Production Index (PI)
Technote 10

HIGHLIGHTS

- A Production Index (PI) allows you to compare the performance of cows within a herd, based on current lactation information.
- A cow's PI and ABVs (including ASI) cannot be compared.
- Use PI as a tool to cull animals, use ABVs as a tool to breed replacements.

What is a PI?

The Production Index (PI) is a measure of the merit of a cow based on her performance in the current lactation, compared to other cows of the same breed in the same herd. It is an estimate based solely on the cow's own performance. It is not a genetic measure – it does not predict the performance of her progeny.

The value of the PI is to identify the under-performing cows as candidates for culling. This is to help improve the profitability of the herd in the short term – the current year and maybe next year.

The PI is designed to allow you to compare cows of a given breed that may be of different ages or at a different stage of lactation. It is based on comparisons of individual test day yields, which are then pooled throughout the lactation, as they become available.

The PI relies on knowledge of how a typical cow performs throughout lactation – this is sometimes called the shape of the lactation curve. We expect the cow to begin lactation at a reasonably high level, reaches a peak after a few weeks and then gradually declines over the next few months. The PI also relies on knowing how age affects yield. We know a typical two year old produces less than a three year old, which produces less that a mature cow. We take advantage of the mathematical relationships between stage of lactation and yield, and between age and yield to calculate PI.

Calculating PI

The first step in the calculation of the PI is the adjustment of the daily yield of each cow to what we expect her to produce if she was at day 150 of lactation and if she was seven years old. All cows are put on an equal footing.

Production Index (PI) – one of the useful pieces of information from your herd test report.

The next step is to compare these adjusted yields with the average of all other cows milking in that herd on that test day. This is what is called the test-day index and it is an important part of the PI. Under Australia's pasture-based production system, the daily yield of the herd can move up and down quite substantially between seasons – or even between days quite close together. By doing all comparisons within test days, this variation can largely be accounted for and removed from the PI scores.

The final step is to combine all test day indices for a cow to produce her publishable PI. This is done using a formula that takes account of the number of test day yields that the cow has and the accuracy of estimating lactation yield from that number of test day yields. It is worth noting that some test days have a greater influence on the PI than others. Examples are those around peak yield (because these test days contribute more to total lactation yield) and the latest test days (because these are the best predictors of what a cow will produce for the remainder of her lactation).

The PI may be based on milk yield only, fat yield only, protein yield only, or a combination of these traits.

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In time, herd test centers will move to calculating the PI based on the Australian Selection Index (ASI) formula, as this will reflect how dairy farmers are paid for milk.

Expression of PI

The base for the PI is 100. That is, if all cows were present at all test days, the average PI would be 100. Because not all cows are present at all test days, the average may vary by a few per cent. Do not be alarmed about this – just compare the relative PIs of the cows that you are considering for culling.

The PI is based on production only. Other factors that may affect profit, such as cow size, temperament and survival, are not included in the PI and should be considered separately.

PI's compared to ABVs

A cow's PI and ABV (including ASI) cannot be compared as they are measuring two different components.

- The cow's PI is a phenotypic measure that can be affected by her environment, such as management, rearing, feeding and health.
- The cow's ABV is her genetic merit based on her pedigree, genomics and her own performance. It is a prediction of how the future progeny of an animal will perform compared with all other animals of that breed throughout Australia.

Using PIs

PIs are a really useful tool to compare animals within the same herd for their current production levels and to select cows for culling, as outlined in Table 1.

Remember that the PI is a within-herd measure and that the PI of a cow in one herd cannot be compared with the PI of a cow in another herd.

Also note that the adjustments for age and stage of lactation are for typical cows. If your young stock are better grown this year and better looked after than the young stock of the typical farmer, then you would expect the PIs of your heifers to be higher than the PIs of your mature cows.

To conclude, the PI is a good measure of the relative performance of cows in the current lactation and is ideal for choosing cows as candidates for culling. The ABV is a prediction of the performance of future.

For more information

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Table 1: The differences between PI and ABVs

Production index (PI)	Australian Breeding Value (ABV)
Use as a tool to cull animals	Use as a tool to breed replacements
Measure of cow performance only	Measure of genetic merit (based on own performance, progeny performance and all known relatives)
Current lactation only	All lactations
Cannot be used to compare animals between herds	Can be compared between different herds
No adjustment for environmental effects	Environmental effects accounted for
Based on comparison with herdmates in same herd/year/season	Based on comparison with herdmates in same herd/year/season
Records adjusted for age and days in milk	Records adjusted for age and days in milk
May be based on milk, fat, protein or a combination of these	Available for milk, fat, protein and ASI

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