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ANALYSIS OF GENETIC RELATIONSHIPS BETWEEN CHARACTERISTICS OF PERFORMANCE TESTING OF YOUNG BULLS AND THE PROGENY TEST OF OFFSPRING'S AT THE GERMAN HOLSTEIN

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1. Background of the Research, Objective

The German Holstein farming is currently characterised by a high level of genetic predisposition in the milk yield meet an insufficient breeding progress in the functional traits of the animals. The high amount of animal health disposal, revenue losses due to deficiencies in the functionality of the animals as well as increasing factor inputs for animal health have a constant negative effect on the profitability of dairy farms. As a result, the priorities of animal breeding in dairy farms include the improvement of the physical appearance and maturity of the animals before first calving, reduction of physical deficits postpartum, improvement of the robustness and durability during lactation, reduction of locomotion deficits, correction of the negative trends in the herd fertility, reduction of metabolic depression and the general improvement of animal health and animal welfare.

Practical experience underlines that poor physical characteristics of feet and legs of breeding animals are the key causes for low animal performance. At the same time, crucially, cows in the first lactation do not correspond to the demands of high level dairy production. In the past few years the rapid implementation of the genomic breeding value estimation in the Holstein breed has shown to work towards promising approaches to accelerate the improvement of the functional characteristics in the herds. However, the rigorous emphasis on genomic breeding values in the selection of breeding animals neglected the phenotypes of the Holstein AI sire. The reasons for this are among others known to be in the increasing milk yield investment in the herds and possibly in the emphasis on the genomic breeding values in the selection of breeding animals.

The rigorous implementation of genome-based selection for AI sire and the bull dams in recent years led to the gradation of the rank of phenotypes in the animal selection process. But it is showed that the phenotype presented, among the existing high standards of environmental conditions, an illustration of the genetic predisposition, including the ability of animals to adapt to the environment to (stability of immune system, susceptibility to diseases).

In the present situation of improving selection to genomic breeding values, it would seem very important if solid genetic correlations between the phenotypic performance parameters of AI sire and the production characteristics of their daughters could be presented. Advantage would be also to question the importance of phenotypes in the breeding animal selection under the terms of the genomic based breeding schemes.

Based on this objective, rearing data of Holstein AI sire were analysed regarding physical characteristics, feet and legs, registered for many years in a German central test station (Meissen-Korbitz, MASTERRIND GmbH). The corresponding performance data of bull offspring's in the dairy production (milk yield, fertility, physique, animal health) were also analysed.

The aim of the study is to investigate the approaches to positive designing of functional characteristics in high performance dairy herd. In addition, the importance of phenotypes in the AI sire selection breeding strategies, under the conditions of the genomic breeding schemes, will be studied. Of importance in the analysis it is to discuss about on current issues of social claims and demands on a sustainable animal breeding. In the foreground are the causalities to the performance factors, for animal welfare and animal health.

The following priorities are pursued in the presented study:

1.) Breeding approaches to improve functional traits as well as the animal hygienic status in the dairy herds.
2.) Breeding approaches to consolidate high milk yields in dairy herds.
3.) Breeding approaches to minimize the risk of mobility problems in the cow herds.
4.) Based on the results to formulate solutions for positively influence the functional traits in the dairy herds

2. Materials and Methods

In the analysis were included the phenotypic rearing parameters of Holstein AI sire (n= 1.626) as well as the performance data of the sire's offsprings (n= 175.603) and the control animals (n = 355.214) of the test cohort from the performance testing in the field. The tested parameters of breeding AI bulls come from the former Central bull test station in Meißen-Korbitz (MASTERRIND GmbH, Germany), as well as the female progeny testing performance data from 533 dairy farms. To achieve a degree of safety in the sayings, established a minimum number of 25 daughters was based on sire selection. Furthermore, the number of daughters was limited by the restriction of the use of artificial insemination bulls to one year after the start of the test use in the herds. The selected animals for analysis come from the Holstein population of the regional breeding Association (SRV, Sächsischer Rinderzuchtverband e.G.) in the period 1995-2008.

2.1. Data base

Phenotypic parameters of AI sire

From the 52 audited performance parameters of the central rearing of potential candidates insemination were selected 24 phenotypes as the main focus of breeding for the dissertation. The analysis focused on the bull parameters in physique and in the feet and legs of the animals. In turn, for the presentation of research results, emphasis was placed on the main parameters of the breeding suitability test (breeding approval) of the young bulls. This focus was chosen, because directly after the breeding suitability of the young bulls was started the AI usage in the dairy herds. The following 12 phenotypes in body and feet & legs were considered:

The audited phenotypic parameters were **STATURE** (cm), **PELVIC WIDTH** (cm), **LIVE WEIGHT** (kg), **DAIRY TYPE** (points 65 to 100), overall assessment **BODY** (points 65 to 100) and **MUSCULARITY** (breeds specific assessment of the body muscle mass; grade 1 *low* to 9 *very strong*). The feet and legs parameters were **DIAGONAL** (claws length of diagonal side, mm), **HEEL DEPTH** (claw feature, grade 1 *very low* to 9 v*ery high*), **BALANCE of CLAWS** (claw feature, grade 1 *very closely* to 9 *extremely open*), **ANGLE PASTERN** (limbs, grade 1 *strongly depressed* to 9 *extremely steep*), **RLCV** (limbs, rear legs, side view; grade 1 *strongly angled* up to 9 *extremely steep*), **RLRV** (limbs, rear legs, rear view; grade 1 *hocks up* 9 *parallel)* and overall assessment feet and legs **FOUNDATION** (points 65 to 100).

Performance data of progeny testing

From the progeny testing of offspring's in the field the performance parameters of the production areas milk production, fertility, body, foundation and animal health have been incorporated into the analysis. From the *Animals Health Test Systemof Saxony* was daughters of sires in the first lactation (n = 21.841) filtered with disease diagnoses. The calculation of sick days was considered as a characteristic of the daughters in the study. The parameters of animal health were **MASTITIS**, **LAMINITIS**, **MORTELLARO** *Dermatitis Digitalis*, **PANARITIUM** *Interdigital Phlegmona dermatitis*, **ENDOMETRITIS** and **CYCLE DISORDER.**

Pedigree data

In the genetic analysis of the study were considered the pedigree data by 538.956 animals in the previous generations. Due to the limited computational resources and the size of the systems of equations, the lineage of animals accepted was limited to the first 3 generations. The completeness of the descent file was placed in the 1st generation at 98%, in the 2nd generation at 95%, and in the 3rd generation at 85%. The mean inbreeding coefficient in the first three generations was reported at 1.89%.

2.2. Software

The descriptive statistics of the data was performed using the SPSS 19 program, the control of environmental factors was performed using the SPSS 19 procedure *factor analysis* and for the variables with the *curve-fitting* procedure for the determination of the regression function of the variable. The modelling was carried out on the basis of significance (T-test) of the factors as well as the goodness of fit (R^2) of the possible regression function of the variables. The estimation of genetic population parameters in mixed linear animal model was performed univariate and bivariate means of the program VCE 6.0.

The control of the estimates and the model evaluation were performed with the software package SAS 9.2 and for the binary features and categorical features with the software program ASREML 2.0.

2.3. Methodology

The main method of analysis is based on the estimation of direct genetic links between the different phenotypic characteristics of the tested breeding and phenotypically tested features of the Bull daughters. The total data matrix (characteristic values, factors, variables, pedigree) formed the basis of genetic parameter estimates for the population.

From the univariate estimate (one feature model) was the Heritability (h^2) and the estimation standard error (h^2 se) used in the analysis. The estimated Heritability (h^2) represents this usable breeding segment of the variation of a trait of considered regional population. All selected animals were tested in this parameter, were incorporated in the univariate estimate. In particular in progeny testing the bull's daughters were, to the increased safety of the estimation results, (n = 175.603) as well as the correspondent animals (n = 355.214) integrated the testing cohort in the investigation.

From the bivariate estimate (two characteristic model; Feature X *bull* and feature Y *daughter*) were the results of Heritability (h^2) estimation error of the Heritability (h^2 se) genetic correlations (r_g), and estimation error of the genetic correlations (r_g se) used for the discussion. The amount of estimation results in the bivariate Calculator (genetic correlation, r_g), the corresponding amount of estimation error (residual effects; r_g se) as well as the status of the VCE calculation (only State 1, completed distribution of the variance in additive-, environmental, the residual variance), were based on the discussion on possible usable effects. The genetic correlations (r_g) resulted from the additive genetic covariance of two characteristics (KOV) and its additive genetic variances (r_g = KOV / (σ X * σ2Y)).

2.4. Statistical models

For genetic analyses were conducted a general discussion about of the model and a model design for the breeding parameters of AI sire and of animals in progeny testing. The amount of data the overall study, the available computing capacity and the size of the system of equations in the overall matrix restricted while a model selection for the estimation of population genetic parameters with VCE. Based on the mixed linear animal model was performed to model the observed performance parameters. The general model discussion welcomed the selection of mixed animal models, since the influence of fixed and random effects to a continuous feature can be considered in a model simultaneously and the systematically environmental influences and the animals can be considered as random as fixed effect. The following equation describes the basic model with the following content: $Y = X ß + Zu + e$

Specifics:

Y = vector of unknowns, to estimated effects fixed

ß = P x 1 vector of unknowns, to estimated effects fixed

u = q x 1 vector of unknown to estimated incidental effects

e = n x 1 vector of unknown random residual effects

X = n x p known attempt plan matrix of fixed effects

Z = n x q test plan matrix of fixed and random effects.

The modelling was carried out on the basis of an examination of the factors with SPSS 19.0 (SPSS *factor analysis*), as well as a determination of the regression function of covariates (SPSS *curve fitting*). The significance of the factors as well as the measure of goodness of fit (R^2) of the possible regression function was crucial for the development of the individual models.

3. Results

The analysis of phenotypes of AI sire shows that breeding characteristics of insemination bulls represent promising approaches to positively affect the genetic predisposition of the amount of milk and the functional characteristics in future breeding groups. In particular, show the phenotypes *MILK TYPE*, *MUSCULARITY*, *BODY*, *DIAGONAL*, *CLAW BALANCE*, *PASTERN* and *FOUNDATION* for breeding maturity of the AI sires useful effects and additional information would be of mating of a genomic selected young bulls.

3.1. Breeding approaches to improve functional properties as well as the animal hygienic status in the dairy herds

The genetic relationships among the daughter's characteristics demonstrate that a targeted breeding and selection according to their phenotypic parameters of pre-selected Holstein AI sire does not negleet its importance even under the conditions of the genomic breeding value estimation. Primary consideration, inter alia, the animal health, vitality and immune stability of potential young bulls, the determinant is reflected in the phenotypes.. Especially true this fact among other things, due to the susceptibility, resistance under the given environmental conditions of the bulls that causes the calf and young cattle rearing problems in the dairy farms (pneumonia, respiratory diseases, diarrhoea, robustness, resistance). Since this causality in turn closely they are linked to the daily feed intake, weight gain and its consequences on the lactation health monitoring of animals. Therefore, it is necessary to selection at animal health deficits in the rearing of young bulls. The complexes characteristic *BODY* and *FOUNDATION* of bulls for breeding maturity would be to work quite well, because they contain information on development, animal health and environmental stability.

Accordingly also increasing freedom of movement of animals in farming would prove to be cheap in terms of vitality and the breed-specific muscles. Since the muscle structure of animals is closely connected with the movement and the muscling good transferable (h^2 0.38) on the muscles of the daughters could about the design of the attitude of the Bull breeding positive effects in the calf rearing and in the first lactation daughters the robustness and resistance can be achieved (strength/ brisket wide r_g 0.54; body deep r_g 0.40; BCS r_g 0.37).

Reaffirms these results, as well on the quality of AI bulls parameters corresponding to the daughters in 1st lactation in the body (r_g 0.40 to 0.90) and in the foundation (r_g 0.38 to 0.65) can be derived. Decide in the body features here, so the results are the key rearing elements *daily feed intake, daily weight gain* and the genetic predisposition of breed-specific *dairy type* and *muscularity* for the development and characteristic proportions of young cattle. By similar evolution female and young male bovines to sexual maturity are targeted rearing of young animal development in animal size, body frame, live weight and muscularity in respecting to the dairy type.

The use of the variance in the *DAIRY TYPE* and *MUSCULARITY* in the exterior parameters of AI bulls formed as interesting. The results show that with increasing *DAIRY TYPE* of insemination bulls to milk yield (r_g 0.46), dairy type (r_g 0.25) and dairy character (r_g 0.25) improves the daughters of Bull, but tends are reduced to be the strength (r_g -0.51), body depth (r_g -0.40), BCS (r_g 0.31) and thus also the muscularity (young animal rearing, milk type to muscling, r_g 0.21).

Positive trends in increasing *DAIRY TYPE* $_{sire}$ of the daughter's body features, at parallel higher genetic predisposition in the milk yield and dairy character in the herds, would cause negative effects on the current animal health in the herds. So would increasingly question the metabolic stability of the daughter's *post-partum* through the necessary but non-existent reserves (BSC, feed intake, weight to calving, muscling). Consequently, the heifers and the young cows cannot compensate this stress situation and it increases the probability of subclinical and clinical adverse effects of animal health. In practice are including acidosis, ketoses, diseases of the upper respiratory tract, abomasum displacement, somatic cell count and also, as in the present study confirmed, the laminitis diseases (*DAIRY TYPE* $_{sire}$ (score 65-100) - laminitis $_{daughters}$, r_g 0.34;) *DAIRY TYPE* $_{sire}$ (scale 1-9) - laminitis $_{daughters}$, r_g 0.71). A consideration of muscling the heifers, so the results, would against not only health risks (negative energy balance in metabolism) they act would constitute a pre-condition for further physical development and maturity of animals from the first to the second lactation.

Since the *DAIRY TYPE* represents a guarantee for milk production (*DAIRY TYPE* $_{sire}$ (score 65-100) - milk yield $_{daughters}$, r_g 0.35; *DAIRY*

TYPE $_{sire}$ (scale 1-9) - milk yield $_{daughters}$, r_g 0.73) and therefore correlated with performance depressive factors of young cows is targeted and strategically to deal in mating system with *DAIRY TYPE* and *MUSCULARITY* of AI bulls.

Table 1: Summary results of the VCE estimate between phenotypic characteristics of the rearing of insemination bulls and the production characteristics of the daughters of AI Bulls (genetic correlations r_g, *targeting variance of characteristic value*)

		CHARACTERISTICS OF AI SIRE					
		STATURE *small - large*	PELVIC WIDTH *narrow - broadly*	BODY *poor - good*	DAIRY TYPE *low dairy - extremely dairy*	MUSCULARITY *low- strongly*	LIVE WEIGHT *low- very high*
PARAMETERS OFFSPRINGS	Stature	0,90					
	Body Strength	0,46			-0,51	0,54	0,12
	Body Depth				-0,40	0,40	0,20
	BSC	-0,22			-0,21	0,37	0,29
	Dairy Type	0,41	-0,12		0,25	-0,14	
	Overall Classification	0,60	0,34	0,21	0,55	0,15	
	Calving Ease	0,11			0,12	0,11	0,17
	Endometritis		-0,36	-0,42		0,31	
	Laminitis			-0,13	0,71		
	Out Time*	0,19		-0,45			
	Cycle Activity				-0,34	0,39	

*Time between calving and insemination

First insemination weight (not less than 400 kg) and first insemination age (not under 16 months) by daughters with high milk type should be aligned with enough of body condition and animal maturity to the first calving. Good muscling of AI bulls would generate in the future daughter's effects in strength, BCS, and pelvic width and would contribute to improving robustness and resilience in the phase post-partum of young cattle's. Effects of a good muscling and a simultaneous low reduction of the dairy character of the daughters would continue contribute to lesser calving interval about improved cycle activity (*MUSCULARITY* $_{Sire}$ - cycle inactivity $_{daughters}$, r_g - 0.39) (hormone secretion, follicular phase, oestrus, luteal phase) and therefore also effects on the effective usage time of the animals. But the increasing of muscularity of future offspring would only produce success in certain of characteristic wide. The danger of increasing BCS through higher feed intake and test tags increase by young bulls (muscling and adiposity in lower dairy type) includes following effects: to increasing problems calving ease (r_g 0.11), increasing stillbirth rate (r_g 0.17) and increasing veterinary costs by violation of the pelvic area of young cows (*MUSCULARITY* $_{Sire}$ - Endometritis $_{daughters,}$ r_g 0.31).

The phenotype parameters of AI sire *STATURE, PELVIC WIDTH, DAIRY TYPE, BODY,* body *MUSCULARITY* and *FOUNDATION* also has a significant reference to the overall classification of the offspring's (r_g 0.34 to 0.60). A future consideration of these AI sire parameters would also bring advantages in the livestock sale.

3.2. Genetic approaches to the consolidation of high milk performance in dairy cattle

The results of the study show that larger compact developed young cows in the first lactation with breed specific Dairy type and Milk character have higher quantities of milk yield with corresponding lower milk ingredients. This positive effect could be demonstrated on milk yield in the use of information the Bull features *STATURE, BODY DEEP, PELVIC WIDHT, BODY,* body *MUSCULARITY.*

Further results of the study in the rearing of the AI sire conformation in many respects confirm the genetic relation to milk yield of the daughter in the 1st lactation. (Tab.2) But also the relation through the increasing functionality in the physique (harmony in the body, *BODY)* on the milk yield in the following lactation would be show information to evaluate and improve milk yield in the future.

Table 2: Genetic correlations ($r_{g)}$ between the exterior parameters of young Holstein AI sire to milk yield (completed lactation) in the offspring's

AI sire parameter	milk yield **1. -3. Lactation** r_g (r_g se)	milk yield 1.Lactation r_g (r_g se)	milk yield 2.Lactation r_g (r_g se)	milk yield 3. Lactation r_g (r_g se)
Stature	0.11 (0.08)	0.15 (0.16)	0.28 (0.19)	**0.47** (0.23)
Body Depth	0.03 (0.12)	-0,08 (0.13)	0.28 (0.28)	0.40 (0.18)
Pelvic Width	0.04 (0.07)	0.32 (0.18)	0.25 (0.13)	0.19 (0.44)
Body (65-88)	0.70 (0.16)	0.70 (0.12)	0.47 (0.23)	0.63 (0.40)
Dairy Type (65-88)	0.46 (0.19)	0.11 (0.10)	0.40 (0.26)	0.70 (0.38)
Muscularity (1-9)	0.38 (0.12)	0.55 (0.10)	0.28 (0.21)	0.30 (0.33)

Consequently, would be an improved functionality in the body at the beginning of the lactation minimized the performance depression factors and have the same time synergistic effects on the milk yield.

3.3. Breeding approaches to minimize the risk of mobility deficits in the cow herds

The results confirm particularly through the relations of functional features and functionality of the movement sequence the *DIAGONAL* length of AI sire breeding value. A mating with AI sire with above-average length of claw, would contribute negative effects (increasing disorder days) on the hoof disease of Laminitis (r_g 0.35) and Mortellaro (r_g 0.23) cause as well as a deterioration in the functionality of the locomotion system (DIAGONAL $_{sire}$ - locomotion $_{daughters}$, r_g - 0.43) significantly influenced the hind leg position (DIAGONAL $_{sire}$ - RLRV $_{daughters}$ (rear legs, rear view), r_g - 0.55) and hock quality (DIAGONAL $_{sire}$ - hock quality $_{daughters}$, r_g - 0.31). An increasing diagonal length of the rear outer claws of the daughters could further the already genetically determined changes in the rear outer claw post-partum (growth thrust to weight balance, stability during locomotion, weight shifting in the hindquarters) exacerbate. Also, the energy consumption in the metabolism of post-partum the already existing vulnerability of laminitis would increase. In the results of genetic effects to the functionality in the area well present resistency and locomotion of the young cows ends the diagonal length of AI bulls is an option feature.

The *HEEL DEPTH* is a defining part of characteristic of the performance parameter of foot angel, which is integrated in the current breeding value estimation. The bull's *HEEL DEPTH* accordingly to a high moderate genetic relation to the daughter's sign foot angle (r_g 0. 49). An attention of *HEEL DEPTH* of insemination bulls owns a relation on the functionality of the daughters in the movement (*HEEL DEPTH* $_{sire}$ - Locomotion $_{daughters}$, r_g 0. 22) caused by the effects of the more *RLCV* (rear legs, side view) (*HEEL DEPTH* $_{sire}$ - RLCV $_{daughters}$, r_g -0.24), more firmer and steeper pastern (*HEEL DEPTH* $_{sire}$ - pastern $_{daughters}$, r_g 0. 22) and narrower balance of claws (*HEEL DEPTH* $_{sire}$ - balance of claws $_{daughters}$, r_g -0.44). The results show in the bull's signs to *HEEL DEPTH* usable tendencies effects to the decrease of the claw illnesses Mortellaro (r_g -0.19) and Panaritium (r_g -0.25) of the daughters. A possibility about a higher HEEL DEPTH in the offspring groups at illness Laminitis were to be influenced by the height of the standard error (r_g se) not unambiguously presentably (HEEL DEPTH $_{sire}$ - Laminitis $_{daughters}$, r_g -0.23/r_g se 0.19). Therefore, a simultaneous influence of the layer thickness of the buffer between epithelium and claw leg horn with increasing heel height of the claws to reduce Laminitis susceptibility in the daughter groups could not be shown.

The feature CLAW BALANCE of sire has a breeding noteworthy importance through the genetic correlations to claw diseases Panaritium (r_g 0.42) and to hock quality (r_g -0.39) of the daughter's diseases. Effects of over open CLAW BALANCE of sire consequently lead to the deterioration of the harmonic movement (Locomotion, r_g -0.26) as well as to low grade in the overall evaluation of foundations (r_g -0.24) in the daughter groups. Due to its moderate heritability in the rearing of young animals (h^2 0.21 to 0.35) and by the high genetic relation between the analogy features of father and daughter (r_g 0.65; r_g se 0.13), there is the breeding feature of AI bulls be very influential on the foundation health of daughters. From a breeding point of view, in terms of animal health and welfare of livestock, must be a rigorous breeding out of all sire in the preselection of young bulls and in the selection of AI bulls with tendency in claws quality of straddle claw.

Table 3: Summary results of the VCE estimate between phenotypic characteristics of foundation (feet and legs) of AI bulls and the production characteristics and Characteristics of the functionality of the daughters of AI Bulls (genetic correlations r_g, *targeting variance of characteristic value*)

		FEET & LEGS PARAMETERS OF AI SIRES					
		BALANCE of CLAWS *extremely open - very closely*	REAR LEGS, SIDE VIEW *strongly angled up - extremely steep*	REAR LEGS, REAR VIEW *hocks up - parallel*	ANGLE of PASTERN *strongly depressed - extremely steep*	DIAGONAL *long- short*	FOUNDATION (feet & legs) *poor- very good*
PARAMETERS OF OFFSPRING'S	**Hock Quality** *filled- dry*	0,39		0,48	0,65	0,31	0,32
	Quality of Pastern *soft-fixed*	0,46	0,83	0,25	0,30	0,15	0,44
	Balance of Claws *open - very closely*	0,65	0,82	0,55	0,39	0,24	
	Locomotion *uncertainty- safely*	0,26	0,56		0,26	0,43	
	Mastitis *day of ill*			-0,71		-0,21	
	Mortellaro *day of ill*	-0,19		-0,61	-0,38	-0,23	
	Panaritium *day of ill*	-0,43					
	Laminitis *day of ill*		-0,35	-0,63		-0,35	-0,31

RLRV (rear legs, rear view) and *RLCV* (rear legs, side view) are determining factors in the movement of the animal and show significant relations for deficits in bad positions and significant relationship with the animal health, the mechanism of the motion sequence and to the overall foundations in the female daughters groups. The results show a strong correlation between the characteristics of father and his daughters (rear legs, side view, r_g 0.38; rear legs, rear view, r_g 0.61). Quality deficits in terms of limbs and in the movement joints in the dairy herds are targeted to influence by the AI sire selection. In this case, it shows practical experience is a narrowing of the variance in a specific range of the rear leg set and -angel in the offspring necessary, depending on the housing systems and floor. About the AI sire selection for these parameters useful for reducing the effects of laminitis are still possible. With steeper rear leg angulation and increasing parallelism in the hind leg position can thus be achieved through a targeted design of the hind limbs, the pressure distribution on the pairs of claws, a reduction of the stress-laminitis. A suitable choice of sire would also bring improved animal health effects (Animal Welfare) with itself, with respect to pain and inflammation of the joints movement and pain in the movement.

The *PASTERN* was an optional feature in the rearing of young bulls and later AI bulls. The feature has been tested in the test station to respond to shortcomings in the field angle and strength of the hind limb Pastern in the herds. The practice shows that bad qualities in Pastern, under loose housing, leading to a reduced-functionality in motion and these deficits developed with increasing lactation as the primary reason for culling for these animals. There were genetic effects between the sire feature *PASTERN* and the claw balance of the daughters (0.39 r_g). Genetic deficiencies in *PASTERN* (increasing angulation) at AI bulls cause in the future breeding's deterioration in *PASTERN* (straddle claw). The use of AI bulls with deficiencies in *PASTERN* the qualities hocks of daughters (r_g 0.65) as well as the overall foundation (r_g 0.46) would also deteriorate. This would not only cause a general degradation of the foundation but also have a strong effect on the health of the movement joints, pain in the motion-reduced animal welfare and a higher probability of a shorter longevity. Similar to the low grades in the CLAW BALANCE also a strict selection goal of young bulls or AI bulls must be issued for animals weaknesses in the quality of pastern have.

4. Conclusions

Breeding practice in dairy cattle shows that in the implementation of breeding strategies to improve physique, foundation and animal health in the herds, the most effective approach is the use of bulls on the mating. Factors (sire mating program, increasing selection intensity in the preselection of AI bulls) are done for the implementation of the population and have evolved over the past years. Further development will be particularly necessary in desired breeding progress in complex performance parameters in the low heritable area such as animal health and reproduction, foundation stability, robustness.. The phenotypes of the insemination bulls point useful approaches. As the most important statement of the present study is the confirmation of the need for breeding to consider the linear characteristics of stature, milk character, body depth, body strength, pelvic width and pelvic angle and the foundation parameter RLRV (rear legs, rear view), RLCV (rear legs, side view), claw angle, hock quality and locomotion in the current genome-based German breeding value estimation of AI bulls. Integration in the breeding value estimation of this genomic parameter of AI bulls could be confirmed in the present study, the shown coupling effects of phenotypic parameters of the bulls on the phenotypic parameters of his daughters.

Apart from the genetic parameters of the bulls that are integrated into the current genetic evaluation, the results show that the phenotypic breeding characteristics such as *DAIRY TYPE*, *MUSCULARITY*, *BODY* and the feet and legs parameters *DIAGONAL*, BALANCE CLAW, ANGLE PASTERN and FOUNDATION should be integrated in the current breeding value estimation. Results show, that phenotypic breeding characteristics of genomic preselection young bulls must be included in the breeding to improve the longevity of the Holstein population. In particular in the conducted breeding licensing of potential AI Bull candidates in the period from 2008 to 2010 was remarkable that the animal development and characteristics of the parameters in body, feet and legs approaches not correspond to the genomic breeding values. Causes for this included raising disorders, feeding behaviour, social behaviour, attitude problems and injuries, showed the tested phenotypes their preference to the genomic breeding values in sire selection. The complex features of BODY and FOUNDATION give indirect information about the resistence and robustness of the animals.

The study also identified that individual phenotype features of the AI-sire in physique and foundations have their specific effects on skeletal features, complex characteristics and the functionality of the offspring (including milk yield, locomotion and illness days). Complex features again show the direct genetic relationships of young bulls and their daughters little or no connection. Causes lie here, focusing on the sex-specific functionality of Body and foundation. This fact is also posing a challenge in the future of genomic breeding value estimation, to consider gender-specific factors in the linkage analysis. This would argue for a performance test in the phenotype characteristics of future AI bulls.

To increase the security of the genomic breeding values from the linkage analysis, it would be helpful to investigate all preselected Holstein bulls for performance in the conformation and funktional traits of daugters in special herds.

. Genomic breeding values of potential animals in the *DIAGONAL, BALANCE of CLAWS* and *ANGLE PASTERN* would be in the preselection of male embryos and AI sire an approach to improve the mobility and the foundation of health and to minimize the likelihood of joint disease. Furthermore, effects would affect the selection of intensity as well as the cost of the rearing.

At the same time, the results of the present study support the necessity to combine phenotypic and genomic breeding values in sire selection. Their synergy could be reflected in the sustainability of breeding work in dairy herds.

However, whether in the breeding program to take account of the examined parameters of gain is economically justified, it needs further investigations in the context of detailed planning breeding approaches. Furthermore it would be advantageous to emphasize studies on the musculaturity in the Holstein breed. In order to make a cost-effective and low-complexity performance test, the centrally organized examination of reproductive ability (suitability for service, sperm quality test) would be future use of bulls in the centre a platform of a possible performance test. This would not meet the positive effects of genomic preselection on the generation interval. Through a systematically organized performance test would benefit further increasing selection intensity in the bull generations.

5. New Scientific Results

1.) Rearing features *live weight*, *daily feed intake* and *breed specific muscling* of young bulls and later AI sires correlate closely with each other in the young animal development and have similar positive genetic effects on the body strength, body depth, BCS and milk quantity of the offspring's in the lactation and have negative genetic correlations on calving characteristics of the offspring's to first calving.

2.) The *milk type* of AI sires correlates positively with the illness days of the hoof disease of laminitis of the daughters.

3.) The phenotypes of *diagonal*, *balance of claws* and *angle pastern* of AI sires correlate positively with the functionality of the movement sequence, animal health and animal welfare of female offspring.

4.) Complex characteristics *body* and *foundation* of the young bulls and later AI sires give information about development and functionality in the areas of performance. This overall impression can be transmitted well through the coupling of the female offspring's.

6. Recommendations for practice

1. Phenotypic traits of the breeding bull candidates (conformation, gain, feed intake) have noticeable information on functional traits of their daughters.

   This information – combined by genome selection-can improve the effectiveness of selection, also at dairy cattle. It would be practical to analyze this possibility by economical calculations, and certain cases to make decision on extension of the system.
2. Central rearing of breeding bull candidates offers chance to register phenotypic information. According to genome-based selection also would be favorable to achieve central performance test of breeding bull candidates originated from

3. It would be practical to combine this with information on reproduction and health of daughters reared on test farms. According to such a structure may assure to stabilize milk production and functional traits.

4. Further investigations are needed to clarify such details as the balance of “dairy character” and “muscularity” and scale of muscularity and condition at calves, heifers and after the first calving.

7. Publications in the Context of the Dissertation

KLUNKER, M. und K. ULBRICHT, (2007):
40 Jahre Eigenleistungsprüfung von Jungbullen in Meißen-Korbitz. Rinderproduktion Heft 12, S. 12-14.

ULBRICHT, K., J. STEFLER, U. BERGFELD, R. FISCHER und M. KLUNKER, (2014): Analyse von Merkmalsbeziehungen in der Holsteinzucht. 1. Mitteilung: Beziehungen zwischen den Merkmalen der Äußeren Erscheinung sowie des Wachstums von Jungbullen und den Leistungen der Töchter. Züchtungskunde, 86, (4) S. 217–236.

ULBRICHT, K., A. Z. KOVÁCS und J. STEFLER, (2014): Investigation on the self-performance of young HF bulls, focused on body conformation, feed intake and live weight. Acta Agraria Kaposváriensis 18 (1), 1-13.

ULBRICHT, K., J. STEFLER, U. BERGFELD, R. FISCHER und M. KLUNKER, (2015): Analyse von Merkmalsbeziehungen in der Holsteinzucht. 2. Mitteilung: Beziehungen zwischen Fundamentmerkmalen von Jungbullen und Fundament- und Gesundheitsmerkmalen der Töchter. Züchtungskunde, 87, (2) S. 73–93.