PN-ABD-314
ISN 62203

DEVELOPMENT OF AN EMBRYO TRANSFER PROGRAM FOR IMPROVEMENT AND PROPAGATION OF DAIRY CATTLE IN JAMAICA

July 31, 1989

FINAL REPORT
USAID - Lincoln University Research Grant

GRANT NUMBER: DAN-5053-G-SS-5101-0

Prepared by:
D.A. Snyder* and S. Meredith

LIBRARY

*Project recipient and initial Principal Investigator

DEVELOPMENT OF AN EMBRYO TRANSFER PROGRAM FOR IMPROVEMENT AND PROPAGATION OF DAIRY CATTLE IN JAMAICA

Prepared by: D. A. Snyder, Ph.D. and Steven Meredith, Ph.D.

Principal Investigators

SUMMARY

The objectives of this research were to determine: 1) The effect of either descending doses or constant doses of follicle stimulating hormone (FSH) on number of ova released from donor cows for purposes of embryo transfer, 2) whether response of cows to either FSH treatment was affected differently when cows were treated during different years, 3) the effectiveness of estrumate vs synchromate B for synchronization of estrus in embryo transfer recipients and 4) to determine pregnancy rates in cows receiving embryos.

Donor cows were superovulated by giving FSH for 4 days beginning between days 7 and 10 of the estrous cycle (estrus = day 1). On the morning of the fourth day of FSH treatment, donor cows received 250 μg Lutalyse and an additional 250 μg during the pm of the same day. In the declining dose of FSH, cows received a total of 28 mg of FSH while in the constant dose of FSH, cows received a total of 40 mg of FSH. Therefore, it was cheaper to use the declining dose of FSH.

Results of the present experiment demonstrated that there was no difference in effectiveness whether FSH was given in a constant or in a declining dose. Farm managers were required to give FSH injections to the donor cows on this experiment, and it was found that it was easier to give the constant dose FSH than the decreasing dose. Therefore, if embryo transfer studies are conducted in the future in Jamaica, it would be preferable to treat all donor cows with a constant dose of FSH because of simplicity, even though the total cost is increased somewhat using this treatment regimen.

Cows received both declining and constant-dose FSH treatments from 1985 to 1988 and there was no difference ($P > .05$) in response of cows to FSH among the four years tested. When treatments were combined, there also was no effect of year on response to FSH. This is an indication that the treatments can be applied to cattle in Jamaica during any normal year and expect results similar to those presented in this summary.

Recipients received two treatments. In the first treatment, cows received two injections of 2 ml Estrumate (250 μg/ml) eleven days apart with the second dose given three days before the day when donors on the farm are expected to be in estrus. In treatment 2, Synchromate B implants were administered eleven days prior to expected estrus for donors. Implants were removed two days before the expected estrus.

There was no overall effect ($P > .05$) of estrous synchronization treatment on pregnancy rates (pooled among farms). Treatment with Synchromate B was discontinued once enough data were collected for comparison, because of an unwillingness of participants to use the product. This was because of the difficulty in administering the synchromate B implant subcutaneously in the ear. Many of the locations used in this

experiment did not have a chute capable of immobilizing the head, therefore some injuries occurred when Synchromate B implants were used. Estrumate and Synchromate B were tested on cows at Tulloch Estates, ALCAN and at Serge Island. The most effective estrous synchronization treatment varied among farms. More cows were pregnant after transfer of embryos to recipients synchronized with Estrumate than with Synchromate B on Tulloch estates. This difference, however, might not have been maintained had additional cows been synchronized using SMB. Only 13 cows were synchronized at Tulloch estates using SMB because of unwillingness of participants at that farm to use the product. A greater number of cows remained pregnant at ALCAN after synchronization using SMB than after synchronization using Estrumate. There was no difference in treatments on results in cows at Serge Island.

There was no significant ($P > .05$) effect of year in which embryos were transferred on success rate of pregnancy maintenance.

It was impossible to test breed differences in recipients because of the different breeds being located on different farms, which resulted in confounding of results.

It is concluded that the project was successful in determining conditions under which embryo transfer could be utilized in Jamaica. Success rate is comparable to some embryo transfer companies operating in the United States, although lower than usually reported in the literature. The lowered success rate could be attributed to many factors. Relying on farm management for preparing donor and recipient cows for embryo transfer could have been a factor. There are differences in success rates depending upon the amount of experience of the embryo transfer technician, although Dr. Snyder has several years experience and this should not have been a major factor in success rate.

Management affecting such things as body condition certainly had an effect since there was a significant difference in success rate among the cooperating farms. Breed of cow could also have had an impact although we were not able to adequately test effect of breeds. Even so, several embryo transfer calves were born in Jamaica due to this project.

DESCRIPTION OF PROBLEM

The development and improvement of cattle that produce acceptable volumes of dairy products in a tropical environment is of prime importance in the Caribbean region. Genetic improvements for milk production in Jamaica date back to the early 1900's (see Ministry of Agriculture, Jamaica, 1972). These programs involved the importation of purebred stock and the grading up of native stock and have led to dairy cattle that are largely Jersey or Holstein with some Zebu blood. Of major concern throughout the development program has been acclimatization to the tropical environment. This involves acceptable performance in terms of: milk yield, age at first calving, lactation length, calving interval, and longevity.

The Jamaica Hope Cattle Breeders Society was established in 1952 (Ministry of Agriculture, Jamaica, 1972). This breed is made up of approximately 80% Jersey, 15% Sahiwal, and 5% Holstein. There are also several herds in Jamaica that are made up of largely Holstein breeding with some (<25%) Indian blood. Most herds maintain a continual influx of genetic material through the use of imported animals or semen and various grading up programs. Although these programs are sometimes necessary because of the low numbers of established dairy animals, their success is severly limited

by acclimatization problems. Major advances in the dairy industry in Jamaica are partially dependant upon increases in dairy cow numbers and improvement in the genetic potential of the dairy animals (Schneeberger, et al, 1982). Grading-up programs generally increase cow numbers but result in reductions in genetic potential, while increases in selection pressure will increase genetic potential but usually decrease cow numbers. Technologies such as artificial insemination and embryo transfer are valuable tools that can be utilized in this situation. Artificial insemination has been used in the improvement of dairy herds, however, its use has been limited and further expansion is necessary (Ministry of Agriculture, Jamaica, 1972). Embryo transfer, on the other hand, has only recently been introduced in Jamaica by Dr. Snyder.

The potential genetic impact of embryo transfer has been reviewed by several investigators (Bradford and Kennedy, 1980; Powell, 1981; McDaniel and Cassell, 1981; Nicholas and Smith, 1983; Everett, 1984; Humes and Godke, 1985). The most important advantage of embryo transfer is the increase in selection pressure that is possible. If it is assumed that each donor cow will produce 10 pregnancies per year, then only the top 10% of the females in the herd could be used to provide all of the calves. If a 50:50 sex ratio and a 25% female replacement rate are also assumed, then replacement females are actually coming from the top 5% of the herd. Because of the male:female ratio in a breeding herd, the selection pressure that is applied to the males could be considerably higher.

To implement an embryo transfer program, several variables must be considered. The response of donor cows to embryo transfer procedures can be evaluated in terms of the estrous response, the number of ova recovered, the percent of ova that are

classified as transferable embryos and the percent of pregnancies that result. Other variables such as: age of donor cow, FSH treatment-schedule and breed and production characteristics of recipient cattle can also have an effect on results in embryo transfer programs. Synchronization of estrus in embryo transfer recipients can be accomplished using several methods. Most researchers utilize either a luteolytic agent (Lutalyse, UpJohn; Estrumate, Haver-Lockart) or a progestin (Synchromate B, Ceva) for synchronization of estrus. Results may vary among different breeds or types of recipients.

Therefore, based upon the previous information, the major objectives were as follows: 1. to introduce embryo transfer technology to veterinarians and farmers in Jamaica, 2. to test the effectiveness of two FSH treatment regiments on ovulation rate in donor cows, 3. to test effectiveness of Synchromate B and Estrumate for synchronization of estrus and pregnancy rates in Jamaica Hope cattle.

MATERIALS AND METHODS

General

The three farms utilized for this project were ALCAN, Tulloch Estates and Serge Island, which are located on the Southwest, Central and Northeast portions of Jamaica, respectively. It was the responsibility of individual farm managers to provide reproductive and production records of potential cows for embryo donors to be used as embryo recipients. It also was the responsibility of managers to carry out the injection protocols necessary for estrous synchronization and superovulation.

Donors

Donors were grouped according to breed and age and assigned randomly to FSH treatment as shown in Table 1. Cows received either a declining or a constant FSH dose during the 4-day superovulation procedure. Treatment began on either Day 7, 8, 9, or 10 of the estrous cycle and 500 μg Estrumate was given on Day 4 of treatment to control time of estrus. Cows were inseminated three times at 12 hour intervals beginning 6-8 hours after the first observation of estrus.

Recipients

Recipients were chosen from two dairy cow breeds (Jamaica Hope and Holstein) and as either heifers or lactating dairy cows. Potential recipients within each group were assigned randomly to having estrus synchronized using either Estrumate or Synchromate B. Cows synchronized with Estrumate received two doses eleven days apart with the second dose given three days before the day when donors on the farm were expected to be in estrus. Synchromate B implants were administered to recipients beginning 11 days prior to expected estrus for donors. Implants were removed two days before the expected estrus.

Embryo Transfer Procedure

The donor and recipient cows were synchronized to be in estrus on the same day as described in the previous two sections. On days 7 or 8 following mating (mating = day 0), embryos were collected nonsurgically from the uterus and late morula or blastocysts obtained. Embryos were collected by placing a foley catheter through the

cervix and into the uterus and was held in place with an inflatable cuff. The uterus was then filled with sterile medium and allowed to drain into a collection flask. This filling and emptying process was repeated several times. Embryos were allowed to settle to the bottom of the collection flask and were recovered and evaluated under a dissecting microscope.

Embryos were transferred nonsurgically to donor cows which were at the same stage of the estrous cycle (i.e. day 7 or 8). To transfer, embryos were loaded into a standard artificial insemination pipet. The pipet was passed through the cervix and the embryo deposited into the uterus.

RESULTS

Donor cows

A total of 75 cows (65 Jamaica Hope and 8 Holstein) on three different farms were superovulated to provide embryos for transfer. Animals used for donors averaged 7.1 $\pm$ .2 years of age. Age distribution and numbers of corpora lutea at each age of donors are shown in Figures 1 and 2, respectively.. For purposes of analysis, age of donor was broken down into three age groups. Those $\leq$ 5 years, those 6-8 years and those $\geq$ 9 years of age. There was no effect ($P < .05$) of age of donor on number of CL, number of embryos collected or on number of transferrable embryos (Table 2).

Of the 75 cows used as donors, 36 were superovulated with a descending dose of FSH and 39 were superovulated with a constant dose of FSH. There was no effect ($P > .05$) of treatment on numbers of CL, embryos recovered or in number of fertilized embryos (Table 3).

Embryos were collected from donor cows over a period of 4 years: 1985, 1986, 1987 and 1988. Response of cows in numbers of CL, embryos and fertilized embryos was not affected ($P > .05$) by year of treatment (Table 4) as determined with one-way analysis of variance tests for each variable. There was no effect of FSH treatment within each year on response of donors (Table 5).

Recipients

A total of 226 cows received either Estrumate or Synchromate B for synchronization of estrus. Not all recipients received embryos because at palpation ovaries were found to have poor development of corpora lutea, adhesions or abnormalities in the reproductive tract of the recipient or embryos from donors were not available (Table 6). Table 7 shows the pregnancy rate of recipients when all cows on treatment were utilized in the calculations. Table 8 shows pregnancy rate when calculated based upon cows which received embryos and there was no effect of treatment ($P > .05$) with either type of calculation.

Analysis of synchronization treatment within farm, based upon pregnancy rates after embryo transfer, resulted in differences among treatments. At Tulloch estates, Estrumate resulted in more pregnant recipients at palpation than did Synchromate B treatment ($P < .05$), however Synchromate B was the superior estrous synchronization

product at ALCAN and there was no effect of treatment on results at Serge Island (Table 9). The success rate of embryo transfer differed among farms (P > .05) when pooled across treatment. The best results were obtained on data collected from Tulloch Estates (Table 9).

There was no effect of year in which embryos were transferred on pregnancy rates (P > .05; Table 10). There was also no difference (P > .05) in pregnancy rates whether embryos were transferred into heifers or into cows (Table 11).

DISCUSSION

Much interest has recently been generated in applying embryo transfer technology to livestock, particularly cattle, in underdeveloped and developing countries (Cunningham, 1989; McGuirk, 1989; Boland and Gordon, 1989: Hasler, 1989; Peeples and Oden; Elsden, 1989). The programs vary in success rate and must be carefully planned with the needs of the country in mind (Seidel and Seidel, 1989).

One of the major goals of the project in Jamaica was to involve personnel in various aspects of the embryo transfer process, and to train and expose veterinarians to the procedure. Trained personnel in Jamaica are now capable of continuing embryo transfer procedures independently.

Few of the variables analyzed had a significant effect on success rate of embryo transfer during the time of this project. One of the major differences found during the experiment was greater success rates on certain farms than on others. Many factors probably contributed to these differences and include differences in animal management. A major factor which could have contributed to differences in success rate among farms

was the different make up of the breeds used. Although the majority of cattle used throughout the experiment were Jamaica Hope cattle, there were more embryos collected from cows with a greater percentage of Holtein at Tulloch Estates than from either ALCAN or Serge Island. Jamaica Hope cattle do not have a constant genetic makeup in percentage of Indian breeding, but all do have some zebu-type blood. After reviewing the records of a large commercial embryo transfer unit, Donaldson (1984b) reported that both estrous response and embryo production were lower for zebu and some zebu crossbreeds than for most other breeds studied.

There was no effect of age of donor in this study. This is not unusual in terms of number of ova produced (Hasler et al. 1983; Donaldson, 1984a). The number of transferable embryos were not affected by age in this study which is in conflict with results of some other studies (Donaldson, 1984a; Lerner at al., 1986). The differences in results could have been due to the small number of animals used in this study compared to the studies reported by Donaldson (1984a) and Lerner et al. (1986).

There also was no effect of FSH treatment of donors on response in number of corpora lutea produced or on number of embryos recovered. Results have been conflicting in other reports. Chupin et al. (1982), using mature dairy cows in France found that FSH administered twice daily for four days in a decreasing dose regimen with a total dose of less than 40 mg, gave the best results. Garcia et al. (1982) and Donaldson (1984c) found no difference between a 4- or a 5-day program with a constant dose or a declining dose of FSH. Donaldson (1984c) found fewer zero responses using a declining

dose program. Since no differences were found between treatments in the present experiment, a constant-dose treatment would be recommended for use in Jamacia because it is the least complicated of the two treatments to administer.

The overall success rate of recipients which remained pregnant after receiving embryos was 33%, which is lower than that reported by Hasler et al. (1983) using Holstein cows, but similar to first-year embryo transfer results in a report from Mexico City, Mexico (Elsden, 1989), and by Gonzalez et al. (1984) using dairy X Zebu breeding.

Results in number of transferable embryos recovered from donor cows averaged approximately 3.1 which was slightly higher than reported by Elsden (1989) during first year studies in Mexico. During the second year of embryo transfer work by Elsden (1989), the success rate of embryo transfer increased and was comparable to the success reported by Hasler et al. (1983) in the United States. There was no improvement in embryo transfer success rates from year-to-year in the present experiment. Perhaps this is a reflection that conditions in Jamaica were optomized during the first year and could not be improved subsequently because of breed of cow. In the Mexico study, researchers used primarily Holstein cows. Breed of cow can certainly have an effect on response. Oriheula et al. (1983) reported a 62% estrous response in Zebu cattle in Mexico when only those with a palpable corpus luteum were given Lutalyse. Using Synchromate B, Gonzalez et al. (1984) found a 100% estrous response in heifers and a 69.5% estrous response in cows of dairy X Zebu breeding. Pregnancy rates when embryos were transferred into these animals were 17.9% for heifers and 39% for cows. In the present experiment, there was no detrimental effect of transferring embryos into heifers.

Overall there was no significant difference in response of recipient cows to either Estrumate or Synchromate B. Since participants in this program did not like to utilize Synchromate B because of the necessity of subcutaneous implants, few animals were placed on this treatment in 1987 and no cows were treated with Synchromate B in 1988. Participants seemed satisfied with using Estrumate for synchronization of estrus.

PARTICIPANTS

Dr. Steven Meredith, Principal Investigator during final 2 years of the project: Duties performed have been administrative in nature and also summarized data and performed data analysis.

Dr. David Snyder, Initially Principal Investigator. Throughout the lifetime of grant award, conducted all embryo transfers performed in Jamaica.

Dr. C. March. Veterinarian-in-charge at ALCAN and provided animal coordination for the majority of animals used in the project. Dr. March also made a trip to Lincoln University, to obtain additional training in embryo transfer and to observe some of the semen collection facilities located in Missouri.

Mr. K.E. Wellington. Instrumental in helping coordinate personnel to assist Dr. Snyder.

Mr. Roger Turner, Tulloch Estates - Owner and manager

LITERATURE CITATIONS

Boland, M.P. and Gordon, I. 1989. Embryo transfer in developing countries - Saudia Arabia. Theriogenology 31:41-42.

Bradford, G.E. and B.W. Kennedy. 1980. Genetic aspects of embryo transfer. Theriogenology 13:13-26.

Chupin, D. and R. Procureur. 1982. Use of pituitary FSH to induce superovulation in cattle: effect of injection regimen. Theriogenology 17:81 (Abst.).

Cunningham, E.P. 1989. The genetic improvement of cattle in developing countries. Theriogenology 31:17-28.

Donaldson, L.E. 1984a. Effect of age of donor cows on embryo production. Theriogenology 21:963-967.

Donaldson, L.E. 1984b. Cattle breed as a source of variation in embryo transfer. Theriogenology 21:1013:1018.

Donaldson, L.E. 1984c. Dose of FSH-P as a source of variation in embryo production from superovulated cows. Theriogenology 22:206-212.

Elsden, R.P. 1989. Mexican government uses embryo transfer to increase production of national dairy herd. Theriogenology 31:47-48.

Gonzalez, R.E., B. Soto, R.C. Boroquez and C.S. Gonzalez. 1984. Pregnancy rate in cross-bred recipients (zebu x dairy breeds) synchronized with "Norgestomet". Theriogenology 21235 (Abst.).

Garcia, G.J.K., G.E. Seidel, Jr. and R.P. Elsden. 1982. Efficacy of shortened FSH treatment for superovulating cattle. Theriogenology 17:90 (Abst.).

Hasler, J.R., A.D. McCauley, E.C. Schermerhorn and R.H. Foote. 1983. Superovulatory responses of holstein cows. Theriogenology 19:83-99.

Hasler, J.F. 1989. Observations on bovine embryo transfer in the People's Republic of China. Theriogenology 31:43-44.

Humes, P.E. and R.A. Godke. 1985. Genetic impact of embryo transfer in beef cattle. Proceedings of Artificial Insemination and Embryo Transfer in Beef Cattle, Denver, Colorado. pp. 38-44.

Lerner, S.P., W.V. Thayne, R.D. Baker, T. Henschen, S. Meredith, E.K. Inskeep, R.A. Dailey, P.E. Lewis and R.L. Butcher. 1986. Age, dose of FSH and other factors affecting superovulation in holstein cows. J. Anim. Sci. 63:176-183., B.T. and B.G. Cassell. 1981. Effects of embryo transfer on genetic change in dairy cattle. J. Dairy Sci. 64:2484-2492.

McDaniel, B.T. and B.G. Cassell. 1981. Effects of embryo transfer on genetic change in dairy cattle. J. Dairy Sci. 64:2484-2492.

McGuirk, B. 1989. The relevance of MOET programmes to developing countries. Theriogenology 31:29-40.

Ministry of Agriculture, Jamaica. 1972. The development of Jamaica Hope breed of dairy cattle. Animal Husbandry Bulletin No. 2. Bodles Old Harbour, Jamaica.

Nicholas, F.W. and C. Smith. 1983. Increased rates of genetic change in dairy cattle by embryo transfer and splitting. Animal Prod. 36:341-353.

Oriheula, A., C. Galina, J. Escobar, and E. Riqueline. 1983. Estrous behavior following prostaglandin $F^2\alpha$ injection in Zebu cattle under continuous observation. Theriogenology 19:795-809.

Peeples, J.G. and A.J. Oden. 1989. Establishment of a permanent embryo transfer and semen production enterprise and facility in Latin America. Theriogenology 31:45.

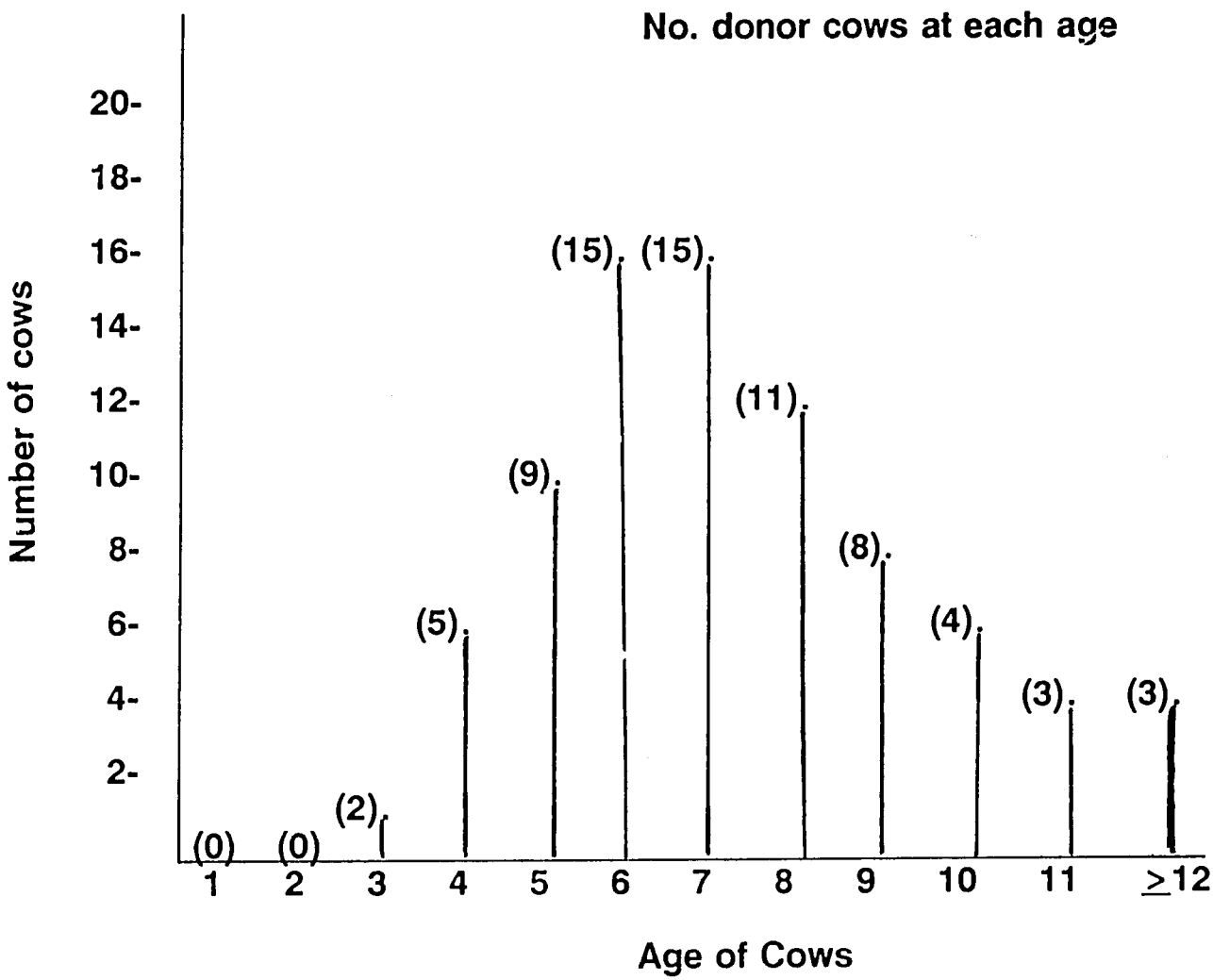
Powell, R.L. 1981. Possible effects of embryo transfer on evaluation of cows and bulls. J. Dairy Sci. 64:2476-2483.

Schneeberger, C.B., K.E. Wellington and R.E. McDowell. 1982. Performance of Jamaica Hope cattle in commercial dairy herds in Jamaica. J. Dairy Sci. 65:1364-1371.

Seidel, G.E., Jr. and Seidel, S.M. 1989. Analysis of applications of embryo transfer in developing countries. Theriogenology 31:316.

Number of donor cows at each age which were superovulated with FSH

Figure 1



69 J. Hope Donar

6 Holstein Donors

Number of corpora lutea ($\overline{X} \pm$SE) of donor cows at each age

Figure 2

TABLE 1. TREATMENT SCHEDULE FOR DECLINING DOSE AND CONSTANT DOSE FSH TREATMENTS.

	Day of treatment			
Treatment	1	2	3	4
Declining FSH	6/6	4/4	2/2	2/2
Constant FSH	5/5	5/5	5/5	5/5

TABLE 2. EFFECT OF AGE OF DONOR ON NUMBER OF CORPORA LUTEA AND EMBRYO RECOVERY RATE (MEAN ± S.E.M.)

Age	N	No. of CL	No. of Embryos	No. of Trans. Emb.
≤ 5 years	16	7.9 ± 1.7	4.2 ± 1.3	1.9 ± .8
6 - 8 years	41	8.8 ± 1.1	4.8 ± 1.1[a]	3.6 ± .9
≥ 9 years	16	9.9 ± 2.1	5.0 ± 2.0[b]	2.9 ± 1.0

[a]Did not flush 5 cows in this age group due to poor ovulation rates.

[b]Did not flush 4 cows in this age group due to poor ovulation rates.

TABLE 3. EFFECT OF FSH TREATMENT ON RESPONSE OF DONOR COWS

Treatment	N	#CL	Embryos Recovered (no.)	Fertilized Embryos
Desc.	36	7.25±1.13	4.8±1.25	3.36±1.0
Const.	39	6.79±1.09	3.6±0.77	2.92±.66

TABLE 4. EFFECT OF YEAR ON RESPONSE OF DONOR COWS

		Mean + S.E.M.		
Year	No. of Donors	CL	Embryos	Fertilization rate
1985	19	7.1±1.4	6.6±2	4.1±1.6
1986	26	8.3±1.4	2.5±0.8	2.1±0.7
1987	19	9.6±1.7	3.0±1.2	2.0±0.9
1988	11	7.3±1.8	6.2±1.7	5.7±1.6

TABLE 5. EFFECT OF TREATMENT WITHIN YEAR IN DONOR COWS ON CL RESPONSE, EMBRYO RECOVERY RATE AND NUMBER OF FERTILIZABLE EMBRYOS

			Mean + S.E.M.		
Year	Treat.	N	#CL	Embryos Rec.	Fert. Embryos
1985	Const.	10	5.1±1.2(51)	2.8±1.0(28)	2.6±1.0(26)
	Desc.	9	9.3±2.5(84)	10.7±3.4(97)	5.8±3.1(52)
1986	Const.	12	10.7±1.8(128)	3.1±1.1(37)	5.8±1.0(31)
	Desc.	14	6.2±2.0(87)	2.1±1.1(29)	1.7±1.0(24)
1987	Const.	11	11.3±2.5(121)	3.9±1.0(44)	2.4±0.6(27)
	Desc.	8	7.2±2.2(58)	1.7±0.8(14)	1.5±0.8(12)
1988	Const.	6	9.5±2.3(57)	5.7±0.8(34)	5.0±0.7(30)
	Desc.	5	9.0±2.0(45)	6.8±3.0(34)	6.6±3.0(33)

TABLE 6. REASONS EMBRYOS NOT TRANSFERRED

	Reasons			
Treatment	No CL	Poor CL	No Suitable Embryos	Abnormal Tract
Estrumate	3	2	9	2
Synchromate B	12	2	2	1

TABLE 7. OVERALL PREGNANCY RATE IN RECIPIENT COWS

Treatment	Total No. Cows Treated	Pregnancy recipients	(%)
Estrumate	155	54	(35)
Synchromate B	71	19	(27)

TABLE 8. PREGNANCY RATE IN COWS WHICH RECEIVED EMBRYOS

Treatment	Embryos	No. Cows Pregnant	(%)
Estrumate	139	54	(39%)
Synchromate	54	19	(35%)

TABLE 9. EFFECTS OF LOCATION ON TRANSFER RESULTS

	Location (Total pregnant/transferred)		
Treatment	Tulloch	ALCAN	Serge Island
Estrumate	27/39(69%)*	16/76(21%)	11/24(46%)
Synchromate B	4/13(31%)	11/27(41%)*	4/14(28%)
Total	31/52(60%)[a]	27/103(26%)[b]	15/38(39%)[b]

[a,b]Proportions with different superscripts within the row differ ($P < .05$).
* Differs from other treatment within column ($P < .05$).

TABLE 10. EFFECT OF YEAR OF TREATMENT ON PREGNANCY RATES OF RECIPIENT COWS.

	No. pregnant/total (%)			
Treatment	1985	1986	1987	1988
Estrumate	8/28 (28)	15/40 (37)	12/30 (40)	9/41 (22)
Synchromate B	6/19 (31)	11/27 (41)	2/8 (25)	--
Total	14/47 (30)	26/67 (39)	14/38 (37)	--

TABLE 11. EFFECT OF TRANSFER OF EMBRYOS TO HEIFER OR COW RECIPIENTS ON PREGNANCY RATE AFTER EMBRYO TRANSFER

Cow status	No. of embryos transferred	No. pregnant	Percent
Heifers	72	24	33
Cows	149	39	26