation | d.f | Deviance |
|---|---|---|
| BREED | 1 | 0.11 NS |
| TREATMENT | 1 | 16.55 *** |
| GROUP | 5 | 3.22 NS |

Table 4-19 Distribution of hoggets in which twin ovulations occurred after CIDR withdrawal.

| Classification | No. | No. ovulating | No. with twin ovulations |
|---|---|---|---|
| BREED | | | |
| Romney | 35 | 30 | 0 |
| BLX | 36 | 29 | 4 |
| TREATMENT | | | |
| CIDR | 36 | 25 | 1 |
| CIDR + PMSG | 35 | 34 | 3 |
| GROUP | | | |
| 1 | 12 | 9 | 2 |
| 2 | 12 | 10 | |
| 3 | 11 | 8 | 1 |
| 4 | 12 | 11 | |
| 5 | 12 | 11 | |
| 6 | 12 | 10 | 1 |

4.3.2. Time of ovulation

Table 4-20 shows the number of animals with recently ruptured follicles observed in the ovaries at 54,60,66 and 72 h after withdrawal according to groups. The mean time of ovulation relative to the breed of animal and treatment is also given in Table 4-21. There were no significant effects of these variables on the time of ovulation.

Comparisons were also made between individual groups as to when ovulation occurred (Table 4-22). The results for Groups 1 and 2 animals show that laparoscopy at 54 h did not affect the occurrence of ovulation by 60 or 72 h. Further the results for Groups 2 v 6 and 3 v 6 shows that laparoscopy at 60 or 66 h, respectively did not affect ovulation at 72 h. Comparisons made between Group 3 and 5 animals shows that laparoscopy at 60 h resulted in more ovulations at 66 h ($P<0.1$), but it was not significant at 72 h. In fact the early laparoscopy clearly did not retard ovulation in the Group 5 animals as 5/9 hoggets also ovulated by 66 h. Laparoscopy at 54 h also did not inhibit ovulation occurring 66 h (Group 4 v Group 3 ; $P<0.01$) and also by 72 h ($P<0.05$). Thus it appeared that the laparoscopy about the time when ovulation might be expected did not suppress its occurrence. However in all groups there were some animals that did not ovulate, even in 2/12 animals examined first at 72 hours after CIDR withdrawal.

Table 4-20 Distribution of animals ovulating by various hours after CIDR withdrawal.

| | Time of Laparoscopy | | | | |
|---|---|---|---|---|---|
| GROUP | 54 | 60 | 66 | 72 | Total |
| 1 | 1/12 | 3/12 | | 4/12 | 8/12 |
| 2 | | 6/12 | | 1/12 | 7/12 |
| 3 | | | 3/11 | 3/11 | 6/11 |
| 4 | 4/12 | | 6/12 | 1/12 | 11/12 |
| 5 | | 3/12 | 5/12 | - | 8/12 |
| 6 | | | | 8/12 | 8/12 |

Table 4-21 Effect of breed and treatment on the mean time of ovulation after withdrawal of CIDR (h).

| Classification | No. of ewes ovulating | Time of ovulation (Mean ± s.e) |
|---|---|---|
| BREED | | |
| Romney | 23 | 64.96 ± 1.29 |
| BLX | 25 | 65.76 ± 1.22 |
| TREATMENT | | |
| CIDR | 17 | 66.71 ± 1.53 |
| CIDR + PMSG | 31 | 64.65 ± 1.07 |

| Source of Variation | Analysis of variance d.f | Mean Squere |
|---|---|---|
| BREED | 1 | 7.73 NS |
| TREATMENT | 1 | 46.15 NS |

Table 4-22 Comparison of time of ovulation (h after CIDR withdrawal) between groups of hoggets

| Comparison Group | Time of observation | No.of animals ovulating | Deviance |
|---|---|---|---|
| 1 v. 2 | 60 | 4/12 v. 6/12 | 0.69 NS |
| | 72 | 8/12 v. 7/12 | 0.18 NS |
| 3 v. 5 | 66 | 3/11 v. 8/12 | 3.67P<0.1 |
| | 72 | 6/11 v. 8/12 | 0.35 NS |
| 3 v. 4 | 66 | 3/11 v.10/12 | 7.79 ** |
| | 72 | 6/11 v.11/12 | 4.36 * |
| 2 v. 6 | 72 | 7/12 v. 8/12 | 0.18 NS |
| 3 v. 6 | 72 | 6/11 v. 8/12 | 0.35 NS |

### 4.3.3. Incidence of oestrus

A) Expected "first " oestrus

Table 4-23 shows the percentage of ewe lambs which came into oestrus within 7 days after CIDR withdrwal. Data from one animal was excluded from the analysis because of death. Surprisingly, even though the groups were selected randomly, analysis shows only group differences were significant ($P<0.05$) in the incidence of "first" oestrus.

B) Expected "second" oestrus

Table 4-24 shows the effect of breed,treatment and group on the occurrence of overt oestrus at the time of expected second oestrus following CIDR withdrawal (i.e. approximatly 14 days after CIDR withdrawal). There were no significant effects of breed, treatment and group nor were the main interactions significant.

Table 4-23 Effect of breed,treatment and group on the incidence of oestrus within 7 days of CIDR withdrawal (%).

| Classification | No. of lambs | Incidence of oestrus (Mean ± s.e) |
|---|---|---|
| BREED | | |
| Romney | 30 | 85.7 ± 0.06 |
| BLX | 24 | 66.7 ± 0.08 |
| TREATMENT | | |
| CIDR | 36 | 69.4 ± 0.08 |
| CIDR + PMSG | 35 | 82.9 ± 0.06 |
| GROUP | | |
| 1 | 12 | 91.7 ± 0.08 |
| 2 | 12 | 75.0 ± 0.13 |
| 3 | 11 | 54.6 ± 0.16 |
| 4 | 12 | 91.7 ± 0.08 |
| 5 | 12 | 83.3 ± 0.11 |
| 6 | 12 | 58.3 ± 0.15 |

Analysis of Deviance

| Source of Variation | d.f | Deviance |
|---|---|---|
| BREED | 1 | 3.62 |
| TREATMENT | 1 | 0.81 |
| GROUP | 5 | 15.21 ** |

Table 4-24 Effect of breed, treatment and group on the occurrence of oestrus at the expected second oestrus after CIDR withdrawal

| Classification | No.of lambs | Incidence of oestrus (%) |
|---|---|---|
| BREED | | |
| Romney | 35 | 80.0 ± 0.07 |
| BLX | 36 | 72.2 ± 0.08 |
| TREATMENT | | |
| CIDR | 36 | 69.4 ± 0.08 |
| CIDR +PMSG | 35 | 82.9 ± 0.06 |
| GROUP | | |
| 1 | 12 | 75.0 ± 0.13 |
| 2 | 12 | 83.3 ± 0.11 |
| 3 | 11 | 72.7 ± 0.14 |
| 4 | 12 | 66.7 ± 0.14 |
| 5 | 12 | 75.0 ± 0.13 |
| 6 | 12 | 83.3 ± 0.11 |

Analysis of Deviance

| Source of Variation | d.f | Deviance |
|---|---|---|
| BREED | 1 | 0.59 NS |
| TREATMENT | 1 | 1.82 NS |
| GROUP | 5 | 1.39 NS |

4.3.4. Synchronization of oestrus

A) Expected "first" oestrus

The effects of treatment and breed on the distribution of the onset of oestrus over the 74 h after CIDR withdrawal are shown in Table 4-25 and Fig.4-7 a and b.

The mean times of onset of oestrus in Romney and BLX animals were 41.5 and 41.7 h and in CIDR- and CIDR + PMSG-treated animals,43.0 and 40.5 h, respectively. Analysis of these data did not show a significant difference between breed or treatment in the time that oestrus was observed. Surprisingly, the group effects were significant ($P<0.05$) and thus the onset of oestrus appeared to be affected by laparoscopy and its associated handling procedures. However in the animals which showed heat most were recorded before the first laparoscopy was attempted.

B) Expected "second" oestrus

Table 4-26 and Fig.4-8 a and b shows the effect of breed and treatment on the distribution of the onset of oestrus during the expected "second" oestrous period. Only animals which initially showed first oestrus within one week of CIDR withdrawal were considered and then the onset of second oestrus was recorded from the day that the first ewe lambs was detected in heat. There were no significant differences between breed or treatment in the frequency distributions recorded.

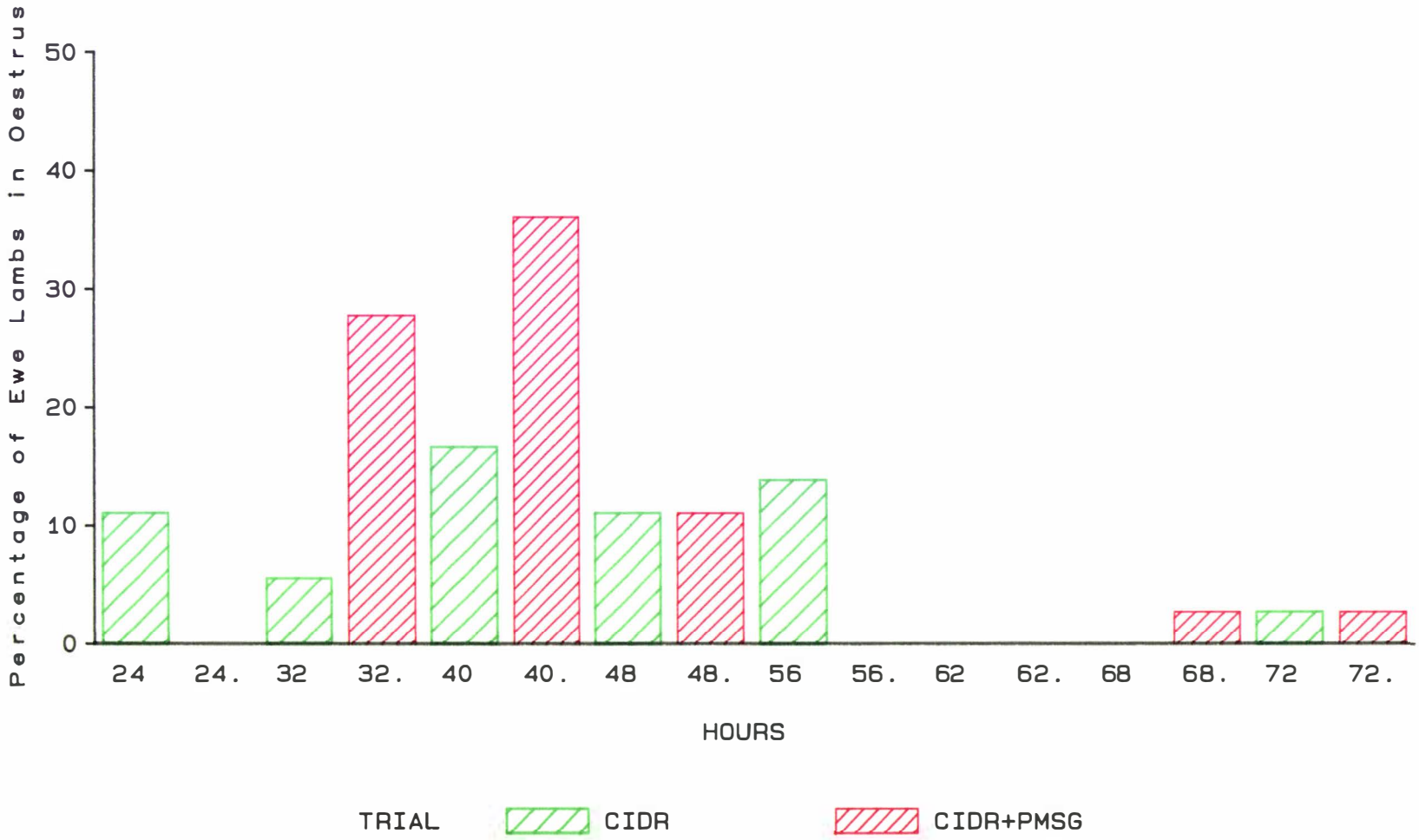
Table 4-25 Effect of breed and treatment on the interval between CIDR removal and the onset of the first oestrus.

| Treatment | Breed | No. treated | Interval (h) 24 | 32 | 40 | 48 | 56 | 62 | 68 | 74 | Total animals (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | No. (%) of ewe lambs in oestrus | | | | | | | | |
| CIDR | Romney | 18 | 1(6) | 1(6) | 5(28) | 1(5) | 3(16) | | | | 11(61) |
| | BLX | 18 | 3(16) | 1(6) | 1(6) | 3(17) | 2(11) | | | 1(6) | 11(61) |
| CIDR+ PMSG | Romney | 18 | | 6(33) | 7(39) | 3(17) | | | | 1(6) | 17(94) |
| | BLX | 18 | | 4(22) | 6(33) | 1(6) | | | 1(6) | | 12(67) |

Analysis of Variance

| Source of variation | d.f | Mean Squere |
|---|---|---|
| BREED | 1 | 0.004 NS |
| TREATMENT | 1 | 0.324 NS |
| GROUP | 5 | 8.524 * |

# FIG.4.7a Distribution of onset of the first oestrus (relative to treatment)




Time after CIDR withdrawal

# FIG.4.7b Distribution of the onset

of the first oestrus

(relative to treatment and breed)

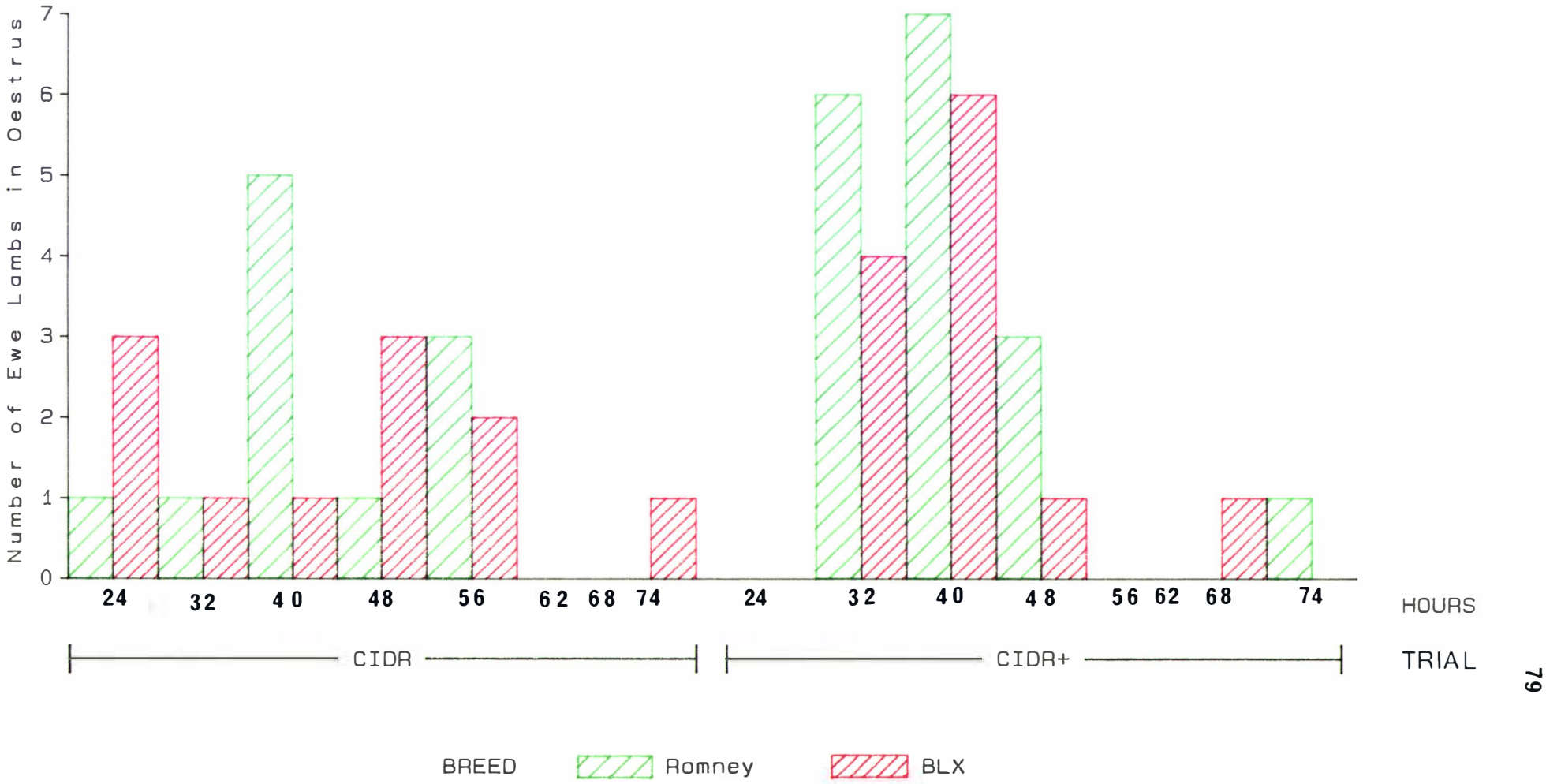


Table 4-26 Breed and treatment effects on the synchronisation of oestrus one cycle after CIDR withdrawal.

| TREATMENT | BREED | No. Treated | Interval Days + 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total No. of hoggets(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | No. (%) of hoggets in oestrus | | | | | | | |
| CIDR | Romney | 18 | | | 2(11) | 3(17) | 6(33) | | | 11 (61) |
| | BLX | 18 | 1(6) | 1(6) | 2(11) | 3(17) | | 2(11) | 1(6) | 10 (56) |
| CIDR + PMSG | Romney | 18 | 1(6) | | 1(6) | 5(28) | 3(17) | 4(22) | 1(6) | 15 (83) |
| | BLX | 18 | | | 1(6) | 3(17) | 5(28) | 2(11) | | 11 (61) |

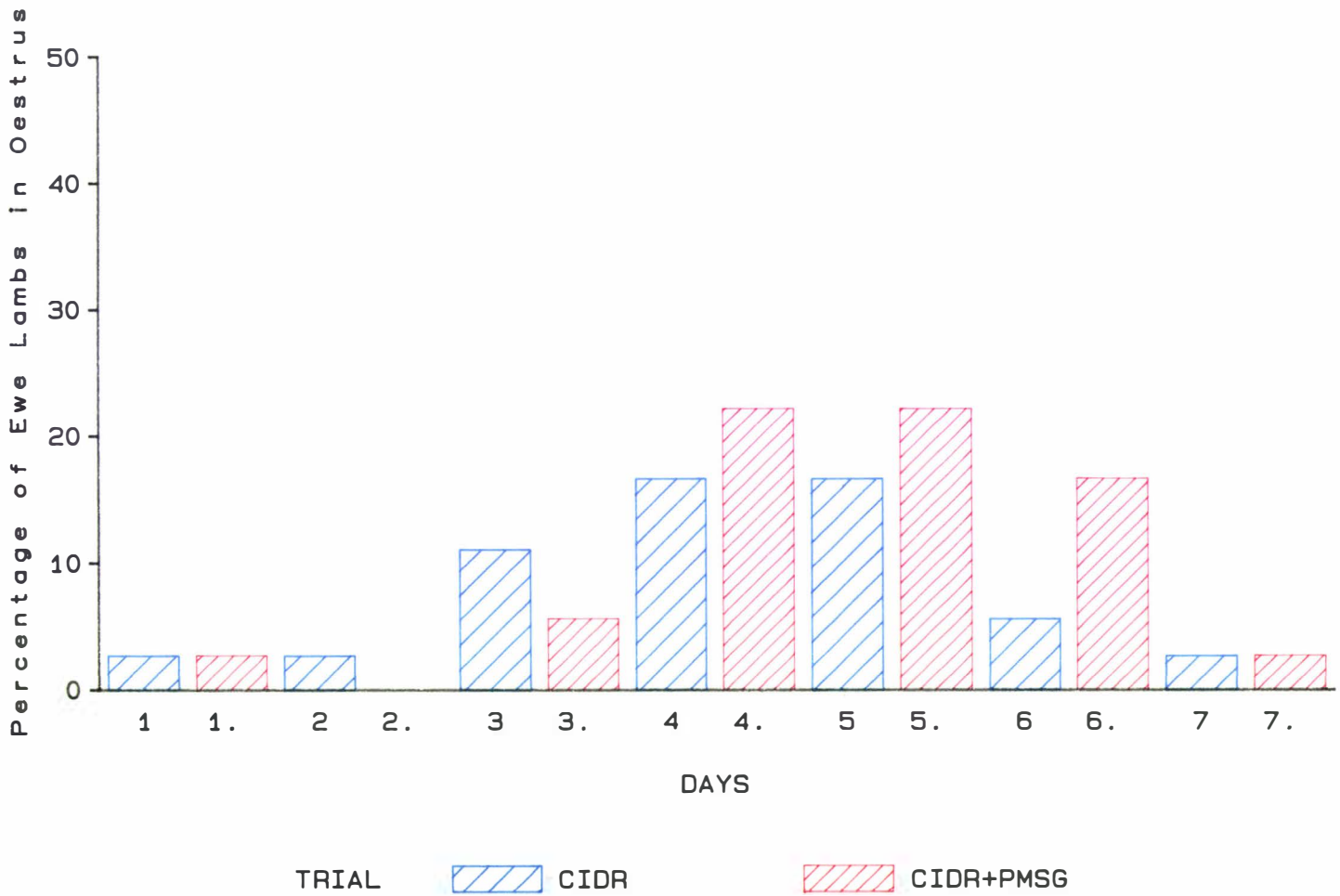
Note: + Recorded from day of the first ewe returning to oestrus

Analysis of Variance

| Source of Variation | d.f | Mean Squere |
|---|---|---|
| BREED | 1 | 0.64 NS |
| TREATMENT | 1 | 3.88 NS |
| GROUP | 5 | 0.74 NS |

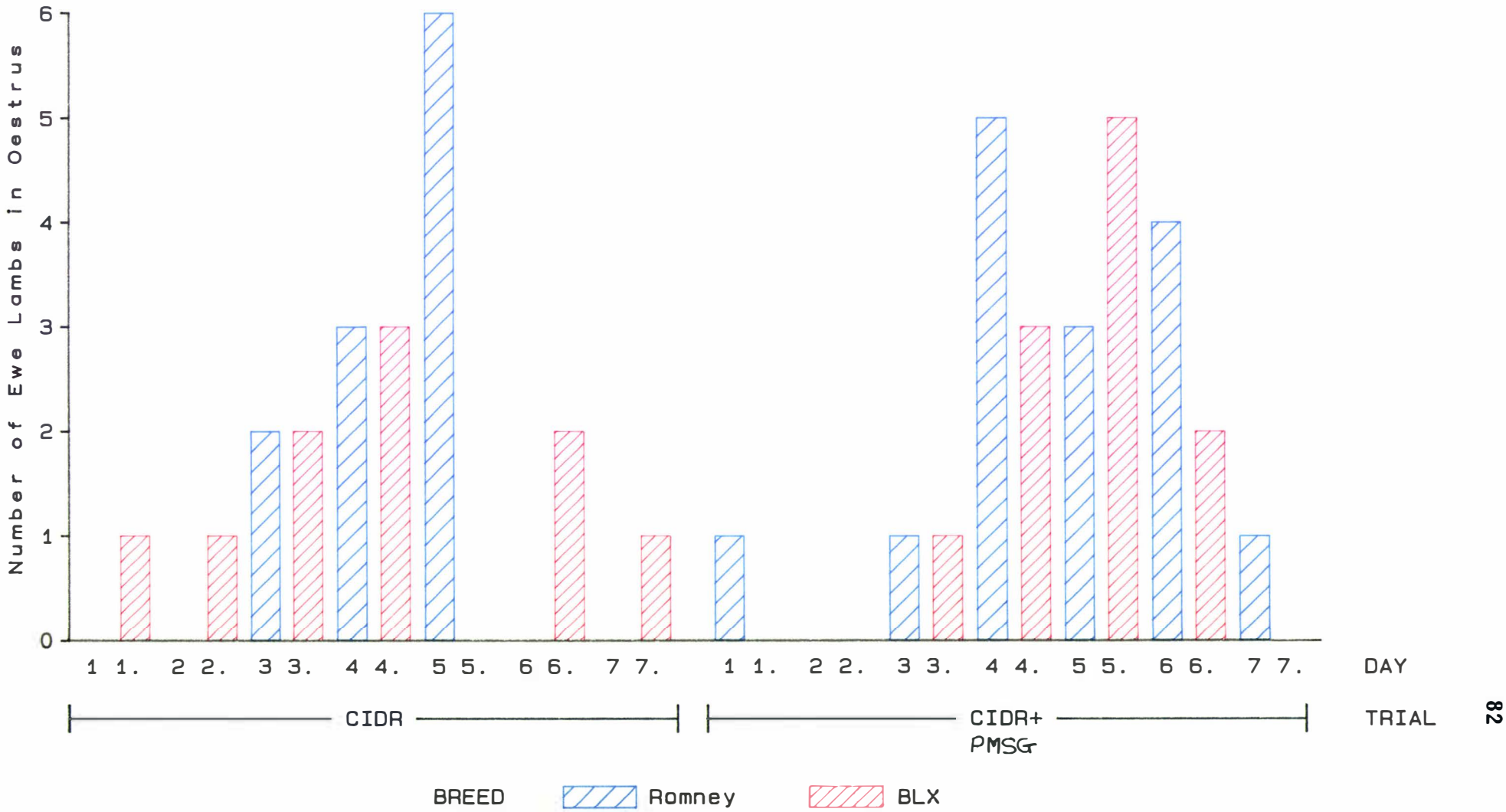
# FIG.4.8a Distribution of onset of

the second oestrus



# FIG.4.8b Distribution of onset

of the second oestrus



### 4.3.5. Cycle length

The effects of breed, treatment and group on the cycle length are summarised in Table 4-27. Animals which did not come into heat during the first week after CIDR withdrawal were excluded from the analysis.

The mean (± s.e) interval between successive oestrous periods was 17.3 and 16.4 days for Romney and BLX animals, respectively, but this difference was non significant.

The two shortest cycle lengths were 13 and 14 days duration while the two longest interoestrous intervals were 23 and 25 days.

PMSG treatment did not shorten the cycle length nor did laparoscopy. There were no significant interactions between any of the main effects.

Table 4-27 Effect of breed, treatment and group on cycle length.(d)

| Classification | No.of hoggets | Cycle length (Mean ± s.e) |
|---|---|---|
| BREED | | |
| Romney | 28 | 17.3 ± 0.41 |
| BLX | 21 | 16.4 ± 0.29 |
| TREATMENT | | |
| CIDR | 22 | 16.5 ± 0.41 |
| CIDR + PMSG | 27 | 17.3 ± 0.36 |
| GROUP | | |
| 1 | 9 | 16.7 ± 0.37 |
| 2 | 9 | 16.2 ± 0.55 |
| 3 | 6 | 16.5 ± 0.34 |
| 4 | 9 | 17.0 ± 0.85 |
| 5 | 9 | 17.6 ± 0.97 |
| 6 | 7 | 17.4 ± 0.48 |

Analysis of Variance

| Source of Variation | d.f | Mean Squere |
|---|---|---|
| BREED | 1 | 9.82 NS |
| TREATMENT | 1 | 7.06 NS |
| GROUP | 5 | 2.39 NS |

## 4.4. APPLICATION AND RETENTION OF CIDRs AND SPONGES

The insertion of the Sponges and CIDR was accomplished in most hoggets without difficulty. However, in several animals it was evident that the Sponge or CIDR had not been deposited very deeply into the vagina. It was decided that excessive force should be avoided and thus any damage to the internal tissues.

The loss rate of Sponges was 34% and 13.5% in 1984 and 1985, respectively. The comparable figures for CIDRs were 2% and 3.9%. Failure to lodge the sponge in the anterior vagina was considered to cause excessive loss of the sponges. In the experiment in 1986 all CIDRs were retained for the full period of treatment.

# CHAPTER FIVE
# DISCUSSION

## 5.1. REPRODUCTIVE PERFORMANCE AFTER CIDR TREATMENT

### 5.1.1. Incidence of oestrus

In the first year's trial 78% of CIDR-treated lambs showed oestrus, which was less than among the Control (86%), Mating (84%) and Sponge treated animals (92%). The proportion of ewe lambs in oestrus in this study was similar to that reported by Asofi (1984 and McMillan (1986) and higher than in most spontaneously cycling hoggets ( 72%: Ch'ang and Raeside,1957; 55%: Hight et al., 1973; 47%: Allison and Kelly,1978).

In the following year 51% of the CIDR-treated animals came into oestrus, and a similar incidence was recorded in the other groups. Within both years of the trial, treatment with CIDRs and Sponges produced a similar incidence of oestrus in the hoggets. The results therefore agree with the finding of Welch et al. (1984) and Maxwell and Barnes (1986) in adult ewes and McMillan (1986) with hoggets, that CIDR treatment can be reasonably effective for induction of oestrus.

There was a significant difference between years in the incidence of oestrus following either type of progestagen treatment. Also the incidence of naturally occurring oestrus differed between years and was highest in 1984. The appreciable difference in pre-mating live weight of hoggets between years (38 kg v 31 kg in 1984 and 1985) is the most likely reason for the variation in occurrence of oestrus. Although insufficent data were available in the present study to quantify the relationship between autumn liveweight and oestrous activity,it is widely recognised that a positive relationship exists (Dyrmundsson,1973; Craig 1982; and Moore et al.,1983).

The injection of a small amount of gonadotrophin following CIDR removal increased the number of hoggets in oestrus in the 1986 trial (83% v 70%). McMillan, (1986) also obtained an improvement in response in Romney x Coopworth animals following a CIDR + PMSG treatment compared to CIDR alone. It is presumed that additional ovulatory activity caused by the injected gonadotrophin is necessary to provide sufficient oestrogen to induce oestrus.

The interval between successive oestrous period did not show a high degree of variability; the range was from 13 to 25 days,and this was similar to that reported by Ch'ang and Raeside (1957), but most animals showed a cycle length close to the mean value. The mean interval of 16-17 days agrees with that previously recorded in Romney lambs (17 days: Ch'ang and Raeside,1957). Unlike many other reports (Hafez, 1952; Mounib et al.,1965; McMillan,1981), mean inter-oestrous intervals in this study were close to those recorded in adults (Eastwood,1975; Dyrmundsson, 1978).

5.1.2. Synchronization of oestrus

Although fewer CIDR-treated than Sponge-treated ewe lambs were mated within 5 days in 1984 (45% v. 70% ), the pattern of mating was similar. The peak of mating occurred on the second day and this was similar to the result of McMillan (1986).

The synchronisation of matings within 3 days of withdrawal in this study was far less than that reported by McMillan (1986) with Romney hoggets, the comparison being CIDR-treated 45% v 79% and Sponge-treated 58% v 82%, respectively. The low synchronisation rate following both treatment systems is probably related to liveweight or growth characteristics of the animals. Welch et al. (1984) reported the best synchrony of oestrus occurred in high bodyweight,high feed allowance ewes. In general,the attainment of puberty is affected by age and liveweight (Bichard et al., 1974; Moore et al.,1978; Moore and

Smeaton,1980; Moore and McMillan, 1984; McMillan,1986). To achieve a good level of reproduction in ewe hoggets Craig (1982) has suggested that satisfactory target weights be recorded by certain ages, such as at least 35 Kg by 1 May.

Although pre-mating mean liveweights of animals in the present study were higher than for Romney hoggets described by McMillan(1986) (37kg v 27-33kg) there was no difference in the occurrence of the mating seasons. This higher synchronisation rate in McMillan's study may be due to genetic superiority (e.g. Waihora Romneys and Marshall Romneys) existing. Evidence of genetic gains in hogget lambing activity is provided by Gibson and Craig (1980) and selected hoggets have demonstrated a two-fold advantage over "commercial" line animals in the number showing oestrus. A high percentage of loss occurred with sponge (34% and 13.5% in 1984 and 1985) than with CIDRs (2% and 3.9% in 1984 and 1985). These values might be compared with the 26% loss from Romney hoggets in the work reported by (Ch'ang et al.,(1968) The sponge loss rate in ewe lambs appears to be within the range considered normal for mature ewes (Keane, 1974a; Quirke,1978b; Reed et al., 1977). In general CIDR loss rate in adult ewes was low and similar to that from sponge-treated ewes, (Maxwell and Barnes,1986; Welch et al.,1984).However, a high loss rate (10%) has been reported, (Harvey,1984) and this high loss rate maybe due to incorrect placement due to the applicator used.

Failure to lodge the sponge in the anterior region of the vagina is likely to be the cause of the loss. It was observed that of the 17 of the 50 ewe lambs that lost sponges 12 did so within four days after insertion. The animals were not examined earlier than 4 days after insertion, so it is not known for haw long the sponge was kept in the vagina.

The retention rate of CIDRs was very high as found in other work (McMillan,1986).

In 1986, the pattern at mating was similar between treatment and breed. In the trial conducted in 1986, some groups received PMSG after CIDR withdrawal,and this caused a higher incidence of oestrus, but the overall pattern of mating was similar in comparisons between treatment and breed. Examination of the number of the animals in oestrus at 32, 40 or 48h after CIDR showed that the PMSG treatment had caused a more precise synchronization of oestrus. Good synchronisation was maintained at the expected second oestrus period. Similar results have been shown by McMillan in ewe lambs (1986) and by Eastwood in adult ewes (1975). Further, other work has shown that progesterone synchronization of oestrus remains effective for 3 oestrous cycles and that laparotomy at each of these cycles does not markedly affect the degree of synchronization in adult ewes (Clarke,1973). In the present work with hoggets repeated laparoscopies conducted to record the time of ovulation did not appear to markedly reduce the synchronization at second oestrus.

5.1.3. Ovarian activity

Of the 60 marked lambs examined for ovarian activity in 1984, all had ovulated. In a large study involving 3032 reported laparoscopies of ewe lambs, Cleverdon(1980) also noted the lack of anovular oestrus. However the occurrence of oestrus without ovulation can be high (6-33%) in untreated puberal lambs (Edey et al. 1977). The phenomenon also occurs in progestagen-PMSG treated lambs (Keane,1975b; Quirke,1979c). In the 1986 trial, a few animals also showed oestrus without ovulation(4.2%).

The incidence of multiple ovulation after CIDR (15%) or Sponge (20%) treatments was similar to that in animals not treated with progestagen (15%). Similar results were reported by McMillan (1986) and he concluded that the ability of the hogget to produce multiple ovulations was independent of the method of synchronisation administered. Significant increases in ovulation rate may occur after progestagen-PMSG treatment (Allen and Lamming ,1961; Keane,.1974b;

Quirke, 1978a) and these are related to the dose level of PMSG (Quirke 1979c, McMillan 1986). In the 1986 trial only a few animals had multiple ovulations after the CIDR (2.7%) or CIDR + PMSG (8.6%) treatment. The low quantity of PMSG (200 I.U.) injected barely stimulated extra ovulation, but it was noticiable that much more follicular activity was present in the PMSG- treated animals than in those given CIDR alone.

The low ovulation rate may also be related to a seasonal effect. The present work was carried out in the early breeding season (late April), while in other studies high ovulation rates have occurred in animal treated later in the breeding season. This suggestion is supported by the observation of Wheeler and Land (1977) who reported that hoggets will respond,in a similar fashion to ewes,with ovulation rate rising to a peak at the second or third cycle of the season caused by the decline in gonadal stimulation.

Information on the time of ovulation was obtained by repeated laparoscopy and inspection of the ovaries to detect rupture of follicles and formation of corpora lutea. The mean time of ovulation was 66.7 and 64.7 h after CIDR and CIDR + PMSG treatment, respectively. Unlike many other studies (Killeen and Moore,1970; Cognie et al., 1970; Baschoff et al., 1973; Evans and Robinson,1980), the time of ovulation in relation to progestagen withdrawal was not advanced significantly by treatment with PMSG. This lack of an effect may have been due to the low level of gonadotrophin administered (200 i.u.). Using a range of gonadotrophin doses and higher than used here, Baschoff et al., (1973) has reported that PMSG significantly decreased the time from sponge withdrawal to ovulation and noted significant, linear and quadratic relationships.

Repeated laparoscopy as a possible stressful factor did not cause any effect on the time of ovulation. Walker et al. 1986 also noted a similar lack of an effect in adult ewes, although repeated laparoscopy is associated with a sustained increase in plasma cortisol levels.The

same researcher reported that preovulatory surges of LH and ovulation were supressed in seasonally anovular ewes by the introduction of rams. However,single laparoscopy followed by frequent blood sampling did not prevent the ewes from ovulating. Furthermore it was unlikely that there was any ,drastic interference with the ovulatory action of the LH surge, since one ewe subjected to repeated laparoscopy had an LH surge and ovulated (Martin et al.,1981)

5.1.4. Pregnancy

The conception rates to all services for joined lambs in the mating, sponge and CIDR-treated groups were 57%, 56% and 56% in 1984 and 34%, 19% and 26% in 1985, respectively. In 1984, no differences occurred in conception percentage between treatments, but in the next year sponge-treated animals showed a poorer result than for the other two groups. This result was similar to that with adult ewes (Boland et al.,1983; Welch et al.,1984.

High fertilization rates have been reported for ewe lambs by several workers (Killeen and Quirke,1979; McMillan and McDonald,1985). Thus there is presumptive evidence that sperm transport within the female tract to the site of fertilisation can be satisfactory and is unlikely to be a major factor limiting fertility in ewe lambs. However appreciable post fertilization losses are apparent in naturally cycling hoggets (McMillan and McDonald,1985) or following hormonal synchronization (Quirke, 1979c) and these will cause a reduction in conception rate.

No genotype differences in fertility were found in this study, nor in that of Hohenboken and Cochran (1976). However, in many others studies the superior fertility in naturally cycling crossbred animals compared to straightbred animals has been noted (Allison et al.,1975; McMillan,1981; Asofi,1984). The small number of animals in the treatment groups in relation to the expected size of any treatment

differences should be noted and probably explains the lack of a breed or genotype difference.

Comparison of the results for the two years shows that in 1985 all groups had low conception rates which was not surprising as the animals were lighter than animals in the previous year. Moore et al.(1983) also reported a difference between years in conception rate and suggested this to be related to variation in body weights of the hoggets. The gestation lengths were 144 and 145 days in the animals that were hormonally treated, but also similar (142, 141 days in 1984,1985) in the mating group animals. There seems to be no apparent reason for a difference of 3 days in gestation length relative to the method of oestrus induction. Prior to analysis, data an hoggets aborting their lambs or delivering at extreme times were excluded so that only pregnancies of "normal" duration were considered.

5.1.5. Lambing performance

As anticipated the animals in the hormone-treated groups had a concentrated period for lambing compared to the mating group hoggets. The mean day of birth between years varied by approximately 1 week and occurred about the 20 October. This is later in the season than when matures ewes will lamb and therefore in comparisons of progeny, those from hoggets in contrast to mature ewes may be disadvantaged. In comparisons of the same genotypes, Asofi (1984) also noted that Romney hoggets produced the heaviest lambs, but McMillan and McDonald (1983) found the reverse to be the situation and the BLX hoggets produced lambs approximately 0.5 kg heavier.

Lamb birth weights differed quite markedly between years. The difference of 4.2kg v 3.3kg can be explained largely by differences in pasture allowances. However in the present trial pasture allowances were not measured but it is considered that the management given to the animals in 1985 would have kept feed intake at a lower value that in

the previous season.

Very few hoggets had multiple births. In similar work with hoggets, McMillan (1986) has reported fertility and multiple birth rate were independent of method of synchronization and he also noted very few multiple births. The BLX animals had more multiple births than Romney hoggets in both years. This result was not surprising as other workers (Coop and Clark, 1965; McMilland and McDonald,1983; Asofi, 1984) have also noted the superiority of crossbred animals that were naturally mated.

The 47% of lambs weaned per ewe joined in 1984 was similar to that reported by Moore et al. (1983) as an average for Romney, Coopworth and Perendale hoggets, and Asofi (1984) with BLX and Romney hoggets. Neither treatment nor breed difference in weaning percentage was observed in either year. The lower weaning rate (21%) in 1985 was mainly due to the lighter joining liveweight which resulted in poor oestrous activity and low conception rate. Craig (1982) has reported a very wide variation during 8 years (4-43%) for Romney hoggets in the Waihora sheep breding scheme, and this was associated with seasonal feed supply and liveweights ottained.

5.1.6. Fleece weight

Fleece weight did not vary significantly between treatment and breed. Superior wool production for one year-old BLX hoggets over Romneys did not appear in the 1984 study (3.7 Kg, BLX v. 3.8 Kg Romney), but did in 1985 (2.7 Kg, BLX v. 2.5Kg , Romney). This result in in agreement with the findings reported by Hight and Jury (1971), McMillan and McDonald (1983), and Asofi (1984).

It is believed that the characteristic effects on fleece weight that might occur in the BLX animals are small (Rae and Wickham,1970).

The year difference of 3.7kg v 2.6kg in 1984 and 1985 is substantial and reflects the difference in feed supply between the two years. Undoubtedly the lamb growth rate was suppressed in 1985 and it is evident in the fleece weight recorded.

Non pregnant hoggets had heavier fleece weights than those that produced lambs. In contrast, Craig (1982) noted that animals with single lambs had 0.3Kg more wool than non pregnant hoggets which were similar to those lambing twins. As hogget shearing usually occurs prior to parturition then any effects on fleece weight are owing to the effect of gestation and not added to by lactation. Baker et al. (1981) observed little difference in hogget fleece weights relative to pregnancy status. However the fleece weights recorded when the animals are shorn prior to mating at 19 months-of-age may well reflect the influence of the hoggets lactational performance (Asofi,1984) and especially if the lactation period was prolonged.

## 5.2. UPTAKE OF PROGESTERONE FROM THE CIDR

The ovariectomised animals provided data on the clearance of progesterone from the CIDR. The levels of progesterone recorded in the blood rose rapidly after insertion of the CIDR. Maximum values were observed 24 h after insertion. The levels then decreased gradually and fell abruptly with the removal of CIDR. These values for ovariectomised treated hoggets were similar to those found by Barnes (1987). Eight hours after removal from animals, plasma progesterone fell significantly to basal levels. These figures are consistent with many others studies(Ainsworth and Downwy,1986; Hamra et al.,1986; Barnes,1987) Progesterone levels were higher in entire ewe lambs given CIDR than in ovariectomised sheep. In fact at Day -2 (before CIDR insertion) one of the entire ewe lambs had a high progesterone level of 2.1 ng/ml which indicated an active corpus luteum. Cunningham et al.(1975) also reported that high pre- implantation progesterone level (0.4-0.9 ng/ml) is suggestive of luteal activity. The entire animals treated with CIDRs also reached maximum levels quickly the peak being obtained by 3 days after insertion. Following this, progesterone declined gradually to 1.08 ng/ml on Day 11. This was a similar pattern to that found by Hamra et al.(1986) using 9% CIDRs.

## 5.3 PROGESTERONE PRODUCTION AFTER INDUCED OVULATION

The pattern of progesterone production during the oestrous cycle after CIDR withdrawal in Control and CIDR + PMSG -treated ewe lambs was in agreement with that in naturally cycling ewes (Sarda et al., 1973) or in adult ewes after CIDR + PMSG induced ovulation (Ainsworth and Downey,1986). There was also a similar pattern of progesterone production recorded in the ewes treated only with CIDRs, but the blood levels were lower, especially on days 8-14, than in CIDR + PMSG-treated animals. This effect was not due to the PMSG-treated hoggets producing more progesterone due to a higher ovulation rate and thus more corpora lutea as none had twin ovulations. However, Evans and Robinson (1980) reported a strong linear and positive relationship between plasma progesterone on days 6 and 13 of the cycle and dose of PMSG. The large part of the increase was due to an increase in the number of corpora lutea plus large luteinized follicles. These latter structures developed from follicles which did not rupture at the time of ovulation but luteinized and became effective producers of progesterone. The linear effect of PMSG on plasma progesterone suggests that over-stimulation of follicles may also result in oversized corpora lutea and consequenty high progesterone concentrations.

## 5.4. CONCLUSION

In the present study, the breeding performance and productivity of CIDR-treated ewe lambs has been recorded in conjuction with Sponge-treated,as well as naturally mated and non-bred contemporary ewe lambs.

The use of CIDRs has been demonstrated to be an effective substitute for sponges in achieving synchronisation and conception in hoggets. In many respects, CIDRs were easier and quicker to insert and withdraw than sponges and lower loss rates were recorded. The unpleasant vaginal discharge, which has been observed often with sponge treatment of sheep, was not noted when using CIDRs. In comparison to natural mating in ewe lambs,treatment with CIDRs was ewfective in respect of the incidence of oestrus, conception rate and weaning performance.

When PMSG was used in conjunction with CIDR treatment although it did not achieve a better synchronization of oestrus it did cause more animals to show oestrus and these ovulated. It is considered that PMSG improved the effectivenes of CIDR treatment and especially if the ewe lambs were required to be bred early in the season. It was apparent that animals needed to be well fed and grown for CIDR treatment to be effective in induction of early breeding.

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