How to Manage Jacks to Breed Mares

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Jacks are bred to mares to produce mules. Traditionally, breeding management of jacks under domestic conditions is considered challenging for both natural breeding and semen collection. The donkey's natural sexual behavior significantly differs from that of horses. This article describes the sexual behavior of donkeys and presents strategies to improve the breeding efficiency of jacks used for natural mating with mares or semen collection. Authors' addresses: Section of Theriogenology, Department of Clinical Sciences, College of Veterinary Medicine, Cornell University, Ithaca, New York 14583 (Canisso) Section of Theriogenology, Department of Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University, Columbus, Ohio 43210 (Coutinho da Silva); Institute of Biological, Environmental and Rural Sciences, Aberystwyth University, Ceredigion, Wales SY23 3AL, United Kingdom (Davies Morel); and Section of Reproductive Studies, New Bolton Center, School of Veterinary Medicine, University of Pennsylvania, Kennett Square, Pennsylvania 19348 (McDonnell); e-mail: ifc5@cornell.edu.

1. Introduction

Traditionally, jacks are considered challenging to manage for breeding purposes.[1–6] They are well known to be slower breeders compared with stallions, and this is true for natural mating and semen collection using either jennies or mares.[1,7,8] The donkey's natural sexual behavior significantly differs from that of other domestic animals. This presents the biggest challenge on mule studs. Normally, only jacks are kept for breeding, because jennies are considered to be disruptive and difficult to manage.

Several procedures have been suggested with the objective of overcoming the poor sexual behavior of jacks when required to breed mares and during semen collection. The aim of this article is to describe the authors' practical experience and observations on the natural behavior of jacks and to apply this knowledge to breeding management to improve the success of using jacks for natural mating or semen collection when using mares.

2. Overview on Jack Sexual Behavior

Domestic jacks kept in free-range conditions show the characteristics of a territorial, non-harem breeder both with jennies[9] and mares.[7] Jacks do not display herding behavior[6,9] as is typical for harem stallions.[10] On one hand, the jack spends most of his time within a specific area (i.e., his territory), which normally provides a source of water, shade, and good availability of grass.[9,11] On the other hand, jennies travel in small migratory groups and are attracted to the jack's territory for food and water. Jennies passing through a jack's territory

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Fig. 1. A group of estrous jennies mounting one another in a sexually active group near a jack. The jenny being mounted is displaying estrous signs (clapping mouth) while a third female watches it (on the right). The male donkey to the left of the group appears disinterested. Photo by Sue M. McDonnell, 1998, Carlos Chagas, Minas Gerais, Brazil.

are available to him for breeding should they be in estrus.[9,12]

Sexual behavior of jennies varies considerably from that of mares.[13–15] Estrous jennies congregate into sexually active groups that display heterosexual behavior (Fig. 1). Additional behaviors of estrus that are not seen in mares include mouth clapping and ears back toward the neck (Fig. 2).[14,15] These characteristics are important in attracting and arousing sexual response of the jack, and they are considered to be responsible for the relatively low efficiency of crossbreeding jacks with mares.[1,7,12]

In the presence of an estrous jenny, the jack's normal response typically includes loud vocalization, Flehmen response, and rolling in the soil that is often followed by mounting without erection; mounting, on average, is made at least one time per mating episode (Fig. 3).[6,7,9,16] During natural mating, the pre-copulatory sequence usually includes two phases. Initially, the jack approaches the jenny, where he teases and may mount without erection but then retreats.[7,9,15] Erection typically commences a few minutes after retreat while the jack seems disinterested by grazing and gazing around. Within another few minutes, the jack typically re-

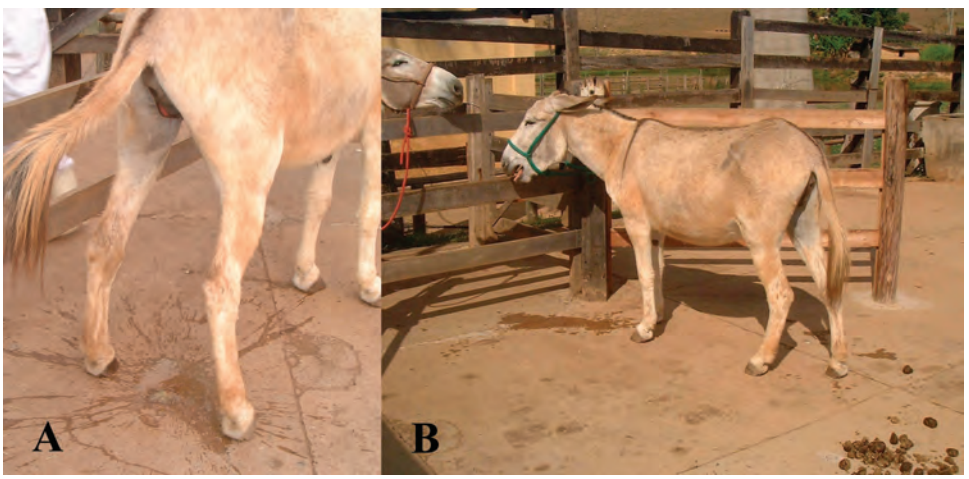

Fig. 2. Classic signs of estrus in jennies when teased by a jack: A) posturing, urination and parting of vulvar lips with exposure of clitoris; B) clapping mouth and ears backwards. Photos by Igor F. Canisso, 2006, Equid Breeding Center, Federal University of Viçosa, Viçosa, Minas Gerais, Brazil.

Fig. 3. Sexually active group of jennies pursuing donkey jack that is masturbating. Note open mouth and ears toward back signs of estrus on jenny to right of jack. Photo by Sue M. McDonnell, 1988, Carlos Chagas, Minas Gerais, Brazil.

turns to the jenny where teasing resumes, culminating in successful copulation.[9] Young jacks are slower to breed[2] and usually perform more than twice as many mounts without erection than mature jacks.[16]

In addition, young jacks may display aggressive behavior toward the female, and this should be avoided by redirecting the jack's attention rather than with punishment that can be counterproductive. In most cases, this aggressive behavior typically diminishes as the jack's experience improves. In our experience, this behavior is usually related to the lack of coordination and confidence of the young and inexperienced jack.

The territorial nature of the jack is of particular importance when intensively managing jacks for breeding. For example, a shorter reaction time can be expected if breeding or semen collection is always performed in the same place, because this emulates the jack's natural territory. As a territorial animal, the donkey is easily distracted by potential threats or intruders to his environment, especially the sight or sound of another donkey, which triggers defensive behavior. Breeding is usually most efficient when the environment is quiet, ideally with the same familiar handlers, minimal traffic of animals, agricultural machines, etc., and especially, away from other donkeys.

In most mule farms, the predominant breeding system is in-hand mating, although artificial insemination (AI) is often used. Breeding mares is unnatural for the jack, and therefore, they usually require training.[8,17] However, under good management conditions, semen can be successfully collected from jacks using mares (Table 1). Studies conducted by Lodi et al.[7] on pasture breeding of mares by jacks reported a low breeding efficiency with $<40\%$ of estrous mares accepting the jack. It seemed that jacks were able to identify mares in estrus; however, the mare's reaction to the jack was minimal, resulting in only brief, less intense teasing interaction.

In a similar experience, one of the authors[a] managed five adult Pêga jacks (Brazilian donkeys) that had been previously conditioned to breed mares. The jacks were kept with a herd of 130 crossbreed Quarter Horse mares throughout the year in large paddocks (30 ha each). However, the foaling rate was only 15%. On clinical investigation, it was determined that the jacks had difficulty in mounting the mares because of the differences in height and the limited number of mares that accepted the jack's approach. Additionally, when a mare showed hostility toward the jack during his initial approach, despite being in estrus, the jack immediately lost

Table 1. Behavior Characteristics of Six Pêga Jacks (4–16 yr) During Semen Collection Using a Mounting Mare in Estrus (n = 180 Semen Collections)*

Behavior Characteristics	Values (Mean ± SD)
Erection latency	18.3 ± 17.7 min
Latency from erection to insertion	5.1 ± 3.5 s
Copulation duration	25.4 ± 7.7 s
Mounts without erection frequency	1.1 ± 1.3
Flehmen response frequency	7.4 ± 5.8

*Adapted from Canisso et al. (2008). Presented at the 5th International Symposium on Stallion Reproduction.

Erection latency, time in minutes spent between the first exposure of the jack to the mare until complete erection for the ejaculatory mount; latency from erection to insertion, time in seconds between complete erection and initial introduction of the penis into the artificial vagina (AV); if during the erection the jack did not mount the mare, the time was added into the erection latency and the timing for latency from erection to insertion; copulation duration, the time in seconds from introduction of the penis into the AV to dismount and retraction of the penis from the AV.

Fig. 4. Mare restrained in stocks for collection of jack semen. Note: A) Flooring of stocks was pitched to facilitate mounting by the jack. Floor was constructed below ground level (15 cm in the front and 25 cm in the back). B) To prevent lateral movement of the jack during semen collection, a pole (1.40 m height) was constructed approximately 30 cm behind the stocks. Photos by Igor F. Canisso, 2007, Guaraciaba, Taruma Mule & Donkeys Stud Farm, Minas Gerais, Brazil.

interest. It seems, therefore, that breeding mares in pasture is often unsuccessful,[7] even when using mating systems successful in breeding jennies.[9] To improve the breeding success, the following strategy was implemented: mares were teased by a stallion and if in estrus, were immediately bred in-hand to a jack at 3-day intervals while in estrus. Mares reluctant to accept the jack were restrained before breeding. Using this management scheme, foaling rates were increased to ~65%.

The jack's sexual behavior and breeding efficiency are affected by the environment and specific management practices. For example, sudden changes from cold, rainy, windy, hot, or sunny weather may have an apparent effect on the jack's sexual response. Similarly, handling activities such as hoof and mane trimming may negatively affect sexual interest. Occasionally, jacks can inexplicably develop a strong aversion to other jacks living within proximity despite only having visual but not physical contact. This evokes territorial defensive behavior and can result in aggression, stall walking, failure to eat, and other behavioral changes. In such cases, simply separating the jacks can restore normal behavior. Additionally, jacks may become inexplicably disinterested in breeding and semen collection despite previous success.[1,3] In most cases, the erratic behavior resulted from a clinical problem, subclinical disease, laminitis, or excessive confinement. Therefore, increased turn-out time and exercise typically seems to significantly improve libido.

3. Breeding Management of Jacks

The authors have applied several strategies to improve efficiency of mating jacks to mares in attempts to imitate the natural sexual interaction between jacks and jennies. One such strategy allows the jack to initially tease a restrained estrus mare followed by mounting without erection. The jack is then taken away (4–6 m) but kept within view of the mare. After erection is achieved, the jack is allowed to breed the mare or semen is collected. If the jack does not achieve full erection within 10–15 min from the estrous female after the initial introduction, a second attempt is performed. If this fails, the jack is returned to his stall, and a new attempt is made later on that day or a subsequent day. In our experience, this system usually works well, because it mimics the behavior characteristic of normal courtship[9,17] and can be particularly helpful for young jacks. In addition, if jennies are available, they can be placed in an adjacent paddock to provide further visual stimulation for the jack (Fig. 4).

However, as discussed previously, most mule studs do not have jennies available, and mares must be used. This presents particular challenges, because mares only show mild estrus signs in the presence of a jack.[17] Thus, mare selection is important. Only mares that are in deep estrus, as determined by teasing with a stallion, should be used, and these mares must naturally show estrus well to jacks. If a suitable mare is not available, another mare should be used; alternatively, additional restraint using a twitch, hobbles, or stocks may be helpful.

A simple stocks that has been successfully used on Brazilian mule studs is constructed of wood or metal rails around a central pit.[5] The floor should be constructed at a lower level than the surrounding ground to compensate for differences in height of jacks and mares. Additionally, the stocks provide good stability for the jack, because the mare is restrained from excessive lateral sway as the jack mounts. The use of stocks also protects handlers from injuries. These stocks are suitable for in-hand natural mating and for semen collection (Fig. 5).

An interesting approach the authors have employed involves keeping a jack, a teaser stallion, and a mare within close proximity but separated by fences to avoid accidents (Fig. 6). The animals are held so as to allow the stallion to tease the mare conventionally head-to-head and allow the jack to be positioned near the mare's perineal area. The

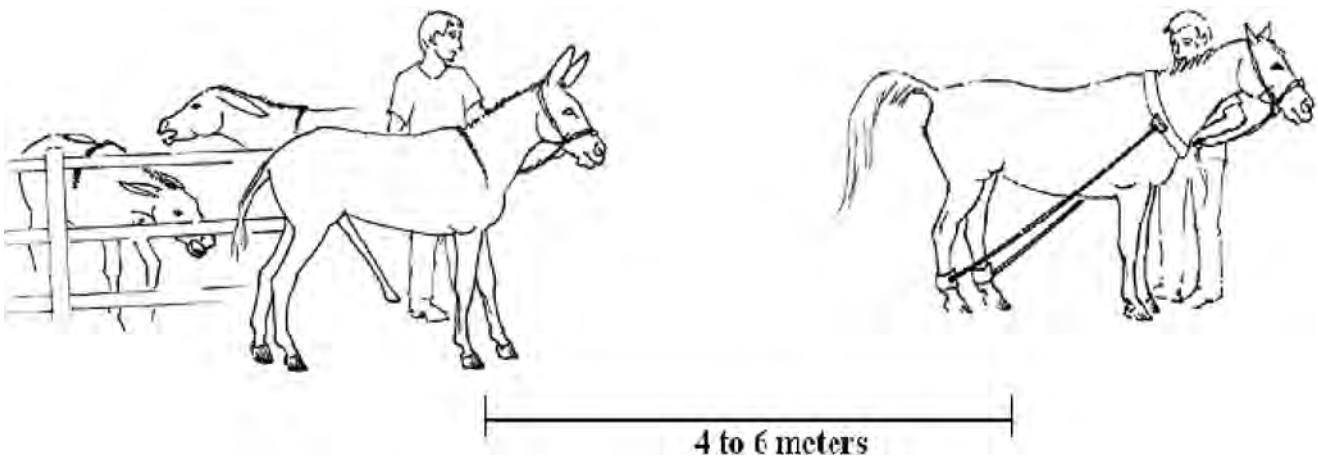

Fig. 5. An illustration of a breeding system used for semen collection or for in-hand natural mating of donkeys. On the right is a restrained mare deep in estrus, in the center is the donkey presenting full erection, kept at a distance (4 – 6 meters) from and gazing at the estrus mare, in the background to the left are a two estrus jennies within visual contact of the jack so emulating the natural system and encouraging sexual behavior in the jack.

mare will show estrus signs to the stallion, and as a result, the jack becomes stimulated and keen to mount the mare. Normally, within a few seconds, the jack will exhibit Flehmen response and loud vocalization. This system results in a rapid interest in the mare in the attempts to mount regardless of whether or not the jack is conditioned to breeding mares or not. This procedure can be used not only to stimulate adult unconditioned jacks to breed mares but also young males during the learning process and jacks with low libido. Young jacks can also be stimulated by watching semen collection and natural service by other jacks, and the use of a teaser stallion to stimulate the mare to show estrous behavior as described previously has also been used successfully to encourage young jacks.

Although mares generally become increasingly accepting of jacks to which they have been bred, pasture or in-hand breeding of mules remains challenging. Thus, AI is often employed. Some practitioners use a dummy mount for semen collection, similar to that used with stallions, and mounting is encouraged by the close proximity of an estrous mare or jenny. In the authors' experience, this is a successful, although time-consuming process, because most jacks require up to 1 h per semen collection. An alternative reported by some practitioners is turning two or three jennies out together

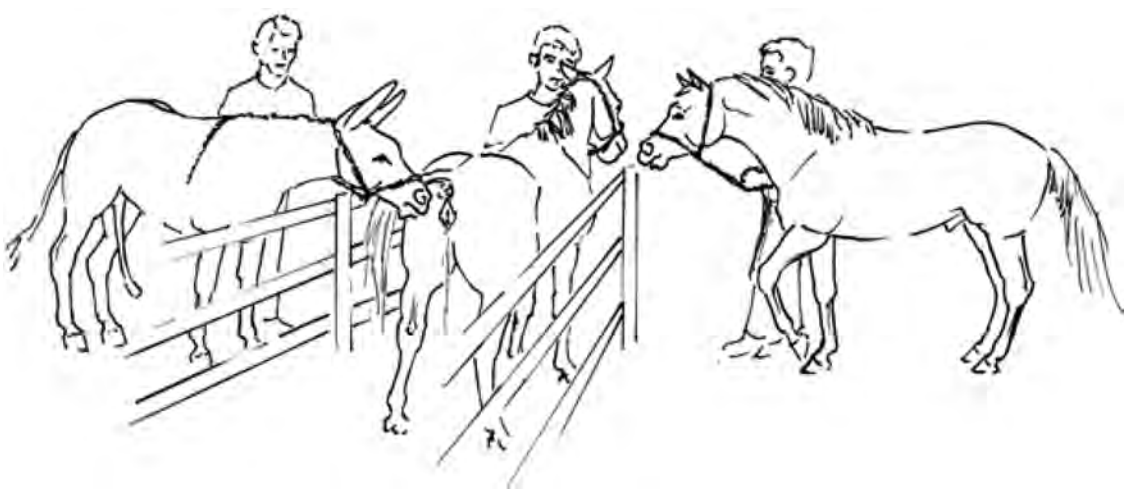

Fig. 6. A drawing to illustrate a stimulatory breeding system which can be used in training to non-conditioned juvenile or elderly donkeys to mate with mares, or for adult donkeys with low libido that are required to breed mares. On the left is the donkey jack being trained which is allowed to approach the perineal area of the estrous mare which is in the center, restrained and held between a double fence. On the right is the teaser stallion which is used to tease the mare and encourage her to show the typical signs of estrus, this estrus behavior encourages sexual behavior in the jack.

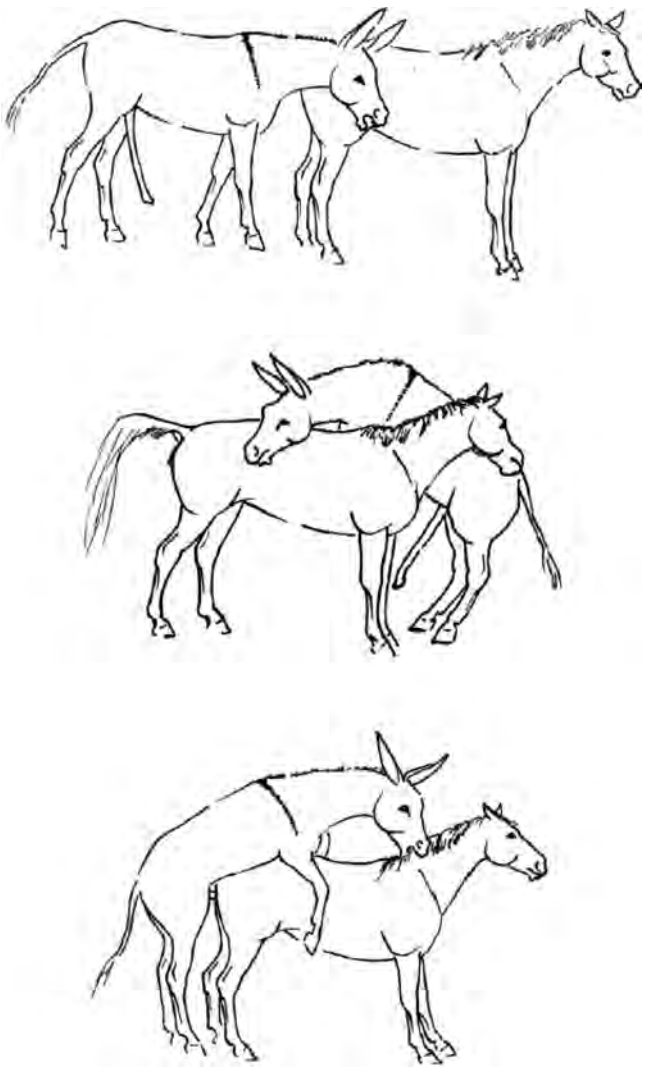

Fig. 7. A drawing to illustrate part of the typical donkey jack sexual behavior evident when a jack is turned out freely in a small paddock or a deep estrus mare (trained to mating with jacks) is inserted in the donkey's stall. Top diagram - the donkey, with full erection, approaching an estrus mare, that is presenting typical passive estrus behavior; Center - the jack donkey mounting the mare, cranial - caudal approach; Bottom - successful copulation.

into a paddock along with a jack. Semen is then collected by rapid intervention with an artificial vagina as soon as the jack mounts a jenny with an erection. Gastal et al.[18] reported a similar system where just one estrous jenny and one jack are turned out free in a small paddock (20 m^2). Alternatively, the mare can be placed inside the jack's stall where natural breeding or semen collection is performed (Fig. 7).

Another strategy used with reasonable success by mule breeders in Brazil is to keep jacks and fillies together from weaning to 2 yr of age. During this period, all physical, visual, and auditory contact with jennies is avoided. It seems that if jacks are only bred with fillies from puberty onward, they become attracted and conditioned to mate mares. However, attention should be paid to managing young jacks, particularly in respect to controlling inter-male aggressive behavior; it is not uncommon and seems to depress libido.

In the authors' experience, jacks conditioned to breed mares can be successfully reconditioned to breed jennies when they reach mature age. Breeders in Brazil have reconditioned jacks to breed jennies as late as 10 yr of age. This reconditioning is not always successful, and some jacks show little interest or even violent rejection of jennies (Canisso I, unpublished observation).[3] Reintroduction to jennies needs to be closely monitored, and sometimes, sedatives are advised to initially relax the jack in the presence of the jenny.

4. Conclusion

The natural sexual behavior of jacks and jennies is distinctive and different from that of mares and stallions. Knowledge of the natural courtship and mating behavior of donkeys is useful in implementing strategies to increase the efficiency of intensive in-hand breeding of donkeys. A significant number of jacks are used for mule production through natural service or AI in the absence of jennies. This presents additional challenges, largely because of the differences in sexual behavior of mares and jennies and also the differences in size. Strategies that emulate the jack's natural breeding environment and behavior can be employed to good effect with both young and mature jacks when used with specially designed stocks for mare restraint.

The authors are thankful to the following institutions and people: CNPq-Brazil; Equid Breeding Center, Animal Science Department, UFV-Vicosa-Brazil; Taruma Stud; Rio do Sangue Farm-MT-Brazil; the Journal Equine Veterinary Education; Professor Giovanni R. Carvalho (UFV); and the veterinarians Pedro G. Ker, Aline L. Rodrigues, and Thiago Castro Senna. Portions of this manuscript have been submitted for publication in *Equine Vet Edu*. Permission has been granted to reprint.

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