

**INBREEDING AND HYBRIDIZATION INFORMATION
WITH DATA SHEET EXPLANATION
BY PAT TAYLOR**

T-TREE QUARTER HORSES
QUARTER HORSE DATA SERVICES
Tim & Pat Taylor
Kerrville, Texas 78028

I realize this letter may get rather wordy but please don't be put off by the term inbreeding vs. linebreeding as the inbreeding coefficient does not differentiate between the two terms. Also, this letter is written to try to help inform of the value of inbreeding and hybridization and one short letter cannot come close to explaining theories that have had volumes written about, I am simply trying to give an adequate introduction to certain breeding philosophies.

The enclosed is meant to give an advantage in predicting the breeding patterns and performance ability of certain horses and is a factual overview of the horse's pedigree. As you know, the breeding and training of horses is not black or white but has many variables. The enclosed Gene Search attempts to outline as many of the genetic variables as possible and give you an outline of the gene make-up of the specified horse. The given values are exact in that they have been calculated on the entire known pedigree of the specified animal. The values in no way mean that the specified animal will or will not excel in any one area but, as before mentioned, are a factual overview of the subject horse. The enclosed is a numerical aid toward breeding practices and to give you an advantage in the breeding shed and the performance arena over that of the "other" horse breeder/owner.

It is well documented that "linebreeding" strengthens characteristics as with linebred Poco Bueno horses which exhibit specific characteristics for more hill dog body type and muscling and also as with linebred Impressive horses which exhibit extreme muscling. Certain characteristics are "set" and inherited from generation to generation when linebreeding is continually practiced. Similar results for obtaining "set characteristics" can be obtained through proper "outcrosses" or by reducing the inbreeding percentage from that of the subject animal's parents AND by doing same you acquire ADDED mathematical hybrid vigor value over that of the simply inbred animal.

As presented in the book "The Horse" published by Freeman in 1990, used by many Universities for their genetics courses; Le. Texas A&M University and Tarlton University, the average Quarter Horse inbreeding coefficient amount in a random sampling of Quarter Horses (Fletcher 1945) was (1.70%) with King Ranch horses being significantly higher with an average of (4.9%). The average relationship among King Ranch horses, however, was (20.1 %), so that random mating of them would have resulted in an average inbreeding coefficient of (10%). Further studies in the 1980's show low

inbreeding levels in Quarter Horses of (1%) to (3%). Literature published by Ed Heimann circa 1990 established the average mathematical hybrid vigor value for quarter horses from (-1.2%) to (+1.75%) for (66%) of running quarter horses. Values above the established norm would have to be considered above average with mathematical hybrid vigor values above (1.80%) being considered above average and thus any horse having those values would have a mathematical advantage in the performance arena. Values above the norm in inbreeding coefficients would also have to be considered as desirable in that it would increase the predictability of each mating. A sampling of great producing inbred Quarter Horses would be King P-234 with (+3.41%) IBC, King Fritz with (+8.38%) IBC, Poco Bueno with (+5.24%) IBC, Easter King with (+7.59%) IBC, Be Aech Enterprise with (+7.57%) IBC, Bill Cody with (+18.10%) IBC, Wimpy with (+15.83%) IBC, Peppy with (+6.29%) IBC, Cutter Bill with (+5.87%) IBC, Pep-Up with (+7.09%) IBC, Leo (all-time top producing broodmare sire) with (+12.73%) IBC, Impressive with (+9.91%) IBC, Conclusive with (+10.86%) IBC Skipper W with (+7.29%) IBC, Easy Jet -SI 100- with (+4.01%) IBC, Jet Smooth -SI 100- with (+4.19%), and Top Deck (TB) with (+4.90%), Fast Smash -SI III- with IBC (+8.44%), Easy Dinero -SI 105- with (+5.25%) IBC. This random sampling should give you a feel for the impact of inbreeding/linebreeding and hopefully an idea of what a desirable value could be to increase the predictability factor of a stallion or broodmare for throwing specific traits.

If you have further interest in reading material about inbreeding, linebreeding and the fundamentals thereof you might be interested in obtaining copies of a series of articles written by John F. Lasley, PhD, Professor at the University of Missouri. Said articles were written for the Quarter Horse Journal in 1968 and '69 and though great strides have been taken in genetic research since the '60's these articles are informative and give a good basis for an understanding of genetics. The Quarter Horse Journal will copy same for you at a cost of approximately \$10.00. Said articles were named "Fundamentals of Genetics" by John F. Lasley and there was a series of (10) of them OR if you so wish you may purchase the book by John F. Lasley called Genetic Principles In Horse Breeding sold by Premier. Publishing, P.O. Box 137, Wamego. KS 66547-0137 (913) 456-2074 for \$12.95 plus shipping and handling. They are written in plain English and should be fair reading.

From history it seems to be inbreds or true 2-way or 3-way hybrids that excel in the breeding shed most consistently. We all know there are always exceptions to the "rule". When superior "selection" is practiced (BEST to BEST) "shotgun" bred horses can excel in the performance arena as well as the breeding shed but you must keep in mind that selection of superior performance horses was practiced and thus superior "genes" (additive gene action) were being inherited by get. This method of breeding can produce superior horses but keep in mind that this breeding method does not "consistently" reproduce. This selection process has to include evaluation of the entire pedigree not just the sire and dam, with each ancestor being superior, for the "odds" to work in your favor for this "type" of breeding program. Theoretically, approximately 1/2 of the genotype (gene make-up) for performance is due to additive genes (those traits readily measurable in the sire and dam, i.e. speed index, performance records for

cutting or reining, etc, or mating "Best to Best") and the other genetic 1/2 is due to non additive genes or hybrid vigor. Selecting stallions or mares for their performance record alone only estimates additive effects, or 1/2 of an individual's genetics. I read this as a 50/50 chance of producing a performer and if you look at the odds closer reality says that of those 50% who perform only 50% of those will excel OR only 25% of those foals produced will go on to the winners circle.

It is also interesting to note that the more traits you breed for in a horse the lower your probability of success in any one specific field of endeavor. An example is people who breed for cutting or reining or halter generally breed strictly with cutting ability, speed index or conformation for halter as the traits they want in the forefront of their breeding program. In general when breeding for cutting or racing ability people put little stress on conformation and breeding for conformation puts little stress on cutting or racing abilities, thus the saying "form to function" applies. If a breeder were to breed cutting horses and add the trait for a specific color or try for a halter horse AND cutting horse then the odds for success are DECREASED. The idea behind my mentioning this is that the FEWER specific traits you breed for then the more success you will have in your breeding program. ALWAYS breed for a conformationally sound animal but keep in mind that each added SPECIFIC trait you add to your breeding program increases the level of difficulty in obtaining the desired product. NOT IMPOSSIBLE JUST MORE DIFFICULT.

For any one ancestor to make any noticeable mark on his descendants that ancestor needs to contribute at least (10%) percentage of blood to the subject horse. So, for instance, a horse would have to have (10%) percentage of blood of King for King to have any influence in his performance abilities or physical makeup. For the ancestor King to have any influence on the subject horse's get the subject horse would have to have a minimum of (20%) percentage of blood of King for the subject horse's get to inherit (10%) percentage of blood of King from the subject horse. As above stated, if the subject horse is NOT linebred on King then the genes being contributed by the subject horse may be different with each breeding thus the need for linebreeding. These are minimum values and do not take into consideration the percentage of blood of King that the other parent may be carrying. The higher the percentages of blood of whatever ancestor you are linebreeding on then the more significant will be the influence of that ancestor on the subject horse.

We should always select superior horses for breeding but limiting our selection process to phenotype (ability) alone is limiting our chances of "consistently" producing superior performance horses. We know why inbreds produce consistently i.e., because their gene pool has been significantly reduced from the average populace and thus they predictably and consistently produce the same "set characteristics" with each breeding. Inbreeding on (1) or more superior individuals can increase our "additive gene action" for obtaining those superior performance genes AND give us more consistent type for "set" characteristics. Through inbreeding we can consistently "clone" the great horses of the past for a future worth owning.

All horses have defective genes and common sense tells us that when inbreeding we are reducing the gene pool. With the reduction of "different" genes and the addition of "matched" genes on pairs of chromosomes we have the advent of the higher possibility of inheriting a quantity of defective genes which when "matched" with other defective genes can become detrimental to the subject horse as such genes are exhibited. Defective genes can be translated into anything from crooked legs to the lack of the ability to thrive because of a suppressed immune system brought on by inbreeding depression. Inbreeding problems can generally be successfully side-stepped if people would make sure that the inbred they are breeding is superior in every way from performance to conformation, exhibiting only those characteristics which you want reproduced. He has to be superior to balance the scales against the inheritance of defective genes. As with the higher possibility of defective genes being inherited by and through inbreds so also comes the higher possibility of "superior" genes being inherited by and through inbreds. An inbred will consistently, reproduce himself and if that individual is superior then he should out produce the hybrid or any other type pedigreed horse consistently whatever he is bred to, and will excel in the breeding shed when linebred in that he will consistently produce himself EVERY time.

A note of interest on inbreeding. Horses have millions of genes on (64) chromosomes or (32) pair of chromosomes. For (1) matched pair of chromosomes you have millions of matched genes which is why only (1) matched pair or an inbreeding coefficient of (+3.33%) would give an animal the ability to throw "set characteristics" with each breeding whether it is linebreeding or outcrossing. Using only (1) gene as an example; each time bred an animal contributes (1) gene at a specific location on (1) chromosome of a pair of chromosomes. We do not know which chromosome of the pair the gene will come from. If the gene contributed to the foal is a "matched" gene which means the exact same gene at a specific location on a chromosome is matched on the other chromosome in the pair at the exact same location, then it doesn't matter which chromosome the gene comes from because the genes are identical. If the gene is NOT a matched gene then you will have a 50/50 chance with EACH breeding (each breeding is a new roll of the dice) that any specific unmatched gene will be thrown. Horses with "shotgun" pedigrees or no common ancestors have a mathematical calculation of throwing approximately (16) billion different combinations of their gene pool. If these "shotgun" bred horses are outcrossed then full siblings from these non-inbred horses can theoretically be TOTALLY UNRELATED or not have any similar genes. Many people express a fear of inbreeding because of the higher possibility of matching defective genes. Look at inbreeding from (2) different aspects. If an animal is (+10.%) inbred then (90%) of his gene pool is unmatched. Looking at inbreeding from the opposite end of the scale I would look at that (90%) figure as meaning you have a 90% chance of NOT matching up defective genes.

Hybrids can be a little touchier to prove or disprove in the breeding shed but it can be successfully argued that hybridization in itself boosts the immune system for better efficiency in all aspects from food digestion to bone density to just plain good health thus giving the hybrid extra "heart", size or speed/agility to out perform "other" horses when the going gets tough. Hybridization can also "cover up" or suppress the expression of defective genes an animal may be carrying allowing that animal to excel

in the performance arena. Hybrid vigor simply stated is the LACK OF INBREEDING. An expansion of this would include a reduction in inbreeding for mathematical hybrid vigor. It can be argued that when breeding the hybrid, hybridization can suppress the inheritance of defective genes by get. This however is not to my knowledge a fact, just arguable. Hybridization itself cannot, however be inherited or passed along to offspring so a non-inbred hybrid only performs but does NOT breed consistently because of it's large varied gene pool. The key to consistently having a breeder/performer is having a horse that possesses mathematical hybrid vigor AND is inbred.

There are several types of hybridization. There is hybridization achieved when crossing two unrelated and non-inbred horses, OR mating (2) unrelated lines with (1) line being inbred (a hybrid), OR mathematical hybridization achieved through crossing two unrelated but inbred horses and there CAN be hybridization which is achieved with proper linebreeding/inbreeding. If an animal carries a hybrid vigor value of less than (-1.2%) they are considered "non-hybrids". A value between (-1.2%) and (+1.75%) is considered average and that animal is considered a hybrid. An animal with a value greater than (+1.8%) is considered to have "mathematical hybrid vigor". The formula I use for figuring this "mathematical hybridization" is an estimation of the homozygosity / heterozygosity [reduction in homozygosity (matched genes)] between the parents and offspring (hybridization) thus it allows for mathematical hybridization in linebred/inbred animals which gives a truer picture of the animals genetic makeup. Another possibility is the 3-way hybrid, i.e. Doc O'Lena. Poco Bueno (an inbred) was outcrossed on a hybrid mare to produce Poco Lena which is a 2-way hybrid with significant mathematical hybrid vigor (remember she survived in the desert without food or water which survival could possibly be attributed to her hybrid vigor). Poco Lena was then outcrossed on a hybrid named Doc Bar to produce a 3-way hybrid, Doc O'Lena and, of course. Dry Doc.

The above information can be applied to all fields of interest, i.e. cutting, reining, racing, etc. A statistical analysis of a pedigree alloy's you to "see" the how's and why's of breeding and get a good "feel" for what works. Knowing just the percentages of blood an animal carries of specific ancestors doesn't give the whole picture but knowing the values for inbreeding, hybrid vigor, probable hybrid vigor breeding values and homozygosity that a specific animal has allows for an educated/informed idea as to the breeding and/or performance potential of that animal. Just having (25%) blood of Doc Bar doesn't make the horse as history has proven with thousands of examples. Combining the knowledge of Doc Bar's breeding values and how those values worked toward creating the "super" horse with knowledge of a specific mare's breeding values you can consistently recreate the history that has already been proven to work. This gives you a consistent way of predicting the outcome of your hard earned efforts in the breeding shed and gives you the advantage over the "non-informed" breeder. The enclosed is meant to be beneficial in determining what bloodlines are playing a major role in the specified horse's makeup and whether the subject horse is inbred, linebred, a 2-way hybrid or 3-way hybrid. The information could be helpful when deciding what "breeding program" to follow and how to acquire additive genes or mathematical hybrid vigor for excelling in the performance arena.

The enclosed package is the most comprehensive diagnostic look at a Quarter Horse today. I have tried to keep this information affordable and thus had to limit my research. With a little more research by yourself in obtaining the performing get records (AQHA code 071 for performing get only) or produce records (AQHA code 101 for 2 gen dams produce record) of the sire and dam and grandsires and grandams of the subject horse you could expand your knowledge to include performing progeny for ancestors, what bloodlines crossed well, and in what areas such get and produce excelled. If into reining contact the NRHA for statistics on ancestors. Knowledge is the key to success.

A note of definition on the Searches. You will first find that some ancestors have asterisks next to their names. These ancestors are the "common ancestors" found in the pedigree or those ancestors found on both the sire's and dam's side. Also, you will sporadically see a number (any number) i.e., 1, 3, 14, etc. which will appear immediately preceding the sex field. These numbers are part of the name of the horse in the AQHA computer, i.e., Little Joe 1 or Red Nell 2. In the name field in the AQHA computer these numbers are placed at the end of the name field and thus I have done the same as I named these horses, placing the numbers in the far right hand side of the name field or at the end of the name field. My name field can hold up to (40) characters in comparison to AQHA's holding of much fewer characters thus the numbers sometimes appear misplaced or separated from the name. This is a problem I am working on but have not come up with a viable solution as yet. Also, there ARE duplicate names in the AQHA computer but they have numbers (as above mentioned) behind their names to give them unique names. In some instances I have given a horse's name then put a forward slash (/) to indicate that horse is "by" the proceeding named sire i.e. Queen/Little Earl or Bay Mare/Traveler or Cotton Eyed Joe/Little Joe. The horse's name in actuality is Queen or Bay Mare or Cotton Eyed Joe but for reference sake and to give the horse a unique name for computer purposes I have also given the sire, since there are many many Queens, Bay Mares and even several Cotton Eyed Joes in the AQHA records. It follows suit that a backward slash (\) would indicate that horse as being "out of" the proceeding named dam. Also, the "T" (title) field, "t" tag field and character field on the gene print-out contain "codes" for my personal use so please ignore any letters which appear here as they will only mean something to me. This Search is used by myself on more than just horses, i.e., dogs, thus the sex field is "male" and "female" instead of "S" for sire or "D" for dam.

The Homozygous % field, which is the first percentage field gives the actual percentage of inherited genes out of the total gene pool (100% of the genes) from that ancestor which are "matched" on the subject animals chromosomes. An example of reading same is if an animal is (3%) inbred this translates in that animal having (3%) of his total gene pool matched with the same genes appearing on both chromosomes in (1) pair so that when bred it doesn't matter which chromosome that gene is contributed from it will be the same gene. This also translates, as before mentioned in this letter, that (97%) of his genes are not matched with no predictable pattern for contribution to get or produce. By using this field you can determine which ancestors are contributing the greatest number of "matched" genes to the subject horse's gene pool. The higher this figure the more prepotent the subject horse will be to consistently throw the same characteristics

inherited from that ancestor. If you are linebreeding on a specific ancestor to try to "reproduce" him then you would want this figure to be higher or greater than any other homozygous percentage in the subject horse's pedigree. Please note that the homozygous % field gives the % of homozygosity inherited from that ancestor WITHOUT taking into consideration the possibility that the specified ancestor may have a descendant which is also used toward calculating the IBC thus the percentages given are what I call "stand alone" values and would be the subject horse's IBC if that ancestor were the only common ancestor in its' pedigree.

I have included on the Pedigrees all AQHA Champions or Supreme Champions and horses with Superiors or NCHA Awards. Since past ROMs have been achieved with as little as (1) performance point I do not note ROMs on the pedigree but instead specify the exact number of performance points attained. If room allows I note each arena event with points achieved. I use AQHA as my sole source for points earned so any NRHA or color awarded points which are not recognized by AQHA are not noted.

At this point I would also like to mention my pricing structure for this type Search. My pricing directly correlates with charges incurred in my research from AQHA. AQHA charges (\$3.00) per minute for Online (computer) time which is somewhat expensive. I am between a "rock and a hard place" with AQHA as their computer records do not match their stud books (which I have a complete set of). When reviewing pedigrees I have to rely on AQHA as an accurate source and it appears that many hundreds to thousands of changes were made in AQHA Stud Books with no erratas (notification of changes) ever issued which means I have to use their computer and have to pay their charges of \$3.00 per minute if I am to get accurate AQHA pedigrees. Not only am I tied to AQHA's computer but it appears that in many cases their computer is incomplete. I have found numerous occasions where I have downloaded a pedigree and the last horse in a line read "mare by horse". I would then double check with my Stud Books and the completed pedigree would be actually "mare by horse by Old Joe Bailey" or some other stallion. In short I am now having to double check AQHA's computer against the Stud Books to get complete pedigrees which adds considerable time to the process of researching a pedigree. Costs being as they are the computer time alone can generate costs to AQHA of \$30.00 or more and I do have instances of (1) horse costing me \$62.00 in computer time. I type (97) words a minute and blaze through the Online menus so access speed for their computer is not my problem! Since my services are vastly different from just plain pedigree work I have to go back into AQHA's computer as far as their database allows with each horse I am contracted to research as genetics don't end at just (5) generations but the repercussions of linebreeding can play an active role in today's horse when the linebreeding occurred past (6), (7), (8) or more generations. The point to this paragraph is that if each AQHA member would write a letter to AQHA and inform them of the discrepancies we would all benefit with more reasonable costs in our endeavors to be informed horseman and be involved breeders for the betterment of the Quarter Horse breed. AQHA should inform it's membership that their Stud Books are corrupt with no corrections ever issued on thousands of horses and they should consider ways to make pedigrees accessible and affordable to their membership. Their current (4) generation pedigree (they call them (5) generation

pedigrees) does not tell you much about that horse and without knowledge of ancestors serves little purpose to the serious breeder be that a breeder of (1) mare or more. Please write to AQHA.

The enclosed Searches are NOT printed with water proof ink. I highly suggest that same be Xeroxed so that if the originals are gotten wet you will have a good copy.

I hope you find the enclosed beneficial. If you have any questions, please feel free to call. I thank you for your patronage.

Sincerely,
Pat Taylor

DATA SHEET EXPLANATION

INBREEDING COEFFICIENT: (IBC)

RELATES TO THE NUMBER OF TIMES ONE OR MORE COMMON ANCESTORS APPEAR IN A PEDIGREE. THE MORE TIMES THOSE SPECIFIC ANCESTORS APPEAR ON BOTH THE SIRE AND THE DAM'S SIDE OF THE PEDIGREE, THE HIGHER THE INBREEDING COEFFICIENT, ALLOWS YOU TO ATTACH A NUMERIC VALUE TO WHAT IS ALSO KNOWN AS LINEBREEDING. (THIS VALUE DOES NOT DIFFERENTIATE BETWEEN THE TERMS INBREEDING AND LINEBREEDING NOR DOES IT DEFINE THE RELATIONSHIP OF THE COMMON ANCESTORS TO THE SUBJECT ANIMAL, i.e., FATHER, UNCLES, GRANDFATHER, ETC. LINEBREEDING IS INBREEDING BUT TO A LESSER DEGREE. FOR THE SAKE OF ARGUMENT INBREEDING IS DEFINED AS AN ANIMAL HAVING AN INBREEDING COEFFICIENT OF (3.33%) PERCENT OR HIGHER (WHICH IS THE EQUIVALENT OF A (3X3) MATCH) AND WHICH GIVES THE SUBJECT ANIMAL (1) OR MORE MATCHED PAIRS OF CHROMOSOMES. LINEBREEDING IS DEFINED AS A SUBJECT ANIMAL, WHICH HAS COMMON ANCESTORS, AND HAS AN INBREEDING COEFFICIENT GREATER THAN (1.80%) BUT LESS THAN (3.33%) PERCENT WHICH WOULD GIVE THE ANIMAL LESS THAN (1) MATCHED PAIR OF CHROMOSOMES. LESS THAN (1.80%) IS CONSIDERED A HYBRID.

HYBRID VIGOR: (HV)

A POSITIVE HYBRID VIGOR VALUE IS TYPICALLY ATTAINED WHEN CROSSING TWO UNRELATED ANIMALS OR WHEN THE INBREEDING COEFFICIENT (HOMOZYGOSITY) OF THE OFFSPRING IS SIGNIFICANTLY LESS THAN THE COEFFICIENT (HOMOZYGOSITY) OF THE PARENTS. HYBRID VIGOR IS THE EXTRA VITALITY OBSERVED WHEN NO DEFECTIVE GENES ARE EXPRESSED AND ALLOWS AN INDIVIDUAL TO EXHIBIT ADDED VIGOR, SIZE, SPEED, ETC. OVER THAT OF THE PARENTS.

PROBABLE HYBRID VIGOR BREED VALUE: (PHVBV) P

THIS IS THE PERCENTAGE OF CONTRIBUTION OF MATHEMATICAL HYBRID VIGOR BY THE SUBJECT HORSE TOWARD ITS NON-INBRED OFFSPRING'S HYBRID VIGOR VALUE. THE HIGHER THIS VALUE THE MORE PROBABLE ITS INBRED OR NON-INBRED OFFSPRING WILL HAVE HYBRID VIGOR.

HOMOZYGOSITY: (HOMO) HZ

THE NUMBER OF MATCHED CHROMOSOME PAIRS OUT OF (32) PAIR. THE HIGHER THIS NUMBER, THE MORE LIKELY THIS ANIMAL WILL BE ABLE TO REPRODUCE ITSELF.

PAT TAYLOR
KERRVILLE, TEXAS 78018