

## Revisions to Jersey Performance Index™ (JPI)

Trait weightings for the AJCA Jersey Performance Index™ and a major component, the Functional Trait Index, were updated and implemented for the August, 2006 bull and cow genetic evaluations.

In the new method (JPI<sub>06</sub>), 60% of the index's value was placed on production traits (PTA protein and PTA fat).

The remaining 40% was contributed by five fitness and longevity traits: the AJCA's Functional Trait Index (FTI<sub>06</sub>) and Functional Udder Index (FUI), and USDA PTAs for Productive Life (PL), Somatic Cell Score (SCS), and Daughter Pregnancy Rate (DPR). Of this 40% of JPI<sub>06</sub>, udder traits account for 14.4% of the emphasis; longevity, 12%; female fertility, 7%; feet and legs, 4.3%; and the remaining functional type traits, 2.3%.

Specific weights for each trait in JPI<sub>06</sub>, with changes from the previous version noted in parentheses, are: 40% PTA Protein (-10%); 20% PTA Fat, 15% FTI (+8.25%); 7% DPR (+3.25%); 3% FUI (-0.75%); and 3% SCS (-0.75%) (see also Table 1, next page).

### More About The Traits in JPI™

As noted above, the majority of selection emphasis in JPI™ is placed on genetic merit for protein and fat yield, expressed by Predicted Transmitting Ability (PTA). Heritability of these traits is 35%.

Functional Trait Index (15%) is designed to separate the impact of production and type traits on lifetime profitability. It is composed of the sum of the PTAs for the linear traits times their relative economic values. Udder Depth is set to 1.0, and all other traits are expressed relative to it. FTI is not published separately. The reason is, since estimates of trait economic importance are calculated holding production constant, FTI needs to be combined with the production traits to be interpreted correctly. Introduced in January of 1992, FTI weights have been updated twice (in 1998

and with the August 2006 summary). These reflect the change in type traits over time (see Table 2, next page).

Productive Life (12%) is defined as "time in the milking herd before removal by voluntary culling, involuntary culling, or death." The heritability of Productive Life is estimated at 8%.

The August 2006 evaluations introduced an economic definition of PL to replace the original definition introduced in 1994.

According to research geneticist Paul VanRaden of the Animal Improvement

a bull with an evaluation of 0. Each 1% increase in PTA DPR equals a decrease of four (4) days in days open.

The heritability estimate for DPR is 4%. While modest, the economic impact of reproductive performance is significant and variation for DPR does exist. The August Active A.I. and Foreign Jersey bulls range from 3.0 to -2.3 DPR. That translates into a genetic difference of 21.2 days open among the daughters of these bulls.

Somatic Cell Score (3%) is an indicator trait for mastitis resistance based on the

direct measure of somatic cells in milk samples. The genetic correlation between Somatic Cell Score and clinical mastitis is about 0.6. Heritability of this trait is estimated at 12%.

Functional Udder Index (3%) weights the Predicted Transmitting Ability (PTA) for fore udder (FU), rear udder height (RH), udder cleft (UC), udder depth

(UD), front teat placement (TP), and teat length (TL) based primarily on their genetic relationship to second lactation Somatic Cell Score (see formula in box, this page). This is based upon previous research partially funded by the AJCC Research Foundation and published by Gary Rogers and colleagues of The Pennsylvania State University in the *Journal of Dairy Science* (Vol. 78, pp. 914-920). Thus, the Functional Udder Index is an aid for predicting mastitis resistance.

### Method Used For 2006 Updates

The revisions implemented to JPI™ in August were based on recent, extensive research conducted by Ronald E. Pearson of Virginia Tech, who developed both the Functional Trait Index and Functional Udder Index. This is the first time that recommendations for revisions to JPI™ have been based on simultaneous evaluation of multiple traits and their relationships to lifetime net income. Previously the weights were based on

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### Calculation of the Jersey Performance Index™

Beginning with August, 2006 genetic evaluations, bull and cow JPI™ are calculated as follows:

$$\begin{aligned} \text{JPI}_{06} = & (40 \times \text{PTA protein} / 15.58) + (20 \times \text{PTA fat} / 20.57) + (15 \times (\text{FTI}_{06} / 3.4) \\ & + (12 \times \text{Productive Life} / 1.7) + (7 \times \text{DPR} / 0.87) + (3 \times \text{FUI} / 3.86) \\ & + (3 \times (3.00 - \text{PTA Somatic Cell Score}) / 0.17) \end{aligned}$$

where:

FTI<sub>06</sub> (Functional Trait Index) = Sum of the bull/cow PTAs of linear type traits multiplied by the respective relative economic value, updated for 2006 (see Table 1)

FUI (Functional Udder Index) = [(2 x PTA FU) + (.6 x PTA RH) + (.5 x PTA UC) + (2 x PTA UD) + (.5 x PTA TP) - (1 x PTA TL)]

Programs Laboratory, USDA, "Cows now get credit for continuing in milk after 305 days of lactation and after 84 months of age. Previously, credits were limited to the first 10 months of each lactation because records for longer lactations had not been stored in the AIPL database. Credits now are based on standard lactation curves, with highest credits at the peak of lactation and diminishing credits across the remainder of lactation. The standard is set such that a second-lactation cow with 305 days in milk gets 10 months credit. First lactations get less credit and later lactations slightly more credit in proportion to average production. Lactation-curve credits ensure that cows with multiple lactations get more total credit than cows with just one long lactation."

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

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estimated income and expenses associated with each trait.

Dr. Pearson used lactation records for Jersey cows born after 1991 and in herds that continued on production testing programs for eight years after the cow was born. Cows were sired by bulls born after 1979. All lactations started by cows' eighth birthday were included. Total days in milk of the cows ranged from 15 to approximately 2,200 days.

Relative lifetime net income (RNI) was estimated for each cow, calculated from DHI lactation data using total lifetime milk, fat and protein; total days in milk and days dry; number of lactations; and age at first calving. RNI is relative because the same prices were used for all herds across the United States.

RNI was then adjusted for costs not directly measured in DHI records (for example, discarded milk, treatment and vet costs). An adjustment was also made for the opportunity cost of premature or delayed culling.

Two types of milk pricing were studied, approximating Federal Order multiple component pricing (\$1.50/lb. fat, \$1.95/lb. protein, \$0.016/lb. milk) and cheese yield pricing (\$1.50/lb. fat, \$2.80/lb. protein, - \$0.010/lb. milk).

The 2006 updates to the Functional Trait Index (FTI), calculated by the AJCA, were based on information analyzed by Dr. Pearson from type records of 68,495 Jersey cows, born since 1991 and located in herds where they had the opportunity to reach their eighth birthday.

Udder traits had the highest weighting, 56%, with 28% on feet and legs, 8% on rump, and 8% on stature and strength. Foot angle and rear udder height were the largest single contributors to FTI, at 21% and 19%

respectively, followed by udder depth (14%) and rear udder width (12%).

### Other Considerations

In addition to the results of Dr. Pearson's analyses, the AJCA Board of Directors considered other factors in making adjustments to JPI™ weightings. These included (1) the impact of changes in

found less of an antagonistic relationship between PTAs for yield and fitness traits in the Jersey breed than is commonly found in most U.S. dairy cows. "The conflict between high production and resistance to mastitis and reproductive efficiency may be less for Jerseys than for Holsteins," he said.

As such, the Board chose to hold the weight for SCS in JPI<sub>06</sub> at essentially the previous level, but it did increase the weight for Daughter Pregnancy Rate dramatically. This was termed a "forward looking action," the intent of which is to maintain and hopefully increase the Jersey breed's notable advantage in reproductive efficiency.

### Summary

"JPI™ has served the Jersey breed very well in the past," stated AJCA President Sherman, following the decision reached by the Board of Directors.

"JPI<sub>06</sub> is a new direction for our principal ranking tool, taking the very latest information available to us to identify which bulls and cows are likely to be more profitable. At the same time, the AJCA directors also looked in the crystal ball and asked, 'What do we want the Jersey cow to be in the future?'"

To summarize:

- 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<sub>06</sub> provides for multi-trait selection with the emphasis distributed as 40% Protein : 20% Fat : 15% FTI : 12% PL : 7% DPR : 3% SCS : 3% FUI. Overall, the ratio of production to fitness traits is 60:40.

**Table 1.** History of weights used to calculate Production Type Index (PTI<sub>98</sub>) and Jersey Performance Index™.

Year	Protein	Fat	FTI	PL	SCS	FUI	DPR
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

calculating Productive Life; (2) observations made by Dr. Pearson about yield and fitness trait relationships in the Jersey breed; and (3) genetic trends in reproduction.

"The changes may seem at first to de-emphasize some critical traits," noted AJCA President Donald S. Sherman, "but there has been no decrease in the economic importance of udder traits and mastitis resistance in JPI™. They are being accounted for elsewhere, particularly in the Productive Life trait."

Relative to Productive Life, "with the new definition of PL, some emphasis is shifted away from fertility toward somatic cell score because longer lactations require more mastitis resistance," AIPL's VanRaden explained.

He also reported that for the Jersey breed, Productive Life has a correlation of +0.38 for combined udder traits, and +0.25 for feet and leg traits. In other words, increasing emphasis on Productive Life has the effect of also selecting for improvement in udder and feet and leg traits.

Dr. Pearson told the Board of Directors at its meeting on June 28, 2006 that he

**Table 2.** Relative economic importance of linear traits for calculating Functional Trait Index (FTI).

Year	Stature	Strength	Dairy Form	Foot Angle	Rear Legs	Rump Angle	Rump Width	Rear Fore Udder	Rear Udder Height	Udder Width	Udder Depth	Udder Cleft	Teat Placement	Teat Length
1998	-0.29	-0.22	-0.31	1.97	-0.83	-0.51	0.17	0.86	1.26	0.78	1.00	0.06	0.38	-1.37
2006	-0.31	-0.23	0.00	1.46	-0.51	0.37	0.18	0.32	1.33	0.82	1.00	0.06	0.19	0.21

Note: Udder Depth is set to 1.0, and all other traits are expressed relative to Udder Depth.