

Use of On-Farm Performance Testing to Enhance the Meat Goat Herd Enterprise

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What is On-Farm Performance Testing?

Performance testing is the comparative evaluation of animals for production traits of economic importance. Reproduction, growth, and carcass merit are the traits of primary economic importance in meat animal industries, including meat goats. However, pedigree and visual appraisal for conformation have been the primary basis of animal selection in most meat goat herds. Most herd expenses are directed towards doe management. Does are expected to become pregnant, deliver live newborns, and raise multiple kids with good growth to weaning. **Reproduction is generally viewed as the most important trait of meat animal production in terms of determining enterprise profitability for commercial producers.** Reproductive output in a meat goat herd is defined as litter weight weaned per doe exposed to the buck. On-farm performance testing includes the comparative evaluation of does for reproductive output, the evaluation of individual kids for weight gain, and in multi-sire breeding programs, herd sire comparisons for progeny performance.

One method of meat goat testing is the 'central buck test' where young herd sire prospects from various farms are brought to a designated test site to compare growth rates and possibly other traits such as carcass merit. Test diets are based on various levels of concentrate and forage and are generally classified as a feed-lot/grain test or a pasture/range test. Buck tests allow seedstock producers to compare their sire prospects with young bucks from other farms under identical environmental conditions. Participation can be viewed as a value-added activity as placing well on a buck test may increase the value of an individual buck or the genetics of a herd in general. One limitation of the buck test is that it does not provide information on doe reproductive merit, that trait of utmost economic significance. Doe reproductive merit requires on-farm record keeping within the breeding herd.

On-farm performance testing is commonplace to assess female productivity in other livestock industries where profit is a primary objective. Calving rates and weaning weights are two of several traits recorded and used for selection decision-making in beef cattle herds. In dairy goats, milk yield is a routinely measured doe performance trait. A similar emphasis on record-keeping for performance traits has not been applied in purebred or commercial meat goat programs. Objective, accurate recording of doe herd performance allows producers to make better selection and culling decisions and to measure performance responses to management changes. Producers can assess the production return (i.e., litter weight weaned) from the expenses incurred for doe management.

How Can an On-Farm Performance Test Be Implemented?

Performance records should be easy to use. Records can be handwritten in a notebook or on index cards. Alternatively, records can be maintained electronically on computer spreadsheets or herd management software. Electronic records allow easy handling of data for analysis, particularly for herds with large sets of data accumulated over several years. However, a hand calculator and a little time are all that may be required for processing data from smaller herds using handwritten records. Under any scenario, proper record keeping is essential to a successful performance testing program. Each animal in the breeding herd should have a separate record.

Animal identification. For each herd member to have a separate record, proper animal identification is required. Ear tags and tattoos are common forms of ID for meat goats. Assign every herd member a unique and permanent ID number. Numbers can be assigned to kids at birth when collecting early data such as birth weights, litter sizes, and neonatal deaths. Newborn kid data need to be matched with the correct doe. In herds with many does kidding together on pasture or range, it can sometimes be a challenge to tell which kids belong to which does. Rejected kids, early newborn deaths, and the occasional swapping of kids by does make it important to properly and adequately ID kids soon after birth, preferably within 12-24 hours.

Scales. Scales are needed to implement a performance testing program. Body weight is undeniably important as a measure of meat animal performance as well as for some aspects of general herd management. A small hand-held scale is sufficient to record birth weights. A larger livestock scale is needed for weaning weights. Scales may be bought, borrowed, or rented depending on the needs and resources of individual operations. A weight tape or other means of estimating body weight are NOT acceptable. A scale should be periodically checked to ensure that it is accurate and precise when weighing animals.



Contemporary Groups. A contemporary group is a set of meat goat kids born and raised together under the same conditions. Objective genetic evaluation requires factors like age, nutrition, and location to be identical for all kids. Kids in a contemporary group are ideally born within a 60-day period and managed together from birth to weaning. Dams should also be managed together from kidding to weaning. Data from kids born outside the 60-day window or managed differently (e.g., on show circuit, bottle babies, kept in separate pastures) are excluded from the group. Contemporary groups for kids weaned at three months old are planned 8-10 months earlier at the start of breeding. Breeding seasons should not extend beyond 6-7 weeks to assure that kids will be within the 60-day age range at weaning. If breeding occurs year-round, then the manager will need to group kids based on birth date to form meaningful contemporary groups. In essence, properly constructed contemporary groups will minimize environmental effects that can affect kid performance.

What Should Be Recorded?

Body Weight. Primary traits to record in a meat goat herd are 1) the number of kids born and weaned for each doe exposed to bucks, 2) kid birth and weaning weights, and 3) dam weight at weaning. Birth weight is the starting point to determine preweaning growth rate. Recording birth weight also facilitates recording the birth date, identification of the dam, and tagging the newborn with a unique ID number. Newborn weights should be recorded within 24 hours of birth.

Record weaning weights at around 90 days of age. Weaning weights are usually recorded on one calendar date for a group of kids that vary in ages. The ages within a contemporary group of kids at weaning should deviate from 90 days by no more than 28 days. It is also useful to weigh the dams when the kids are weaned. Dam weights are used to calculate the efficiency of doe production. If the producer prefers an earlier weaning weight, then 60 days can be the target date. Similarly, a later date such as 120 days can be used. If a management scheme is to wean buck kids earlier than doe kids, all kids can be weighed when the

bucklings are weaned. The 90-day recommendation is used in an effort to move towards an industry-wide standard such as the 205-day benchmark for beef cattle weaning weight assessments and the 305-day standard for dairy goat evaluations. If a producer prefers to wean kids at an older age, then kids can be weighed at a 90-day point and left on the does until the desired weaning age at which time the producers can then record the actual herd weaning weight.

Litter Size. For each doe exposed to the buck, record the number of live births and the number of kids weaned. Note stillborns in a doe's file, but do not use them for litter size and they need not be weighed. Artificially-raised kids are not credited to the dam for weaning litter size or weight. In cases when a doe adopts a kid from another doe, the adopted kid can be credited to the 'foster' dam for weaning data. Failure to birth or wean a kid following buck exposure are recorded as zero (0) for the doe. It is important that does that do not wean a kid, regardless of the reason, be included in the records for whole-herd evaluation. The reason why an individual doe does not wean a kid should be recorded (e.g., did not cycle, did not get pregnant, aborted, kids died, etc.)

How Are Individual Animals Evaluated

Kid Evaluation. Kid weight comparisons can be biased because ages vary in a contemporary group of kids at weaning. It is NOT necessary to weigh every kid when it turns 90-days-old. All kids will be weaned on one day. However, recognize that on that single weigh date a 79-day-old kid cannot be expected to weigh as much as a 112-day-old kid. Therefore, weaning weights are converted to a standard 90-day age basis. Two equations are used to generate 90-day weights. First calculate average daily gain (ADG):

$$\text{ADG} = (\text{weaning weight} - \text{birth weight}) \div \text{weaning age}$$

After the average daily gain is determined, the second equation gives the 90-day weight:

$$\text{90 Day Weight} = (\text{ADG} \times 90) + \text{birth weight}$$

When birth weight is not recorded, ADG cannot be determined. In the absence of a recorded birth weight, replace the previous equations with the following equation based on weight per day of age:

$$\text{90 Day Weight} = (\text{weaning weight} \div \text{weaning age}) \times 90$$

Adjustments to the 90-day weights are required because litter size and age of dam can affect weaning weight. On average, weaning weights decrease as litter size increases and young does wean lighter kids than mature does. Multiply 90-day weights by the appropriate correction values (Table 1) to get adjusted 90-day weights. Buck kids are typically heavier than doe kids, but sex of kid adjustments are not required because comparisons are made within single sex groups (i.e., buck kids are compared only to other buck kids and doe kids compared to other doe kids).

Table 1. Adjustment values for 90-day meat goat kid weaning weights

<i>Effect</i>	<i>Group</i>	<i>Value</i>
<i>Litter Size, born & weaned</i>	1 & 1	1.00
	1 & 2	1.14
	2 & 1	1.04
	2 & 2	1.18
	3 & 1	1.08
	3 & 2	1.23
	3 & 3	1.27
	<i>Age of Dam, years</i>	1
2		1.09
3+		1.00
<i>Sex of Kid</i>	Buck	1.00
	Doe	1.11
	Wether	1.08

Values courtesy of David R. Notter, Ph.D., Virginia Tech

An additional step is generating weaning weight ratios. Within each sex group, individual kid weights are compared to the group average to produce ratios for relative evaluations. Ratios show the deviations of kid weaning weights from the contemporary group average. A ratio is calculated with the following equation:

$$\text{WWT Ratio} = (90 \text{ day kid weight} \div 90 \text{ day herd weight average}) \times 100$$

A ratio of 100 is equal to the group average. A kid with a weight ratio of 122 is 22% heavier than the group average. Conversely, a kid with a ratio of 91 is 9% lighter than the group average.

Table 2. Doeling Weaning Records

Doeling Weaning Records											
KID ID	DAM	SIRE	Litter Type	BWT	WWT	AGE	ADG	Dam ADJ	Litter ADJ	90-d WWT	WWT Ratio
5011	607	447	2-2	7.1	36.2	109	0.27	1	1.18	36.7	92
5018	427	251	1-1	10.4	52.3	107	0.39	1	1	45.6	108
5022	256	250	2-2	6.6	39.0	107	0.30	1	1.18	40.0	100
5044	261	251	3-2	6.0	48.5	105	0.41	1.09	1.23	56.9	135
5107	622	456	2-2	5.4	33.8	103	0.28	1	1.18	35.7	89
5112	640	251	3-3	5.0	39.2	103	0.33	1	1.27	44.3	110
5173	411	251	2-2	6.5	34.7	82	0.34	1	1.18	44.1	105

Table 2 provides an example of how records can be used to assess kid performance for weaning weight. Based on actual weaning weight (WWT), kid #5018 was the heaviest at 52.3 pounds. In a pen of kids, the 5018 doeling would probably stand out as being the largest based on visual appraisal. However, note that the kid was the only single in the group. Using the formulas and correction factors provided earlier, the 90-day adjusted weights (90-d WWT) and contemporary group ratios (WWT Ratio) are determined. After adjustments for age of kid, litter size, and age of dam it is revealed that in genetic terms, the best kid for weaning weight was actually kid #5044. She had an adjusted weight of 56.9 pounds and was 35% heavier than the group average; this kid was out of a two-year-old doe, born a triplet, and weaned a twin. Although a big kid, #5018 had some non-genetic advantages (e.g., mature dam, single kid) that contributed to a heavier weight. If a producer was to simply select the heaviest kids without accounting for correction factors, a producer might unknowingly select single kids as doe replacements that could lead to an increasing number of single kid-producing does in the herd. These types of record assessments will be more important when selecting kids as replacement breeding stock than for kids destined for the meat market.

Sire Evaluation. In herds using multiple sires, kid weights and ratios can be used to compare sires for progeny performance if each kid's sire is known. Buck and doe kid ratios may be combined for sire evaluations. Adjusting doe kids to a buck kid weight equivalent (Table 1) may be used to combine buck and doe kid weight records for sire evaluation.

Table 3. Sire Evaluation

TSU Sire Evaluation (2004-07)			
Sire	Kids	90-d Wt	Ratio
249	53	43.1	101
286	20	39.9	102
307	11	37.5	99
456	29	43.3	103
470	24	44.4	108
471	26	34.1	89
601	80	39.1	93
614	54	42.3	103
657	16	45.2	112

Table 3 provides an example of how sires within a breeding program can be evaluated. These bucks were all mated to does of similar quality and have between 11 and 80 progeny weaning weights across up to eight contemporary groups. Two buck can be selected from the table for comparison. Kids from Buck #470 have an average 90-d weight of 44.4 pounds and average 8% heavier than contemporaries, whereas kids from Buck #471 have an average 90-d weight of 34.1 pounds and average 11% lighter than contemporaries. On visual appraisal both bucks selected (each a '100% NZ Kiko' sire) look to be of similar quality. However, the kids from #470 are 10 pounds heavier, on average than kids from #471. The 10-pound difference per kid can be significant for a commercial producer selling market kids by the pound. If kids are selling for \$1.30/lb, what would be the difference in cash return for a trailer-load of kids sired by #470 versus #471? How about if kids are selling for \$0.90/lb or \$1.70/lb? The management costs are no different, only the choice of sire has impacted herd productivity and cash returns. Without recording kid weaning weight data, sire differences would go undetected. Although pedigree and appearance may suggest the quality of a buck, **the true value of a buck is in how well his kids perform.** Some of the best-looking bucks (on registration certificate or standing in the pen) have been shown to produce poor growing kids upon progeny testing and visa versa for bucks that do not 'look' very attractive. Care must be taken when comparing sires that they are mated to does of similar quality and that kids are of the same contemporary group or are linked to a common 'reference' sire. Objective selection and culling decisions within the sire battery can be made using progeny performance records such as those presented in Table 3.

Doe Evaluation. For each dam, add the weights of all kids she weaned. Actual or 90-day weights can be used for doe evaluations. Actual weights are preferred because they credit the ability of does to breed early and raise kids for a longer period of time, weaning off more weight on average compared to does bred later in the season. When comparing young and mature does, correct kid weights for age of dam (Table 1). A sex of kid correction can also be made to put doe kids on a buck kid weight equivalent for unbiased litter weight evaluation. Litter size corrections are NOT made to kid weights for doe evaluation. Do not exclude those does that fail to raise a kid to weaning. Zero (0) is recorded for litter weight weaned of does not weaning a kid.

Litter size at birth and weaning should be assessed for each doe. After two or three production years, a certain average number of kids weaned by does should be expected such as 1.5 kids weaned per buck exposure. Doe production efficiency can be measured by how much total litter weight a dam is able to wean relative to her own body weight. A heavier doe (e.g., 150 pounds) requires more management inputs than a lighter doe (e.g., 100 pounds). However, the heavier doe may or may not be able to convert the greater inputs into a correspondingly heavier litter weaning weight. If dams are weighed when kid weaning weights are recorded, the following equation can provide the efficiency of doe production:

$$\text{Doe Production Efficiency} = (\text{litter weaning weight} \div \text{dam weight at weaning}) \times 100$$

Nutritional resources are used by does for self-maintenance, reproduction to produce kids, and milk production to raise kids. In young does, growth must also be supported. Forage and feed inputs may be available in limited or unlimited supply to does and usually represent the primary expense of herd management. Doe production efficiency values vary widely, ranging from less than 50% to over 100%. Does with consistently higher production efficiency values within a given set of environmental/ management conditions are considered better converters of management resource inputs to marketable litter weight weaned; these does are more efficient, profitable herd members.

Tables 4 and 5 illustrate how kid weaning weights can be used to help evaluate doe performance. Records indicate that Does #640, 650, and 622 have consistently produced at levels higher than the population averages, whereas Does #606 and 636 have been poor performers. In Table 4, the top three does average twins weaned per year, weaned 25 pounds or more compared to the population average, and produced about 80% of their body weight. In contrast, the bottom two does only wean one kid per year, weaned 15 to 20 pounds or less than the population average, and only produce about 40% of their body weight. Table 5 shows the cumulative production over four years in the herd where the top end does produced over 100 pounds more than the herd average and 170 pounds more than the bottom end does. Management costs are equal for all of the does in the test herd. However, depending on the market price of kids, profitability would be more probable with the twin-bearing dams than the single-bearing dams. If the annual doe cost was \$50 and kids sold for \$1.25/lb, the average doe in the herd would be profitable. However the top-end does would be very profitable while the bottom-end does would represent a financial loss. Profit and loss values would, of course, change as annual doe management costs and market prices of kids vary from year to year. Tables 4 and 5 demonstrate the potential impact of reproductive performance as measured by litter size weaned to influence profit and loss in a breeding meat goat operation. It should be recognized; however, single-bearing does may not be a liability under specific management circumstances such as in very low input, extensive production systems where costs are low enough for single-bearing does to be profitable.

Table 4. Annual Doe Reproductive Performance

Weaning Traits: Spanish Does (4 Matings)			
Doe	Litter Size	Litter Wt	L/D Wt, %
640	2.25	87.1	80.7
650	2.00	87.7	85.3
622	2.25	79.1	93.4
Span Avg	1.55	54.7	64.9
Herd Avg	1.32	49.7	56.9
636	1.00	37.7	36.6
606	1.00	33.7	43.0

*L/D Wt = Litter weight weaned / dam weight at weaning

Table 5. Four-Year Doe Reproductive Output

Lifetime Weaning: Spanish Does (4 Yrs)			
Doe	Kids	Weight	Wt Diff.
640	9	348.4	+ 129.6
650	8	348.4	+ 129.6
622	9	316.4	+ 97.6
Span Avg	6.2	218.8	0
Herd Avg	5.3	198.8	
636	4	150.8	- 68.0
606	4	134.8	- 84.0

*Wt Diff = Difference in 4-year weight weaned of doe compared to Spanish doe group average

Nevertheless, while litter size at weaning is a good indication of doe performance, litter weight weaned provides a better measure of doe reproductive output. Relatively low-performing does should be identifiable within a couple of production years. On-farm performance testing allows for the identification of high- and low-performing does and subsequent selection and culling decisions.

A variety of management choices may be implemented to increase doe reproductive rates or kid preweaning growth rates. However, added cash return from the increased weaning yields must be greater than the increased cost of the new management procedure to justify the management change. For example, a management decision may be to implement a creep-feeding program. To be justified, the price received for the extra pounds weaned must more than off-set the added management costs associated with creep-feeding. Conversely, a management change to lower input costs should not lead to a significant drop in doe herd performance leading to a loss of net income per doe. In any case, it is very difficult to determine the economic impact of a change in herd management without a system of on-farm performance record-keeping to assess changes in herd productivity in response to changes in management.

Should Other Traits Besides Weaning Traits Be Recorded?

Other production-related traits may be of interest to meat goat producers. Growth rates after weaning can be evaluated on-farm when goats are retained to heavier post-weaning market weights or when developing replacement breeding stock. Keep detailed health records on each animal. Periodic evaluation of records is recommended for traits associated with internal parasitism, lameness, abortions, mortalities and other health concerns to help in making selection and culling decisions and reviewing herd management procedures. Although the primary focus has been on preweaning kid growth and doe reproductive output, evaluation of other performance traits is encouraged in meat goat herds.

Summary

On-farm performance testing of the doe herd is important in commercial meat goat operations expecting good doe-kid performance with minimal management inputs. On-farm performance testing is important in seedstock operations that expect to provide genetics to commercial meat goat producers. Each producer will



set herd-specific performance levels for animal selection and culling. Procedures described here are for within-herd animal evaluation and not meant to compare animal across different herds. Performance records, when used with visual appraisal and pedigree, facilitate improvement for economically important traits. Performance records allow for the evaluation of management procedures and how management changes affect performance. Performance records, when coupled with financial records, provide the basis of assessing the economic status of an enterprise and the likelihood of making a profit or incurring a loss annually. Performance and financial targets should provide direction to breeding programs. On-farm performance testing helps to achieve herd goals.