2015 Jersey Performance Index™ (JPI)

Calling Jersey Performance Index™ "a strategy for breed improvement," the AJCA Board of Directors authorized updates including adjusted trait weights and the addition of new traits for implementation with the December 2014 genetic evaluations.

The objective of Jersey Performance Index™ is to increase lifetime net income. The 2015 version of JPI was developed from the most extensive evaluation of production, longevity and health data ever undertaken for a JPI™ update, conducted by geneticist Kent Weigel of the University of Wisconsin–Madison.

In JPI$_{2015}$, 58% of the index's value is placed on production traits (PTA protein and PTA fat). The remaining 42% is contributed by six health, fitness and longevity traits: the Functional Trait Index (FTI), and USDA PTAs for Productive Life (PL), Somatic Cell Score (SCS), and three fertility traits: Daughter Pregnancy Rate (DPR), Cow Conception Rate (CCR), and Heifer Conception Rate, HCR).

Traits and their relative weights in JPI$_{2015}$, with changes from the previous version noted in parentheses, are 43% PTA protein *(+1%)*; 15% PTA fat *(no change)*; 15% Functional Trait Index *(no change)*; 10% Productive Life *(-2%)*; 6% Somatic Cell Score *(no change)*; and 7% Daughter Pregnancy Rate *(-3%)*, plus 2% Cow Conception Rate *(new)* and 2% Heifer Conception Rate *(new) (see also Table 1)*.

While most traits of the JPI™ index have trended in desired directions since the previous update in 2010, fertility traits have not been improving, leading to the decision to increase selection pressure by adding the cow and heifer conception traits. Also, because the demand for and value of protein continues to grow in domestic and international milk markets, the slight shift of 43% protein to 15% fat puts additional selection pressure on protein yield.

Regrouping by functional categories, production receives 58% of the emphasis in the new formula. Udder health at 20% is a combination of direct selection for lower Somatic Cell Score (especially important to capture quality premiums), plus udder traits included in the Functional Trait Index (FTI). There is 11% on herd life, through PTA Productive Life plus the body and feet traits in FTI. Lastly, 11% is placed on fertility.

"Selection for an index of economically important traits is the optimal way to achieve breed improvement," Dr. Weigel observed, "however, the index must be updated periodically to ensure that it reflects current economic conditions on the farm, as well as current strengths and weaknesses of the breed.

"The 2015 revision focused on prediction of lifetime net profit from production, type, health, longevity, and fertility traits that are available early in life, with an emphasis on using the most recent cow population possible and achieving a balance between timely input prices and stability of these prices over time."

Method Used For 2015 Updates

Unlike previous updates, which included only cows with completed productive life, Weigel also analyzed cows from the current population. Records from 328,312 Jersey cows with first calving from January 1, 2001 through December 31, 2012 were provided through the cooperation of the dairy records processing centers (DRPCs).

A total of 264,681 cows had left the herd at the time of analysis, and their lifetime profit records were considered as complete. An additional 63,631 cows were still in the herd, and their records were considered as in-progress, such that their profit totals to date were compared with those of contemporary cows in the same year of first calving. Up to nine lactations per cow were used, and lifetime profit records for cows that remained in the herd after nine lactations were treated as in-progress.

Income sources considered were from protein, fat and total

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Calculation of the Jersey Performance Index™

Beginning with December 2014 genetic evaluations, JPI™ is calculated as follows:

$$\text{JPI}_{2015} = (43 \times \text{PTA protein} / \text{SD}) + (15 \times \text{PTA fat} / \text{SD})$$
$$+ (10 \times \text{PTA Productive Life} / \text{SD}) + [6 \times (3 - \text{PTA Somatic Cell Score}) / \text{SD})]$$
$$+ (7 \times \text{PTA Daughter Pregnancy Rate} / \text{SD}) + (2 \times \text{PTA Cow Conception Rate} / \text{SD})$$
$$+ (2 \times \text{PTA Heifer Conception Rate} / \text{SD}) + \text{Functional Trait Index}_{2015}$$

where Functional Trait Index equals the PTAs of linear type traits weighted by their relative economic contribution to JPI$_{2015}$ (see Table 2).

DPR 7% CCR 2% HCR 2%
SCS 6%
Productive Life 10%
Functional Trait Index 15%
PTA Fat 15%
PTA Protein 43%
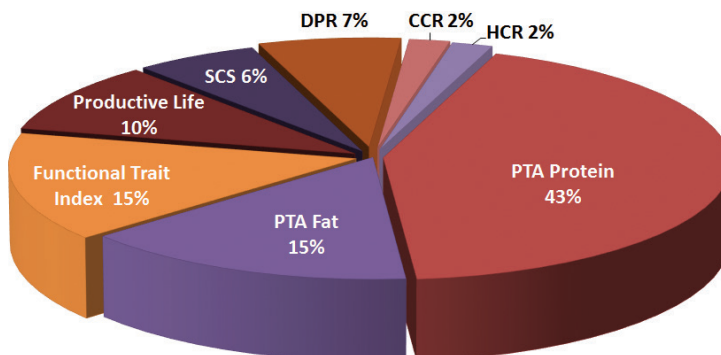
Table 1. History of Traits and Weights (%) Used to Calculate PTI (1998) and Jersey Performance Index™.

Year	Protein	Fat	FTI	PL	SCS	FUI	DPR	CCR	HCR
1998	55.5	22.2	16.7		5.6				
2002	50.0	20.0	15.0	5.0	5.0	5.0			
2005	50.0	20.0	15.0	3.75	3.75	3.75	3.75		
2006	40.0	20.0	15.0	12.0	3.0	3.0	7.0		
2010	42.0	15.0	15.0	12.0	6.0		10.0		
2015	43.0	15.0	15.0	10.0	6.0		7.0	2.0	2.0

solids, as well as milk quality premiums, salvage value and calf value. Expenses included feed for lactation, growth and maintenance during the rearing, lactating and dry periods, as well as breeding costs and replacement costs.

Input prices for milk, feed, salvage, and calf value were from the USDA Agricultural Marketing Service, whereas input prices for replacement females were from the Jersey Marketing Service. Prices represented weighted averages from the past three years.

FTI Updates, Presentation of Jersey Udder Index

Of the eight components of JPI™, only one—the AJCA Functional Trait Index—captures the effects of type traits *within* production on lifetime profitability. It assesses how functional type traits are important to the Jersey cow's economic survival. As such, it pinpoints where improvement is needed and needed most, and where opportunities for further gains are possible.

A new approach was used by Dr. Weigel to delineate the direct contribution of each type trait within the Functional Trait Index to Jersey Performance Index™. In the geneticist's words, the relationships are now "transparent."

Table 2 shows that what will make the most difference in improving Jersey profitability going forward is increasing selection pressure on udder traits. But as always, some traits are more important than others, a fact clearly depicted in the updated Jersey Udder Index™, which is derived from FTI. Udder Depth is the most important, followed by three traits (Fore Udder Attachment, Udder Cleft and Rear Udder Height) that have similar influence on cow survival and lifetime net income.

Jersey Udder Index™ was previously reported in PTA form. Now the JUI number is simply how many points udder traits add (or subtract) from Jersey Performance Index™. In short, JUI's meaning is linked directly to an animal's JPI.

To illustrate, A, F and G code bulls in the December 2014 evaluation averaged 10.6 for JUI. The JPI average was 121. So for the hypothetical average Jersey bull at JPI 121, 10.6 of those points are from JUI. Think of them as JPI udder points.

Fertility Traits

Direct selection for fertility was added to JPI™ in 2005 and has seen increasing emphasis with each subsequent update. In addition to Daughter Pregnancy Rate (DPR), JPI$_{2015}$ includes two new fertility measures, bringing total emphasis to 11% in the index.

The first, Cow Conception Rate (2%), measures the lactating cow's ability to conceive defined as percentage of inseminated cows that become pregnant at each service. A CCR of 1 implies that daughters of this bull (or cow) are 1% more likely to become pregnant during that lactation than daughters of a bull with an evaluation of 0.

The second, Heifer Conception Rate (2%), refers to the maiden heifer's ability to conceive defined as percentage of inseminated heifers that become pregnant at each service. An HCR of 1 implies that daughters of this bull (or heifer) are 1% more likely to become pregnant as a heifer than daughters of a bull with an evaluation of 0.

Daughter Pregnancy Rate (7%) is defined as the percentage of non-pregnant cows that become pregnant during each 21-day period. A bull with a DPR of 1 indicates that his daughters are 1% more likely to become pregnant during an estrus cycle than a bull with an evaluation of 0. Each 1% *increase* in PTA DPR equals a *decrease* of four (4) days in days open.

For detailed information on USDA traits included in JPI$_{2015}$, refer to the Council on Dairy Cattle Breeding (CDCB) website at www.cdcb.us/reference.htm.

Summary

Jersey Performance Index™ (JPI™) is a breed-specific selection tool that has been continually reviewed and updated based on sound science and relative to the economics of dairying.

JPI$_{2015}$ includes eight traits as follows: 43% Protein : 15% Fat : 15% FTI : 10% PL : 7% DPR : 6% SCS : 2% CCR : 2% HCR. Overall, 58% of its emphasis is on production, 20% on udder health, 11% on longevity, and 11% on fertility.

Expected genetic response from JPI$_{2015}$ is annual gains of 5.2 lbs. PTA protein and 6.2 lbs. PTA fat, 6.7 days of Productive Life, plus changes in desirable directions for somatic cell score and cow fertility.

"The Board action to update JPI™ is grounded in science and the economics of profitability," commented AJCA President Chris Sorenson. "We are confident that it charts the proper course for selecting productive, fertile, healthy, long-lasting and trouble-free Jersey cows."

Table 2. Relative weights for specific traits and trait groups in Jersey Performance Index$_{2015}$.

Trait Group	Relative Weight (%)	Specific Trait (Direction)	Overall Weight (%)
Production	58.0	Protein (+)	43.0
		Fat (+)	15.0
Health	27.0	Productive Life (+)	10.0
		Somatic Cell Score (-)	6.0
		Daughter Pregnancy Rate (+)	7.0
		Cow Conception Rate (+)	2.0
		Heifer Conception Rate (+)	2.0
		Functional Trait Index:	
Udder	13.8	Udder Depth (+)	5.1
		Fore Udder Attachment (+)	2.6
		Udder Cleft (+)	2.1
		Rear Udder Height (+)	1.9
		Teat Placement (+)	1.0
		Teat Length (-)	1.0
		Rear Udder Width (+)	0.1
Body	1.0	Stature (-)	0.6
		Rump Width (+)	0.2
		Strength (-)	0.1
		Rump Angle (-)	0.1
		Dairy Form (+)	0.0
Mobility	0.2	Foot Angle (+)	0.1
		Rear Legs (-)	0.1

Calculation of the Jersey Udder Index™

This index is the sum of PTAs for udder traits multiplied by their percentage contribution to the animal's Jersey Performance Index$_{2015}$:

$$\text{JUI}_{15} = [(2.6 \times FU / SD\ FU) + (1.9 \times RH / SD\ RH) + (0.1 \times RUW / SD\ RUW)$$
$$+ (5.1 \times UD / SD\ UD) + (2.1 \times UC / SD\ UC)$$
$$+ (1.0 \times TP / SD\ TP) + (-1.0 \times TL / SD\ TL)]$$