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# Evaluation of three synchrony programs for pasture-based dairy heifers

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ABSTRACT

The objective was to evaluate the efficacy and economic benefits of three synchrony programs in 1137 heifers from 10 pasture-based dairy herds. Heifers were randomly assigned to one of three treatments within each herd on Day −13 (Day 0 = start of the breeding program). They were treated with: (1) $PGF_{2\alpha}$ on Days −13 and −2, with AI after detection of estrus between Days 0 and 3 (Double PG); (2) GnRH, $PGF_{2\alpha}$, and GnRH on Days −9, −2, and 0, respectively, with placement of an intravaginal progesterone (P4)-releasing device between Days −9 and −2, and set time AI on Day 1 (GPG + P4); or (3) same as the GPG + P4 group but with the set time AI on Day 0 (Cosynch + P4). Plasma P4 concentrations were determined on Days −20 and −13 to determine pubertal status. The Cosynch + P4 treatment had a higher ($P < 0.05$) conception rate to AI (57% vs. 47% vs. 48% for Cosynch + P4, GPG + P4, and Double PG, respectively), 21-day in-calf rate (76% vs. 72% vs. 63% for Cosynch + P4, GPG + P4, and Double PG), and a shorter median interval from the start of the breeding program to conception (0, 14, and 19 days for Cosynch + P4, GPG + P4, and Double PG). Heifers that had reached puberty before breeding, compared with those that had not, had higher ($P < 0.05$) in-calf rates to AI (53% vs. 47%) at 21 days (74% vs. 64%) and at 42 days (91% vs. 84%). Pubertal status was associated with herd, breed, age, and body condition score at the start of mating ($P < 0.05$). A partial budget model demonstrated that, compared with the Double PG program, there was an economic benefit from the Cosynch + P4 (mean, NZ$25.73; 95% confidence interval, 2.99–50.69), but not the GPG + P4 program (mean, NZ$−0.65; 95% confidence interval, −21.87 to 21.58). We concluded that the Cosynch + P4 program resulted in the highest fertility and economic benefit of the three programs evaluated, and that reproductive response was affected by pubertal status.



## 1. Introduction

Synchronization of estrus and ovulation of dairy heifers, in combination with AI, facilitates improving the rate of genetic gain by shortening the generation interval and obtaining replacements from dams with the highest genetic merit in a herd [1]. However, the use of AI in dairy heifers has historically been limited in New Zealand. For example, in 2006 and 2007 only 118,226 yearlings were mated using AI compared with 2,904,667 cows, from a total population of 5.3 million dairy cattle [2]. The practicalities of inseminating heifers after either daily estrous detection or some form of synchrony might be barriers to uptake of the technology.

Various synchrony programs for dairy heifers have previously been evaluated in pasture-based systems [3–6]. However, these programs generally included the use of estradiol, which can no longer be used in food-producing animals because of the European ban, or involved detection of estrus. Therefore evaluation of new programs was required, including those that did not require estrous detection and were practical under the extensive pasture-based management systems of New Zealand.

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Use of fixed-time insemination (FTAI) removes the requirement for estrous detection, but conception rates have been reported to be significantly lower using FTAI after two injections of $PGF_{2\alpha}$ 10 to 14 days apart ("Double PG") than for dairy heifers inseminated on detection of estrus [7]. These low conception rates were attributed to variations in time to estrus and ovulation depending on the stage of the estrus cycle at $PGF_{2\alpha}$ administration, and the lack of efficacy of $PGF_{2\alpha}$ in prepubertal animals [8,9].

Optimal synchrony of estrus and ovulation requires control of follicle development and luteal function [10]. This can be achieved in dairy cows using programs involving GnRH injections 9 days apart with $PGF_{2\alpha}$ 2 days before the final GnRH treatment, with FTAI 16 hours after the final GnRH treatment (GPG or Ovsynch), but such programs used in heifers do not achieve conception rates comparable with AI after detection of estrus, because of a lack of synchrony of estrus [11,12]. Insemination might also occur coincident with the final GnRH treatment (Cosynch). The Cosynch program reduces the number of handlings of cattle required, but has been reported to result in lower conception rates compared with Ovsynch [13]. However, in beef heifers, a Cosynch program resulted in pregnancy rates superior to a Double PG program [14]. Addition of progesterone (P4) to GPG programs also resulted in significantly increased conception rates after FTAI in beef heifers [15], and improved synchrony of estrus in dairy heifers [16].

Heifers that are prepubertal at the commencement of synchrony programs are less likely to exhibit estrus [17], and have lower conception and pregnancy rates than postpubertal heifers [18]. In prepubertal beef heifers, inclusion of P4 in the synchrony program significantly increased submission and pregnancy rates [17], and conception rates [19].

The aim of the current study was to evaluate the efficacy and economic benefits of three synchrony programs in heifers from pasture-based dairy herds. The programs were GPG or Cosynch, both with the addition (+) of P4, and Double PG. It was hypothesized that more heifers would conceive to AI and be pregnant by Day 21 of the breeding program after a GPG + P4 program than after Double PG, and that conception rate to AI would be noninferior after Cosynch + P4 compared with GPG + P4.

## 2. Materials and methods

### 2.1. Heifers and treatments

The study was conducted after approval from the Animal Ethics Committee of AgResearch Ruakura, Hamilton, New Zealand.

Dairy heifers (N = 1137) from 10 herds (mean ± SD, 114 ± 26 per herd) were enrolled on one calendar day for each herd. All herds were spring-calving and located within the Waikato region of New Zealand. Blood samples (10 mL) were drawn from the tail vein into an evacuated glass tube containing lithium heparin as an anticoagulant (Vacutainer; Becton Dickson, Franklin Lakes, NJ, USA) on Days −20 and −13 (where Day 0 = start of the breeding program) for evaluation of P4 concentration in plasma by RIA (Coat-a-Count; DPC Corporation, Los Angeles, CA, USA). Heifers were defined as prepubertal if the P4 concentration in both samples was <1.0 ng/mL, and postpubertal if P4 concentration in one or both samples was ≥1.0 ng/mL.

On Day −13, the body condition score (BCS) of each heifer was assessed on a one to 10 scale [20], and tail paint applied to aid estrus detection. Heifers were randomly assigned, within sequentially presented blocks of three heifers, to one of three treatment groups. Different color tail paints were used for identification of each treatment group, but all heifers within a herd were managed as a single management group.

The three treatments were:

- Double PG: Heifers were treated with cloprostenol (Ovuprost 500 μg im; Bomac Laboratories Ltd., Manukau City, New Zealand) on Days −13 and −2, with AI upon estrus detection between Days 0 and 3 (N = 380; 33%);
- GPG + P4: Heifers were treated with an intravaginal P4-releasing device (Cue Mate; Bomac Laboratories Ltd.) from Days −9 to −2, and gonadorelin (Ovurelin 100 μg im; Bomac Laboratories Ltd.) on Day −9, 500 μg cloprostenol im on Day −2, and 100 μg gonadorelin on Day 0, with FTAI on Day 1 (N = 383; 34%); and
- Cosynch + P4: Heifers were treated in the same manner as for GPG + P4 but with FTAI coincident with the final gonadorelin treatment (N = 374; 33%).

The timing of the treatments was such that the second cloprostenol treatment for the Double PG group coincided with the cloprostenol treatment of the other two groups. Treatments were given between 9:00 AM and 1:00 PM.

All heifers were assessed once daily from Days 0 to 3 for loss of tail paint while yarded for drafting for AI. Herd owners decided which of the heifers in the Double PG group were in estrus and were to be inseminated each day based on removal of tail paint or their own observations on pasture. When a heifer had been inseminated, no more estrous observations were conducted.

Experienced AI technicians attended each herd at approximately midday on Days 0 to 3. In seven herds, one technician undertook all inseminations, whereas in the remaining three herds, two technicians undertook inseminations. Where two technicians were used, they undertook inseminations on each day of the program. Heifers in the Double PG group detected in estrus between Days 0 and 3 were inseminated on the day of detection. Heifers in the GPG + P4 group in estrus at the time of the second GnRH injection (Day 0) were recorded as in estrus, but not inseminated until Day 1.

Frozen semen from 40 sires was used for AI in the study (one to four sires were used in each treatment group). After the last AI on Day 3, bulls were placed with the heifers for a mean (±SD) total duration of 80 ± 10 days. The number of bulls required for each management group was calculated assuming that 50% of the heifers would conceive to first service and that those not conceiving would return to estrus over a 5-day period on average 21 days later. Sufficient bulls were introduced such that no more than three services per bull per day would occur on average.