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# Reducing variation in growth performance through pST interventions at weaning

## Final Report
## APL Project 2013/044

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**SunPork Farms**
Mr Robert Hewitt and Prof Robert van Barneveld
PO Box 5950
Manly QLD 4179

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## Executive Summary

Porcine somatotropin (pST) is one of the most effective growth promoting technologies available to the Australian pork industry. Improved growth performance, increased feed efficiency and the reduction in backfat observed in pigs treated with pST in the finisher phase allows for reduced feed inputs (Core Objective 2, Strategy 1), reduced variation within a batch and results in improved carcase quality (Core Objective 2, Strategy 2).

Somatotropin is a naturally occurring protein hormone produced by the pituitary gland and secreted into the circulatory system, it plays many important roles in the regulation of the growth of muscle, bone, fat and the liver in growing animals and coordinates the metabolism of lipid, protein and minerals within mammals. When circulating levels of somatotropin are increased nutrients are directed away from fat tissue growth towards increased growth in muscle and bone (Etherton and Bauman, 1998), this increase in circulating somatotropin can be achieved through the exogenous use of pST.

Treatment of finisher pigs with pST has also shown an ability to reduce the variation in performance. Dunshea (2005) showed a significant reduction ($P<0.001$) in the coefficient of variation (CV) around average daily gain in pigs treated with pST (22.1 v 19.9% for controls and pST treated respectively). The CV around P2 backfat was also significantly reduced ($P<0.001$) by pST (16.2 v 14.2%).

However, the use of pST has fallen out of favour as a result of animal welfare issues, both perceived and real, associated with its administration – with daily injection being the optimal treatment, OH&S issues associated with its administration and market access issues with some supply agreements prohibiting its use, as a result of a general mistrust and misunderstanding of the use of hormones in food animals.

In this study, we proposed to use targeted administration of pST to reduce the variation in weaner performance. The use of pST in small pigs is not in itself a novel concept, although many studies have looked at its use for an extended period of time. Sillence *et al.* (2002) looked at administering pST from 5 days of age through to 40 days of age and found significant increases in average daily gain during the administration period. However, these effects became diminished over time.

Whilst the newly weaned pig is associated with a reduced feed intake as they transition from milk to solid feed, the transition appears to be better handled by larger weaners. Improving the performance of 'at-risk' pigs to allow them to better utilise the feed that they do consume will be beneficial. Understanding how this technology could be used in weaner pigs will also provide us with an important tool to reduce variation within a production batch.

Three experiments, building on each other as the study progressed, were originally proposed as part of this study. However, upon reviewing results as the study progressed changes to the planned experiments occurred. Experiment One was designed to investigate whether a single small trigger dose of pST at weaning was able to boost the performance of newly weaned pigs.

After review of experiment one and discussions with other researchers it was suggested that weaned pigs are relatively unresponsive to somatotropin such that a large dose, equivalent to dose rates used in heavy finishers, would be required to overcome somatotropin resistance (F Dunshea 2013 *pers. comm.*) and that establishing the pulsatile nature of somatotropin release was also likely to be very important (R Ball 2013 *pers. comm.*). Experiment Two investigated the use of a larger dose of pST for seven days post-weaning during the first week immediately post-weaning, or in the second week post-weaning once the transition to solid feed was established.

The lack of response to treatment in Experiments One and Two led to further consultation as to the appropriate design of the third experiment. As a response to consultation Experiment Three was designed to investigate whether the administration of pST prior to and post-weaning was able to boost

the performance of newly weaned pigs and reduce the post-weaning growth check associated with weaning.

The short-term use of pST in weaner pigs did not appear, based on this series of experiments, to be a suitable method to boost their performance. Instead, there appeared to be a degree of hindrance to performance during the administration period. Whilst there was some small non-significant improvements in production efficiency observed across all experiments through the administration of pST (across different dose rates and timings), these small benefits would not warrant the costs associated with the product and it's administration.

The judicial use of pST failed to meet the objectives of this study. There was no improvement in weaner pig performance as a result of pST administration; there was therefore no ability to increase the whole of life performance of low weight weaners, no ability to reduce the frequency of pST administration whilst maintaining improved performance, and no ability to reduce within batch variation.

Future research in this area probably needs an extended timeframe of administration to allow the effects of pST to be established. This is likely to lead to similar OH&S and animal welfare issues that have been associated with its administration in larger animals. Investigating this area again may be of value when a longer term method of administration has been developed.

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## 1. Background to Research

Porcine somatotropin (pST) is one of the most effective growth promoting technologies available to the Australian pork industry. The improved growth performance, increased feed efficiency and the reduction in backfat observed in pigs treated with pST in the finisher phase allows us to reduce feed inputs (Core Objective 2, Strategy 1), reduce variation within a batch and results in improved carcase quality (Core Objective 2, Strategy 2).

Treatment of finisher pigs with pST has shown an ability to reduce the variation in performance. Dunshea (2005) showed a significant reduction ($P<0.001$) in the coefficient of variation (CV) around average daily gain in pigs treated with pST (22.1 v 19.9% for controls and pST treated respectively). The CV around P2 backfat was also significantly reduced ($P<0.001$) by pST (16.2 v 14.2%).

However, the use of pST has fallen out of favour as a result of animal welfare issues associated with its administration – with daily injection being the optimal treatment, OH&S issues associated with its administration and market access issues with some supply agreements prohibiting its use, as a result of a general mistrust and misunderstanding of the use of hormones in food animals.

The Australian pig industry has investigated the use of this very good technology in other aspects of pig production. Gatford *et al.* (2009ab) investigated the administration of pST to the gilt/sow during gestation, with increased birth weights experienced in gilts and sows treated from d 25 to d 100 of gestation, with this birth weight advantage being carried through weaning and finishing. However, treated sows had a higher culling rate post-weaning – associated with body condition loss during lactation, although those sows that did make it to their subsequent farrowing did not perform differently to untreated sows.

The use of pST in small pigs is not in itself a novel concept, although many studies have looked at its use for an extended period of time. Sillence *et al.* (2002) looked at administering pST from 5 days of age through to 40 days of age and found significant increases in average daily gain during the administration period. However, these effects became diminished over time. In this study, we proposed to use targeted administration of pST to reduce the variation in weaner performance. Whilst the newly weaned pig is associated with a reduced feed intake as they transition from milk to solid feed, the transition appears to be better handled by larger weaners. Improving the performance of 'at-risk' pigs to allow them to better utilise the feed that they do consume will be beneficial. Understanding how this technology can be used in weaner pigs may provide an important tool to reduce variation within a production batch.

Using this technology in weaner pigs offers significant advantages over use in finisher pigs; OH&S issues are greatly reduced with the easier handling of smaller pigs (that are routinely handled), the use of exogenous hormones in non-market pigs is likely to be less controversial and animal welfare is less impacted with a reduced number of doses.

## 2. Objectives of the Research Project

The primary objective of this project was to:

- Reduce the variation within a batch of pigs through the judicial use of pST.

The secondary objective of this project was to:

- Maintain the improved performance of weaner pigs whilst reducing the frequency of pST administration.
- Increase the whole of life performance of low weight weaners through the judicial use of pST.

## 3. Introductory Technical Information

Somatotropin is a naturally occurring protein hormone produced by the pituitary gland and secreted into the circulatory system, it plays many important roles in the regulation of the growth of muscle, bone, fat and the liver in growing animals and coordinates the metabolism of lipid, protein and minerals within mammals. When circulating levels of somatotropin are increased nutrients are directed away from fat tissue growth towards increased growth in muscle and bone (Etherton and Bauman, 1998).

Exogenous somatotropin (pST) treatment consistently improves average daily gain, feed conversion efficiency and protein deposition and reduces fat deposition and its efficacy in improving growth performance is unquestioned (Dunshea *et al.* 2005).

The exogenous use of pST on sows during gestation (Gatford *et al.* 2009a) did not affect the growth performance of progeny with no difference in average daily gain, feed intake or feed conversion between untreated sows or those injected with pST daily from d 25 to 50 or d 25 to 100 of gestation. However, those pigs born from dams receiving pST through to day 100 of gestation where heavier at all milestones (Table 1, Gatford *et al.* 2009a), as a result of increased birth weights (Table 2, Gatford *et al.* 2004; Table 3, Gatford *et al.* 2009b).

***Table 1.*** *Effects of maternal pST treatment and parity on progeny finisher and carcase weights (from Gatford et al. 2009a).*

| | Gilt progeny | | Sow progeny | | Significance | | |
|---|---|---|---|---|---|---|---|
| | Control | pST d25- | Control | pST d25- | Treatment | Parity | T x P |
| Live wt entry (kg) | 62.5 ± 0.8 | 64.6 ± 0.8 | 64.5 ± 0.7 | 69.1 ± 0.6 | <0.001 | <0.001 | 0.207 |
| Live wt exit (kg) | 85.8 ± 0.9 | 87.1 ± 0.9 | 86.6 ± 0.8 | 91.2 ± 0.7 | 0.011 | <0.001 | 0.377 |
| Hot carcase wt (kg) | 62.7 ± 1.1 | 64.9 ± 1.1 | 65.1 ± 0.8 | 69.5 ± 1.1 | 0.006 | 0.001 | 0.439 |

***Table 2.*** *Effects of maternal porcine somatotropin (pST) treatment and diet from d 25 to 100 of pregnancy on progeny size at birth (from Gatford et al. 2004).*

| | Low-protein diet | | High-protein diet | | Significance | | |
|---|---|---|---|---|---|---|---|
| Dose of pST, mg/d | 0 | 2 | 0 | 2 | Litter | pST | Diet |
| Number of gilts | 22 | 25 | 22 | 17 | | | |
| Number of progeny | 220 | 235 | 225 | 164 | | | |
| Progeny size at birth | | | | | | | |
| Body weight, kg | 1.38 ± 0.02 | 1.49 ± 0.02 | 1.37 ± 0.02 | 1.60 ± 0.02 | <0.001 | <0.001 | ns |

***Table 3****. Effects of maternal treatments and parity on litter average fetal and placental size (from Gatford et al. 2009b).*

| | Gilts | | Sows | | Significance | | |
|---|---|---|---|---|---|---|---|
| | Control | pST | Control | pST | Treatment | Parity | T x P |
| Number of dams | 8 | 7 | 8 | 8 | | | |
| Number of fetuses | 59 | 73 | 99 | 78 | | | |
| Fetal weight (g) | 37.1 ± 1.5 | 41.7 ± 1.5 | 36.0 ± 1.5 | 39.6 ± 1.4 | 0.013 | 0.288 | ns |
| Placental weight (g) | 97 ± 8 | 116 ± 8 | 105 ± 8 | 115 ± 8 | ns | ns | ns |
| Fetal:placental weight | 0.40 ± 0.03 | 0.40 ± 0.03 | 0.38 ± 0.03 | 0.40 ± 0.03 | ns | ns | ns |

When pST was supplied exogenously to neonatal pigs (daily from d 3), average daily gain to weaning (d 28) improved significantly (Figure 1), but was not associated with a reduction in fat deposition (Sillence et al. 2002). Once the administration of pST was withdrawn (d 40), the anabolic effect of pST gradually declined, such that the live weight of treated and control pigs was identical at d 168 (Figure 2).

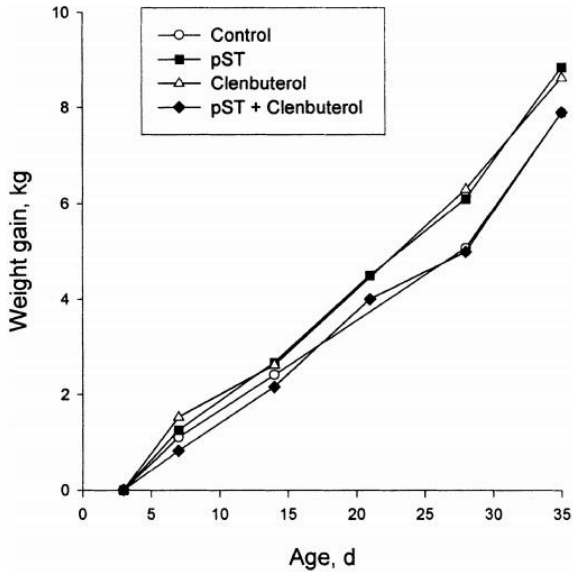


***Figure 1.*** *Cumulative weight gain of pigs whilst receiving treatment until 40 days of age (from Sillence et al. 2002).*

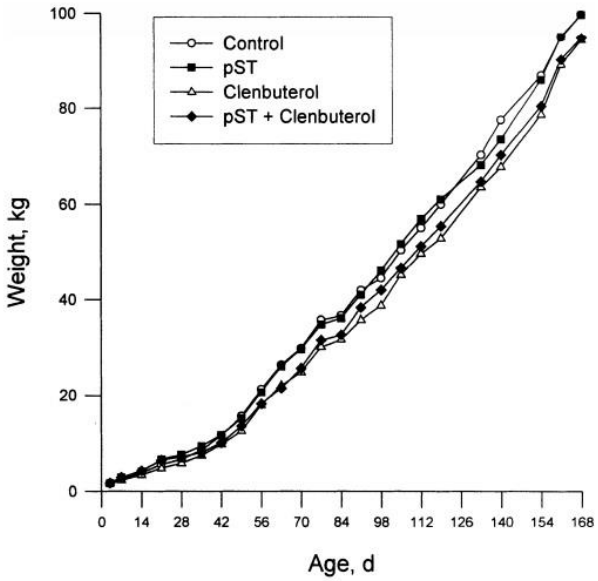


***Figure 2.*** *Cumulative weight of pigs through to market that received treatment until 40 days of age (from Sillence et al. 2002).*

Dunshea (2005) reviewed the impact of pST use on variation in liveweight and back fat depth from a series of 16 experiments conducted across multiple farms within Australia. Variation in liveweight, as measured by coefficient of variation (CV), was reduced through the use of pST with a higher impact on boars than gilts (2 vs 10%) reduction in CV (Table 4), whilst increasing the liveweight of the pigs on test. However, the effect of pST on nutrient partitioning, resulted in a much greater reduction in the depth of back fat depth and a considerable tightening of the variation – 7% reduction in back fat CV in gilts, 17% reduction in CV of boars. Given these two production parameters are the basis for payment grids within Australia, pST offers a significant tool to increase the number of pigs within prime pricing.

***Table 4.*** *Effect of porcine somatotropin (pST) and sex on descriptive statistics around final liveweight and P2 back fat (from Dunshea 2005).*

| | Control | | pST | | | Significance | | |
|---|---|---|---|---|---|---|---|---|
| | **Gilt** | **Boar** | **Gilt** | **Boar** | **SE** | **pST** | **Sex** | **P x S** |
| Liveweight (kg) | | | | | | | | |
| Mean | 93.1 | 95.4 | 97.5 | 103.2 | 0.001 | <0.001 | <0.001 | <0.001 |
| Std Dev | 7.24 | 8.14 | 7.32 | 7.73 | 0.190 | 0.32 | <0.001 | 0.074 |
| CV | 7.75 | 8.21 | 7.58 | 7.44 | 0.0048 | <0.001 | <0.001 | <0.001 |
| P2 back fat (mm) | | | | | | | | |
| Mean | 14.3 | 13.3 | 11.9 | 11.9 | 0.145 | <0.001 | <0.001 | <0.001 |
| Std Dev | 1.96 | 1.95 | 1.70 | 1.75 | 0.0001 | <0.001 | <0.001 | <0.001 |
| CV | 16.0 | 16.4 | 14.9 | 13.5 | 0.67 | <0.001 | 0.47 | 0.11 |

## 4. Experiment One

Three experiments, building on each other as the study progressed, were originally proposed as part of this study. However, upon reviewing results as the study progressed changes to the planned experiments occurred.

Experiment One was designed to investigate whether a single trigger dose of pST at weaning was able to boost the performance of newly weaned pigs.

### *4.1 Objectives*

- Establish the response of weaned pigs to a trigger dose of pST.
- Establish the ability to reduce variation in pigs through the use of pST.

### *4.2 Research Methodology*

Three treatments were investigated in this experiment, a **control** treatment, a **pST** treatment of 2 mg per pig on day 1 post-weaning and a **pST oil** treatment of 3 mg per pig suspended in vegetable oil administered on day 1 post-weaning. These dose rates were based on 100 µg pST/kg body weight utilised by Sillence *et al.* (2002) with a multiplying factor to provide the trigger dose.

There were 10 pens per treatment (5 male, 5 female), with 14 pigs per pen. One-hundred and forty (140) pigs entered the facility each week, over a three-week period, and were split by sex and then graded into large, small and medium pigs by sight and assigned a pen. Pens were weighed and allocated to treatment using a randomised block design with pST dose as the treatment with sex, weight and entry week as blocking factors. Pens are of identical configuration, measuring 1 m x 2.8 m, with plastic floor tiles and open galvanised panelling. Supplemental heating is provided via a radiant bar heater under a hutch, with water supplied *ad libitum* via two nipple drinkers per pen. All pigs had *ad libitum* access to the same wheat-based diet (15.0 MJ digestible energy (DE)/kg, 0.8 g available lysine (AvL)/MJ DE) from a round multi-space plastic transit feeder, feed was delivered by hand from a scaled trolley.

Pigs were weighed individually at the start of the experiment and on a weekly basis for the following four weeks. Weekly feed disappearance per pen was calculated from feed deliveries and weighed refusal on the final day of the experimental week. Feed conversion was calculated from weight and feed data. Water usage was measured via individual water meters on each pen.

All pigs received 0.25 ml of Draxxin (*Tulathromycin* 100 mg/ml) intramuscularly upon entry to the facility with other medications administered via the drinking water – 65.7 g of Sol-u-mox (*Amoxycillin trihydrate* 870 mg/g) and 42.9 g of Linco-Spectin (*Lincomycin hydrochloride* 222 mg/g, *Spectinomycin sulfate* 445 mg/g) per 1,000 kg of liveweight for 28 and 21 days respectively.

Data were analysed via a GLM analysis of variance (ANOVA) with week of entry as a covariate, with differences between treatments determined by LSD ($P<0.05$).

### *4.3 Results*

There was no significant effect of pST administration on production parameters in the first week post-weaning, in which the treatment occurred, or in the weeks subsequent (Table 5 and 7). There was no significant difference in average daily gain or average daily feed intake, however, in the week that treatment occurred (week one) there was a numerical, but not significant, difference in feed conversion between the control and the pST treatments. The administration of pST showed a significant spike in water usage compared to those that received pST in oil, with the control treatment intermediate (Table 6). Variation within treatment groups was not significantly affected by pST treatment (Table 8).

***Table 5.*** *Effect of a trigger dose of porcine somatotropin (Control, 0 mg/pig; pST, 2 mg/pig pST d0; pST oil, 3 mg/pig pST in oil d0) on the growth performance of newly weaned pigs.*

| | Control | pST | pST oil | SED | *P* value |
|---|---|---|---|---|---|
| Liveweight (kg) | | | | | |
| Entry (d0) | 5.5 | 5.6 | 5.5 | 0.08 | 0.801 |
| d7 | 6.1 | 6.2 | 6.1 | 0.09 | 0.849 |
| d14 | 7.7 | 7.8 | 7.7 | 0.12 | 0.920 |
| d21 | 9.8 | 9.8 | 9.6 | 0.15 | 0.835 |
| Exit (d28) | 12.1 | 12.1 | 11.9 | 0.15 | 0.747 |
| Week one (d0 – d7) | | | | | |
| ADG (kg/d) | 0.084 | 0.087 | 0.088 | 0.004 | 0.896 |
| ADFI (kg/d) | 0.12 | 0.11 | 0.12 | 0.004 | 0.880 |
| FCR (kg/kg) | 1.46 | 1.33 | 1.34 | 0.038 | 0.303 |
| Week two (d8 – d14) | | | | | |
| ADG (kg/d) | 0.224 | 0.224 | 0.228 | 0.005 | 0.945 |
| ADFI (kg/d) | 0.29 | 0.29 | 0.29 | 0.006 | 0.952 |
| FCR (kg/kg) | 1.31 | 1.29 | 1.30 | 0.014 | 0.847 |
| Week three (d15 – d21) | | | | | |
| ADG (kg/d) | 0.300 | 0.292 | 0.277 | 0.006 | 0.321 |
| ADFI (kg/d) | 0.45 | 0.43 | 0.43 | 0.007 | 0.429 |
| FCR (kg/kg) | 1.52 | 1.49 | 1.57 | 0.018 | 0.211 |
| Week four (d22 – d28) | | | | | |
| ADG (kg/d) | 0.333 | 0.326 | 0.320 | 0.006 | 0.685 |
| ADFI (kg/d) | 0.57 | 0.57 | 0.55 | 0.009 | 0.580 |
| FCR (kg/kg) | 1.74 | 1.78 | 1.73 | 0.031 | 0.819 |

ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio; SED, standard error difference of the means.

***Table 6.*** *Effect of a trigger dose of porcine somatotropin (Control, 0 mg/pig; pST, 2 mg/pig pST d0; pST oil, 3 mg/pig pST in oil d0) on water usage of newly weaned pigs.*

| | Control | pST | pST oil | SED | *P* value |
|---|---|---|---|---|---|
| Water usage (L/pig/day) | | | | | |
| Week one (d0 – d7) | 4.0[ab] | 7.8[a] | 3.3[b] | 0.75 | 0.028 |
| Week two (d8 – d14) | 4.4 | 5.5 | 6.0 | 0.44 | 0.299 |
| Week three (d15 – d21) | 7.0 | 7.1 | 6.6 | 0.48 | 0.904 |
| Week four (d22 – d28) | 8.5 | 8.7 | 8.5 | 0.56 | 0.978 |

[a,b]Means in a row with different superscripts differ significantly (P<0.05); SED, standard error difference of the means.

***Table 7.*** *Cumulative effect of a trigger dose of porcine somatotropin (Control, 0 mg/pig; pST, 2 mg/pig pST d0; pST oil, 3 mg/pig pST in oil d0) on the growth performance of newly weaned pigs.*

| | Control | pST | pST oil | SED | *P* value |
|---|---|---|---|---|---|
| Week one (d0 – d7) | | | | | |
| ADG (kg/d) | 0.084 | 0.087 | 0.088 | 0.004 | 0.896 |
| ADFI (kg/d) | 0.12 | 0.11 | 0.12 | 0.004 | 0.880 |
| FCR (kg/kg) | 1.46 | 1.33 | 1.34 | 0.038 | 0.303 |
| Week two (d0 – d14) | | | | | |
| ADG (kg/d) | 0.154 | 0.155 | 0.158 | 0.004 | 0.911 |
| ADFI (kg/d) | 0.21 | 0.20 | 0.21 | 0.005 | 0.923 |
| FCR (kg/kg) | 1.34 | 1.30 | 1.30 | 0.011 | 0.276 |
| Week three (d0 – d21) | | | | | |
| ADG (kg/d) | 0.203 | 0.201 | 0.198 | 0.004 | 0.865 |
| ADFI (kg/d) | 0.29 | 0.28 | 0.28 | 0.005 | 0.727 |
| FCR (kg/kg) | 1.42 | 1.39 | 1.42 | 0.010 | 0.279 |
| Week four (d0 – d28) | | | | | |
| ADG (kg/d) | 0.235 | 0.232 | 0.228 | 0.003 | 0.684 |
| ADFI (kg/d) | 0.36 | 0.35 | 0.35 | 0.006 | 0.762 |
| FCR (kg/kg) | 1.53 | 1.52 | 1.53 | 0.009 | 0.842 |

ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio; SED, standard error difference of the means.

***Table 8.*** *Effect of a trigger dose of porcine somatotropin (Control, 0 mg/pig; pST, 2 mg/pig pST d0; pST oil, 3 mg/pig pST in oil d0) on coefficient of variation of weight of newly weaned pigs.*

| | Control | pST | pST oil | SED | *P* value |
|---|---|---|---|---|---|
| Coefficient of variation (CV), weight | | | | | |
| Entry (d0) | 10.7 | 8.0 | 9.5 | 0.52 | 0.092 |
| d7 | 12.1 | 10.8 | 11.7 | 0.54 | 0.618 |
| d14 | 13.9 | 11.5 | 13.0 | 0.65 | 0.324 |
| d21 | 14.6 | 12.7 | 14.7 | 0.58 | 0.312 |
| Exit (d28) | 15.9 | 15.0 | 15.0 | 0.67 | 0.822 |

SED, standard error difference of the means.

### *4.4 Discussion*

The administration of a single trigger dose of pST is not an appropriate methodology for using this technology in weaner pigs. There was no impact on growth performance within the experimental period and the use of pST failed to improve uniformity in live weight. Increased water use in pigs administered pST, but not pST in oil, during the administration group was not expected and was not conserved in later weeks. The numerically reduced value for feed conversion in the first week post-weaning, when the pST was administered, probably indicates that the pST was active. However, a single initial dose is unlikely to overcome somatotropin resistance in the newly-weaned pig.

Upon review of this experiment and discussions with other researchers future experiments will use a larger dose of pST (1 mg/kg of bodyweight) as weaned pigs are relatively unresponsive to somatotropin (F Dunshea 2013 *pers. comm.*) and the pulsatile nature of somatotropin release would also appear to be very important (R Ball 2013 *pers. comm.*).

# 5. Experiment Two

After review of experiment one and discussions with other researchers it was suggested that weaned pigs are relatively unresponsive to somatotropin such that a large dose (1 mg pST/kg of bodyweight) would be required to overcome somatotropin resistance (F Dunshea 2013 *pers. comm.*) and that establishing the pulsatile nature of somatotropin release was also likely to be very important (R Ball 2013 *pers. comm.*). As a result the second experiment was modified from that in the original application.

Experiment Two investigated the use of a larger dose of pST for seven days post-weaning during the first week immediately post-weaning, or in the second week post-weaning once the transition to solid feed was established.

## *5.1 Objectives*

- Establish the response of weaned pigs to a starter program of pST.
- Establish the response of weaned pigs to pST during the transition period immediately post-weaning compared to pST administration once feed intake has been established.

## *5.2 Research Methodology*

Three treatments were investigated in this experiment, a **control** treatment, a **pST week 1** treatment of 5 mg pST per pig per day administered intramuscularly for the first seven days post-weaning and a **pST week 2** treatment of 6 mg pST per pig administered intramuscularly in the second week post-weaning. The latter treatment was chosen to investigate differences in response to pST between weaned pigs that were in the transition from milk to solid feed (pST week 1) and those that were established consumers of solid feed (pST week 2).

There were 10 pens per treatment (5 male, 5 female), with 14 pigs per pen. One-hundred and forty (140) pigs entered the facility each week, over a three-week period, and were split by sex and then graded into large, small and medium pigs by sight and assigned a pen. Pens were weighed and allocated to treatment using a randomised block design with pST dose as the treatment with sex, weight and entry week as blocking factors. Pens are of identical configuration, measuring 1 m x 2.8 m, with plastic floor tiles and open galvanised panelling. Supplemental heating is provided via a radiant bar heater under a hutch, with water supplied *ad libitum* via two nipple drinkers per pen. All pigs had *ad libitum* access to the same wheat-based diet (14.9 MJ digestible energy (DE)/kg, 0.8 g available lysine (AvL)/MJ DE) from a round multi-space plastic transit feeder, feed was delivered by hand from a scaled trolley.

Pigs were weighed at the start of the experiment and on a weekly basis for the following four weeks. Weekly feed disappearance per pen was calculated from feed deliveries and weighed refusal on the final day of the experimental week. Feed conversion was calculated from weight and feed data. Water usage was measured via individual water meters on each pen.

All pigs received 0.25 ml of Draxxin (*Tulathromycin* 100 mg/ml) intramuscularly upon entry to the facility with other medications administered via the drinking water – 65.7 g of Sol-u-mox (*Amoxycillin trihydrate* 870 mg/g) and 42.9 g of Linco-Spectin (*Lincomycin hydrochloride* 222 mg/g, *Spectinomycin sulfate* 445 mg/g) per 1,000 kg of liveweight for 28 and 21 days respectively.

Data were analysed via a GLM analysis of variance (ANOVA) with week of entry as a covariate, with differences between treatments determined by LSD ($P<0.05$).

## *5.3 Results*

There was no significant effect of the timing of pST administration on liveweight across the experimental period (Table 9). Administration of pST within the first week saw no effect on average

daily gain or feed intake, however, the administration of pST in the second week resulted in significantly reduced daily gain (P<0.05) when compared to the control or other pST treatment group, a numerically lower feed intake and numerically worse feed conversion suggests disruption to feeding occurred. In comparison to Experiment One, pST treatment appears to be associated with a reduction in water usage in treatment weeks, but the pattern was not significant (Table 10). The significant reduction in average daily gain associated with the administration of pST during week two had only a numerical effect on a cumulative basis (Table 11).

***Table 9.*** *Effect of timing of porcine somatotropin administration (Control, 0 mg/pig; pST week 1, 1 mg/kg body weight per day during week one (d0-7); pST week 2, 1 mg/kg body weight per day during week two (d8-14) on the growth performance of newly weaned pigs.*

| | **Control** | **pST week 1** | **pST week 2** | **SED** | ***P* value** |
|---|---|---|---|---|---|
| Liveweight (kg) | | | | | |
| Entry (d0) | 5.1 | 5.1 | 5.1 | 0.09 | 0.945 |
| d7 | 5.7 | 5.7 | 5.8 | 0.10 | 0.975 |
| d14 | 7.1 | 7.1 | 7.0 | 0.10 | 0.670 |
| d21 | 8.9 | 8.9 | 8.8 | 0.14 | 0.552 |
| Exit (d28) | 11.5 | 11.6 | 11.5 | 0.18 | 0.667 |
| Week one (d0 – d7) | | | | | |
| ADG (kg/d) | 0.088 | 0.083 | 0.095 | 0.004 | 0.435 |
| ADFI (kg/d) | 0.15 | 0.13 | 0.15 | 0.004 | 0.074 |
| FCR (kg/kg) | 1.70 | 1.60 | 1.63 | 0.046 | 0.877 |
| Week two (d8 – d14) | | | | | |
| ADG (kg/d) | 0.198[a] | 0.201[a] | 0.168[b] | 0.004 | 0.006 |
| ADFI (kg/d) | 0.31 | 0.30 | 0.28 | 0.006 | 0.107 |
| FCR (kg/kg) | 1.55 | 1.52 | 1.70 | 0.037 | 0.125 |
| Week three (d15 – d21) | | | | | |
| ADG (kg/d) | 0.251 | 0.262 | 0.255 | 0.007 | 0.733 |
| ADFI (kg/d) | 0.39 | 0.40 | 0.39 | 0.006 | 0.571 |
| FCR (kg/kg) | 1.60 | 1.53 | 1.52 | 0.035 | 0.982 |
| Week four (d22 – d28) | | | | | |
| ADG (kg/d) | 0.390 | 0.394 | 0.398 | 0.009 | 0.903 |
| ADFI (kg/d) | 0.55 | 0.57 | 0.56 | 0.012 | 0.658 |
| FCR (kg/kg) | 1.41 | 1.47 | 1.40 | 0.026 | 0.381 |

[a,b]Means in a row with different superscripts differ significantly (P<0.05); ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio; SED, standard error difference of the means.

***Table 10.*** *Effect of timing of porcine somatotropin administration (Control, 0 mg/pig; pST week 1, 1 mg/kg body weight per day during week one (d0-7); pST week 2, 1 mg/kg body weight per day during week two (d8-14) on water usage of newly weaned pigs.*

| | **Control** | **pST week 1** | **pST week 2** | **SED** | ***P* value** |
|---|---|---|---|---|---|
| Water usage (L/pig/day) | | | | | |
| Week one (d0 – d7) | 4.5 | 3.3 | 4.5 | 0.47 | 0.348 |
| Week two (d8 – d14) | 7.2 | 7.0 | 5.8 | 0.71 | 0.311 |
| Week three (d15 – d21) | 9.5 | 7.9 | 7.3 | 0.56 | 0.363 |
| Week four (d22 – d28) | 11.8 | 10.0 | 11.0 | 0.68 | 0.517 |

SED, standard error difference of the means.

***Table 11.*** *Cumulative effect of timing of porcine somatotropin administration (Control, 0 mg/pig; pST week 1, 1 mg/kg body weight per day during week one (d0-7); pST week 2, 1 mg/kg body weight per day during week two (d8-14) on the growth performance of newly weaned pigs.*

| | **Control** | **pST week 1** | **pST week 2** | **SED** | ***P* value** |
|---|---|---|---|---|---|
| Week one (d0 – d7) | | | | | |
| ADG (kg/d) | 0.088 | 0.083 | 0.095 | 0.004 | 0.435 |
| ADFI (kg/d) | 0.15 | 0.13 | 0.15 | 0.004 | 0.074 |
| FCR (kg/kg) | 1.70 | 1.60 | 1.63 | 0.046 | 0.877 |
| Week two (d0 – d14) | | | | | |
| ADG (kg/d) | 0.147 | 0.143 | 0.134 | 0.003 | 0.303 |
| ADFI (kg/d) | 0.22 | 0.21 | 0.21 | 0.004 | 0.383 |
| FCR (kg/kg) | 1.53 | 1.50 | 1.59 | 0.027 | 0.319 |
| Week three (d0 – d21) | | | | | |
| ADG (kg/d) | 0.183 | 0.183 | 0.173 | 0.004 | 0.318 |
| ADFI (kg/d) | 0.28 | 0.27 | 0.27 | 0.004 | 0.574 |
| FCR (kg/kg) | 1.53 | 1.49 | 1.55 | 0.018 | 0.429 |
| Week four (d0 – d28) | | | | | |
| ADG (kg/d) | 0.229 | 0.232 | 0.227 | 0.004 | 0.529 |
| ADFI (kg/d) | 0.34 | 0.34 | 0.34 | 0.005 | 0.679 |
| FCR (kg/kg) | 1.49 | 1.48 | 1.49 | 0.015 | 0.836 |

ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio; SED, standard error difference of the means.

### *5.4 Discussion*

The administration of pST in the first week post-weaning resulted in no significant effect on average daily gain, however, there was a trend ($P<0.10$) for feed intake to be reduced, but it was not large enough to result in any changes to feed conversion (Table 2). When pST was given to weaned pigs in the second week post-weaning it had no significant effect on feed intake, although they were numerically lower. However, administration in the second week resulted in significantly lower growth rate ($P<0.05$). This unexpected result may be a response to the negative interaction of handling and pST administration with a fall, though non-significant, in feed consumed during the second week when that treatment group was being administered pST. Feed conversion was also affected, although the numerically large difference was not statistically significant. Performance in the third week, when no pST administration was being undertaken, showed no differences between treatments – this further adds to the interaction being the cause of the poorer performance.

## 6. Experiment Three

The lack of response to treatment in Experiments One and Two led to further consultation as to the appropriate design of the third experiment. As a response to consultation Experiment Three was designed to investigate whether the administration of pST for prior to and post-weaning was able to boost the performance of newly weaned pigs and reduce the post-weaning growth check associated with weaning.

### *6.1 Objectives*

- Establish the response of pigs to the administration of pST across the wider weaning event.
- Establish the ability of pST to alleviate the post-weaning growth check.

### *6.2 Research Methodology*

Two treatments were investigated in this experiment, a **control** treatment and a **pST** treatment where pigs received bidaily intramuscular injections of 12.5 mg pST per pig 2, 4 and 6 days prior to weaning, and 6.25 mg pST per pig daily for 7 days from the day of weaning.

There were 10 pens per treatment (5 male, 5 female), with 14 pigs per pen. Suckling piglets were selected from litters due to be weaned on a common day, and were randomly assigned to the two treatments and identified by two different coloured eartags. One-hundred and forty (140) pigs entered the facility each week, over a two-week period, and were split by sex and then graded into large, small and medium pigs by sight and assigned a pen. Pens are of identical configuration, measuring 1 m x 2.8 m, with plastic floor tiles and open galvanised panelling. Supplemental heating is provided via a radiant bar heater under a hutch, with water supplied *ad libitum* via two bowl drinkers per pen. All pigs had *ad libitum* access to the same wheat-based diet (15.0 MJ digestible energy (DE)/kg, 0.8 g available lysine (AvL)/MJ DE) from a round multi-space plastic transit feeder, feed was delivered by hand from a scaled trolley.

Pigs were weighed individually at the start of the experiment and on a weekly basis for the following four weeks. Weekly feed disappearance per pen was calculated from feed deliveries and weighed refusal on the final day of the experimental week. Feed conversion was calculated from weight and feed data. Water usage was measured via individual water meters on each pen.

All pigs received 0.25 ml of Draxxin (*Tulathromycin* 100 mg/ml) intramuscularly upon entry to the facility with other medications administered via the drinking water – 65.7 g of Sol-u-mox (*Amoxycillin trihydrate* 870 mg/g) and 42.9 g of Linco-Spectin (*Lincomycin hydrochloride* 222 mg/g, *Spectinomycin sulfate* 445 mg/g) per 1,000 kg of liveweight for 28 and 21 days respectively.

Data were analysed via a GLM analysis of variance (ANOVA) with week of entry as a covariate, with differences between treatments determined by LSD ($P<0.05$).

### *6.3 Results*

There was no significant effect of pST administration on production parameters in the post-weaning phase (Table 12 and 14), however, during the pre-weaning administration period (from 6 days prior to weaning), pST pigs grew significantly slower than the controls, however, there was no significant difference in average daily gain or average daily feed intake during the seven day post-weaning administration period. No differences in water usage per treatment were observed (Table 13).

***Table 12.*** *Effect of porcine somatotropin (Control, 0 mg/pig; pST, 12.5 mg/pig pST d2, 4, 6 prior to weaning and 6.25 mg/pig pST daily for 7 days post-weaning) on the growth performance of pigs prior and post weaning.*

| | Control | pST | SED | *P* value |
|---|---|---|---|---|
| Liveweight (kg) | | | | |
| Pre-weaning (d-6) | 2.4 | 2.6 | 0.06 | 0.061 |
| Entry (d0) | 4.8 | 5.0 | 0.38 | 0.574 |
| d7 | 5.3 | 5.3 | 0.05 | 0.336 |
| d14 | 6.8 | 6.9 | 0.10 | 0.261 |
| d21 | 8.6 | 8.7 | 0.13 | 0.196 |
| Exit (d28) | 11.0 | 11.1 | 0.23 | 0.705 |
| Pre-weaning (d-6 – d0) | | | | |
| ADG (kg/d) | 0.306[a] | 0.291[b] | 0.006 | 0.017 |
| Week one (d0 – d7) | | | | |
| ADG (kg/d) | 0.066 | 0.060 | 0.006 | 0.336 |
| ADFI (kg/d) | 0.18 | 0.17 | 0.012 | 0.466 |
| FCR (kg/kg) | 2.82 | 3.20 | 0.443 | 0.412 |
| Week two (d8 – d14) | | | | |
| ADG (kg/d) | 0.204 | 0.226 | 0.011 | 0.070 |
| ADFI (kg/d) | 0.31 | 0.32 | 0.020 | 0.829 |
| FCR (kg/kg) | 1.54 | 1.40 | 0.083 | 0.112 |
| Week three (d15 – d21) | | | | |
| ADG (kg/d) | 0.257 | 0.266 | 0.012 | 0.442 |
| ADFI (kg/d) | 0.44 | 0.44 | 0.023 | 0.920 |
| FCR (kg/kg) | 1.75 | 1.67 | 0.109 | 0.473 |
| Week four (d22 – d28) | | | | |
| ADG (kg/d) | 0.342 | 0.329 | 0.024 | 0.601 |
| ADFI (kg/d) | 0.59 | 0.55 | 0.031 | 0.252 |
| FCR (kg/kg) | 1.74 | 1.69 | 0.089 | 0.574 |

ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio; SED, standard error difference of the means.

***Table 13.*** *Effect of porcine somatotropin (Control, 0 mg/pig; pST, 12.5 mg/pig pST d2, 4, 6 prior to weaning and 6.25 mg/pig pST daily for 7 days post-weaning) on water usage of newly weaned pigs.*

| | Control | pST | SED | *P* value |
|---|---|---|---|---|
| Water usage (L/pig/day) | | | | |
| Week one (d0 – d7) | 1.5 | 1.5 | 0.36 | 0.878 |
| Week two (d8 – d14) | 2.7 | 2.7 | 0.49 | 0.889 |
| Week three (d15 – d21) | 4.2 | 3.5 | 0.57 | 0.209 |
| Week four (d22 – d28) | 4.9 | 3.9 | 0.71 | 0.192 |

[a,b]Means in a row with different superscripts differ significantly (P<0.05); SED, standard error difference of the means.

***Table 14.*** *Cumulative effect of porcine somatotropin (Control, 0 mg/pig; pST, 12.5 mg/pig pST d2, 4, 6 prior to weaning and 6.25 mg/pig pST daily for 7 days post-weaning) on the growth performance of newly weaned pigs.*

| | Control | pST | SED | *P* value |
|---|---|---|---|---|
| Week one (d0 – d7) | | | | |
| ADG (kg/d) | 0.066 | 0.060 | 0.006 | 0.336 |
| ADFI (kg/d) | 0.18 | 0.17 | 0.012 | 0.466 |
| FCR (kg/kg) | 2.82 | 3.20 | 0.443 | 0.412 |
| Week two (d8 – d14) | | | | |
| ADG (kg/d) | 0.135 | 0.143 | 0.007 | 0.261 |
| ADFI (kg/d) | 0.24 | 0.24 | 0.014 | 0.864 |
| FCR (kg/kg) | 1.80 | 1.69 | 0.095 | 0.229 |
| Week three (d15 – d21) | | | | |
| ADG (kg/d) | 0.176 | 0.184 | 0.006 | 0.196 |
| ADFI (kg/d) | 0.30 | 0.30 | 0.016 | 0.912 |
| FCR (kg/kg) | 1.74 | 1.65 | 0.085 | 0.328 |
| Week four (d22 – d28) | | | | |
| ADG (kg/d) | 0.217 | 0.220 | 0.008 | 0.705 |
| ADFI (kg/d) | 0.37 | 0.36 | 0.018 | 0.696 |
| FCR (kg/kg) | 1.70 | 1.64 | 0.075 | 0.473 |

ADG, average daily gain; ADFI, average daily feed intake; FCR, feed conversion ratio; SED, standard error difference of the means.

### *6.4 Discussion*

The administration of pST across the weaning period (for a week prior- to and post-weaning) did not result in improved performance. Feed intake, feed conversion and growth rate was not impacted at any stage during the four week post-weaning period. Similar to the response to administration seen in experiment two, growth rate was reduced in the administration period, significantly so in the pre-weaning period. Whilst there was a consistent pattern of better production efficiency in the pigs administered pST, at no stage was this difference significant between treatments.

The short-term administration of pST to weaner pigs across the weaning period failed to deliver significant improvements in weaner pig performance.

## 7. Implications & Recommendations

The short-term use of pST in weaner pigs does not appear, based on this series of experiments, to be a suitable method to boost their performance. Instead, there appears to be a degree of hindrance to performance during the administration period. Whilst there was some small non-significant improvements in production efficiency observed across all experiments through the administration of pST (across different dose rates and timings), these small benefits would not warrant the costs associated with the product and it's administration.

The judicial use of pST failed to meet the objectives of this study. There was no improvement in weaner pig performance as a result of pST administration; there was therefore no ability to increase the whole of life performance of low weight weaners, no ability to reduce the frequency of pST administration whilst maintaining improved performance, and no ability to reduce within batch variation.

Future research in this area probably needs an extended timeframe of administration to allow the effects of pST to be established. This is likely to lead to similar OH&S and animal welfare issues that have been associated with its administration in larger animals. Investigating this area again may be of value when a longer term method of administration has been developed.

## 8. Intellectual Property

There was no protectable intellectual property generated from this series of studies.

## 9. Technical Summary

The three experiments in this project aimed to influence weaner pig performance through the judicious short-term use of somatotropin. These experiments failed to show improvements in performance or reductions in variation when differing short-term administration programs were investigated. Previous studies (Sillence *et al.* 2002) have been able to deliver advantages from somatotropin use from longer term administration; this would appear to be the required response until a longer term gradual release product is developed.

## 10. Literature cited

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## 11. Publications Arising

There have been no publications currently generated from this project.