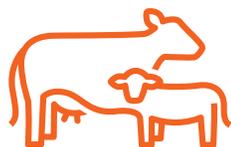


Технический прорыв

1 марта 2016



Формирование здорового стада с CLARIFIDE® PLUS

Производители молока могут использовать CLARIFIDE Plus для отбора телок на основании показателей здоровья с целью формирования здорового и более продуктивного стада.

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Ключевые тезисы

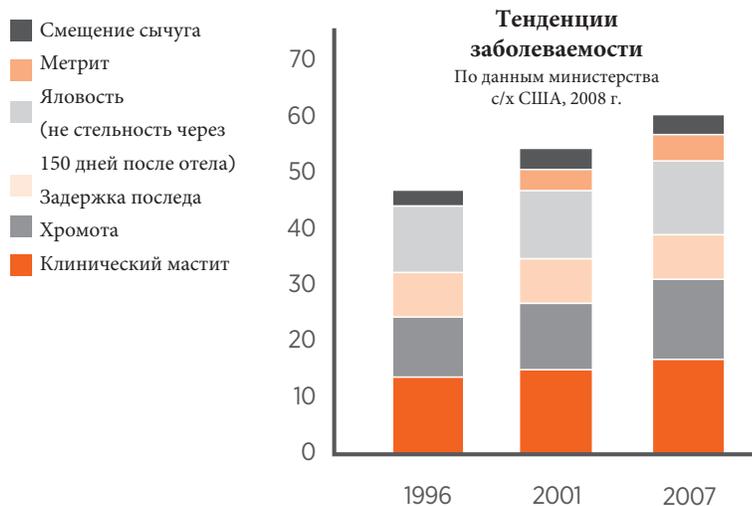
- CLARIFIDE® Plus представляет первую коммерческую доступную генетическую оценку, специально разработанную по показателям здоровья для молочного скота США.
- Геномные прогнозы от CLARIFIDE Plus предоставляют надежную оценку генетических факторов риска по экономически важным заболеваниям Голштинского скота.
- Использование индекса доп. прибыли от состояния здоровья лактирующих коров DWP\$ предлагает возможность выбора, сравнимую с индексом NM\$ (Индекс доп. прижизненного уровня дохода). Это сходство делает DWP\$ практическим решением для производителей, которые традиционно использовали другой индекс, но хотели бы применить дополнительное средство отбора по показателям здоровья.
- CLARIFIDE Plus предлагает широкий выбор инструментов генетического отбора, предоставляющий важную информацию для производителей молока, стремящихся к постепенному улучшению здоровья, продуктивности и рентабельности молочного скота.

ВВЕДЕНИЕ

Генетическая оценка и отбор в молочном животноводстве в основном сосредоточены на признаках продуктивности, таких как молоко и белок. Существуют косвенные показатели здоровья и оплодотворяемости (например, количество соматических клеток, продуктивная жизнь, уровень оплодотворяемости дочерей), и есть возможность достичь некоторого генетического улучшения этих признаков. Тем не менее, по-видимому, в результате генетических противоречий между показателями продуктивности и здоровья, а также изменений в практике управления, данные указывают на увеличение количества многих распространенных заболеваний в современной системе молочного производства^{2,3,4}. Следовательно, молочные коровы считаются менее "здоровыми", чем предыдущие поколения. Эта информация имеет серьезные последствия для здоровья и воспроизводства современных коров.^{5,6}

Прибыльные молочные коровы - это животные, способные к оплодотворению, продуктивные, требующие минимальных вложений для поддержания их здоровья. Как правило, им требуется меньшее количество врачебных вмешательств, без ущерба для здоровья, или экономической эффективности животного, также они менее подвержены ранней выбраковке.^{7,8} Программы генетического совершенствования, внедряющие сведения о различиях в риске заболеваний в стратегии селекции и разведения, способствуют повышению рентабельности молочного производства за счет совершенствования профилактики и контроля экономически важных заболеваний, а также увеличению продуктивности животных.

График 1: Заболеваемость коров.



Улучшение состояния и показателей здоровья с помощью генетической селекции представляет прекрасную возможность для производителей молока управлять заболеванием и improve profitability when coupled with sound management practices. To date, direct predictors for wellness traits related to common disease conditions in dairy production have not been readily available in the U.S. CLARIFIDE® Plus represents the first commercially available dairy

genetic evaluation specifically designed for wellness traits in U.S. dairy cattle, providing predictions describing the risk for six common diseases.

Routine dehorning of commercial dairy cattle is also of concern for the industry as it relates to animal well-being and costs associated with routine dehorning methods.^{9,10} The selection and breeding of polled stock has been proposed as a strategy for proactively managing these concerns, including use of direct tests for polledness in cattle as well as including the economic benefits within selection indexes.¹¹ CLARIFIDE Plus includes the Zoetis Polled genomic test prediction in the offering to accurately identify and differentiate homozygous vs. heterozygous polled Holstein animals.

Разработка прогнозов по показателям здоровья

Genomic predictions for wellness traits were developed by Zoetis based on an independent database of pedigrees, genotypes and production records assembled from commercial dairies and internal assets. Health events were assembled from on-farm dairy production records provided with consent by commercial dairy producers. Data editing procedures to reduce recorded disease incidence to a common format were developed based on review of event codes in on-farm software and consultation with dairy production and veterinary experts. Targeted phenotypes included:

- Мастит (MAST)
- Хромота (LAME)
- Метрит (METR)
- Задержка последа (RP)
- Смещение сычуга (DA)
- Кетоз (KET)

All diseases were defined as a Holstein female diagnosed with the respective disease one or more times in a given lactation on the basis of qualifying event codes in on-farm dairy software in the case of commercial data, or clinical research records in the case of internal research assets. As of August 2015, the database used to derive CLARIFIDE Plus predictions incorporated, primarily large commercial U.S. dairy operations from across the nation and included more than 10 million lactation records; 4 million cases of mastitis; 3 million cases each of metritis, retained fetal membranes, displaced abomasum, and lameness; more than 1.9 million cases of ketosis; and more than 15 million pedigree records. Additional records are continuously added to this database on a monthly basis from producer-supplied farm records.

Genomic data was obtained from commercially tested animals with owner consent or available genotypes within Zoetis research databases. More than 100,000 genotypes were available for consideration as of August 2015. Additional commercial genotypes are added on a weekly basis. Genotypes included in the evaluation were derived from both low and medium density genotypes, all imputed to Illumina®

BovineSNP50v2 using an internal imputation reference set and FImpute.¹²

CLARIFIDE Plus predictions are derived from a weekly internal genetic evaluation that employs single-step statistical methods for estimating genomic breeding values. This method for genetic evaluation derives a joint relationship matrix based on pedigree and genomic relationships and provides a unified framework that eliminates several assumptions and parameters, thus enabling more accurate genomic evaluations.¹³ Table 1 shows the average reliability of genomic predictions for wellness traits in CLARIFIDE Plus. Among approximately 29,901 Holstein heifers less than 2 years of age within the reference dataset, the average reliability was greater than or equal to 49% for all traits. Notably, as direct predictions for individual wellness traits are not presently available, this represents a substantial increase in reliability from zero. Further, the average reliability of genomic predictions for wellness traits continues to increase as more records are added to the evaluation.

Таблица 1: Достоверность геномных прогнозов по показателям здоровья молочного скота на основании данных о 29901 телках Голштинской породы возрастом до двух лет.

Показатели здоровья молочного скота	Средняя достоверность	Стандартное отклонение	Минимум	Максимум
Мастит	51	6	19	65
Хромота	50	6	18	65
Метрит	49	6	18	64
Задержка последа	50	6	18	64
Смещение сычуга	49	6	18	64
Кетоз	50	6	18	64

Таблица 2: Геномные стандартные передающие способности (STA) по показателям здоровья на основании данных о 76840 животных с прогнозами о показателях здоровья и результатами CLARIFIDE.

Показатели здоровья молочного скота	Среднее	Стандартное отклонение	Минимум	Максимум
Мастит	100	5	76	115
Хромота	100	5	73	115
Метрит	100	5	75	115
Задержка последа	100	5	71	116
Смещение сычуга	100	5	69	111
Кетоз	100	5	72	113

REPORTING OF WELLNESS TRAITS IN CLARIFIDE PLUS

CLARIFIDE® Plus predictions for wellness traits are expressed as genomic standardized transmitting abilities (STA), similar to how type traits are expressed. Values are centered at 100 with a standard deviation of 5. The reference population included 76,840 animals that had wellness predictions and CLARIFIDE results (Table 2). For all wellness trait predictions, a value of 100 represents average expected disease risk and values of greater than 100 reflect animals with lower expected average disease risk relative to herdmates with lower STA values. Higher values are more desirable for all traits, thus selecting for a high STA will apply selection pressure for reduced risk of disease.

CLARIFIDE Plus predictions for the Polled test will be reported as:

- Tested homozygous polled: The genotype demonstrates that the animal is homozygous polled and will always produce a polled animal regardless of the horned status of the other parent. (Coded PP)
- Polled carrier: The genotype reveals a heterozygous polled animal capable of producing a horned progeny. (Coded PC)

- Tested free of polled (i.e., horned): The genotype is consistent with an animal that is horned. (Coded TP)
- Indeterminate: The polled status of the animal cannot be definitively determined. (Coded I)

TWO NEW DAIRY WELLNESS INDEXES

In addition to reporting of individual wellness traits, CLARIFIDE Plus also reports two economic selection indexes to inform selection decisions. Selection indexes are a critical component of many selection strategies as they provide a path for dairy producers to select for comprehensive genetic improvement across many economically important traits. The use of economic selection indexes helps to ensure that the distribution of selection pressure applied to component traits is appropriately balanced relative to the economic impact of the individual traits on dairy profitability.

To support selection for reduced risk of disease in dairy females, two economic indexes were developed.

- *Wellness Trait Index (WT\$)*: This multi-trait selection index exclusively focuses solely on the wellness traits¹ (Mastitis,

Lameness, Metritis, Retained Placenta, Displaced Abomasum, Ketosis² and Polled) and directly estimates potential profit contribution of the wellness trait for an individual animal that will be passed onto the next generation.

- *Dairy Wellness Profit Index (DWP\$)*: This multi-trait selection index includes production, fertility, type, longevity, calving ability, milk quality and the wellness traits, including Polled test results. By combining the wellness traits with those found in the current Net Merit (NM\$) index, DWP\$ directly estimates the potential profit contribution an individual animal will pass along to the next generation.

The economic indexes in CLARIFIDE Plus were derived using standard selection index theory.^{14,15} Economic assumptions were derived from those used in NM\$¹⁶ for the case of core traits, and from a review of peer-reviewed literature for wellness traits.^{9,10,16-24} Economic values for health traits that are considered in the derivation of NM\$ were removed to avoid double-counting of the contributions of disease to dairy profitability. Economic values were then adjusted within the range of reported values based on the covariance among traits to achieve the final index weights.

To assess the extent to which use of CLARIFIDE Plus wellness trait indexes would alter selection emphasis relative to use of NM\$, the expected response to selection per standard deviation of genetic improvement in the index was estimated.¹⁴ In examining the response of selection between DWP\$ and NM\$, it is clear that use of DWP\$ will result in greater genetic improvement in wellness traits and largely the same selection response for the rest of the traits. There is some decrease in selection

emphasis and expected genetic progress for production traits associated with the use of DWP\$ (Table 3), which is consistent with our understanding of the relationship between increased production and disease risk.²⁵ However, selection using DWP\$ will increase milk, fat and protein production, just at a slightly lower genetic rate than would be achieved with alternative indexes that do not consider direct selection for wellness traits. Importantly, the use of DWP\$ would be expected to offer very similar selection emphasis to that achieved by NM\$, making it a practical consideration for producers who have historically used NM\$ but would like to apply additional selection emphasis on wellness traits to achieve healthier, more profitable cows.

Table 3: Expected response to selection expressed in units of the underlying trait associated with selection using NM\$ and DWP\$ when average NM\$ and DWP\$ are increased by one standard deviation.

Показатель	NM\$	DWP\$
MILK	246	200
FAT	16	14
PROT	10	9
PL	1.7	1.7
SCS	-0.06	-0.06
BDC	0.01	-0.02
UDC	0.25	0.21
FLC	0.18	0.16
DPR	0.60	0.69
CA	8.32	8.40
HCR	0.56	0.53
CCR	0.89	0.94
MAST	0.86	2.09
MET	1.64	2.37
RP	-0.01	0.41
DA	1.72	2.05
KET	1.69	2.04
LAME	1.04	2.02

Таблица 4: Показатели, экономические и относительные значения по двум индексам показателей здоровья и NM\$ (Индекс доп. прижизненного уровня дохода)

Показатель	Относительное значение (%)		
	NM\$	DWP\$	WT\$
Мастит	0	12	41
Хромота	0	8	27
Метрит	0	6	19
Задержка последа	0	2	6
Смещение сычуга	0	2	6
Кетоз	0	<1	1
Молоко	-1	2	0
Жир	22	17	0
Белок	20	15	0
Продуктивная жизнь	19	13	0
Кол-во сомат. клеток	-7	-3	0
Размер тела	-5	-3	0
Вымя	8	5	0
Ноги/копыта	3	2	0
Уровень оплодотворяемости дочерей	7	5	0
Уровень оплодотворяемости телок	2	1	0
Уровень оплодотворяемости коров	1	1	0
Способность к отелу\$	5	3	0

Table 4 defines the relative values for component traits in each of the two wellness indexes. All indexes are expressed in a dollar value with higher positive numbers indicating the animal has the genetic potential to generate and transmit more profit over her lifetime.

ЗАКЛЮЧЕНИЕ

Dairy producers have enjoyed the availability of a comprehensive list of economically relevant traits and a robust genetic evaluation system to fuel their genetic improvement strategies. To date, a gap has existed in the ability to improve dairy profitability and dairy cow well-being through direct genetic selection for susceptibility to common diseases. CLARIFIDE® Plus provides accurate genetic predictions for wellness traits derived using cutting-edge genetic evaluation methodology applied to data collected from commercial production settings. The result is an expanded suite of genetic selection tools that provides highly relevant information to dairy producers that seek to continue to improve the health, productivity and profitability of the dairy cattle they care for.

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