EQUINE VETERINARY EDUCATION
Equine vet. Educ. (2009) **21** (12) 652-659
doi: 10.2746/095777309X479058

Tutorial Article

Strategies for the management of donkey jacks in intensive breeding systems

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Keywords: horse; donkey; jack; mating; breeding; sexual behaviour; mule; mares

Summary

Donkeys are bred throughout the world and often play an important role in agriculture. They are also bred to produce mules. Traditionally, jacks are considered challenging to breed in domestic conditions, whether for natural breeding or semen collection using either jennies or mares. The donkey's natural sexual behaviour significantly differs from that of other domestic animals. This presents challenges for in-hand donkey breeding, particularly on mule studs where normally only jacks and mares are kept for breeding. This article describes some of the authors' observations on sexual behaviour in donkeys and practical experience of some of the strategies employed to apply this knowledge to breeding management, in order to improve the success of using donkeys for both natural service and semen collection.

Introduction

Donkeys are bred throughout the world. In many countries they play an important role in agricultural activities, particularly in poorer regions, and they are also bred to produce mules, for example in United States, Brazil and other Latin American countries (Canisso 2008; Canisso *et al.* 2008a) and for entertainment and leisure, for example in the UK and northern Europe.

Traditionally, jacks are considered challenging to handle for breeding purposes (Morais *et al.* 1993; Gebers 1995; Taylor and Mathews 1998; Tibary 2007; Canisso *et al.* 2008a, 2010). They are known to be slow breeders compared with stallions, whether for natural breeding or semen collection using either jennies or mares (Morais *et al.* 1993; Lodi *et al.* 1995; Henry *et al.* 1998; Canisso *et al.* 2010). In particular, problems with and disturbances in sexual behaviour are evident if the natural behaviour of jacks is not understood and accommodated. The donkey's natural sexual behaviour significantly differs from that of other domestic animals. This presents the biggest challenge on mule studs where normally only jacks are kept for breeding, as jennies are considered to be disruptive and difficult to manage due to their migratory behaviour and drive to seek out a jack when in oestrus. However, even in mule studs breeding practices that take into consideration the jack's natural behaviour can give satisfactory results (Canisso 2008; Canisso *et al.* 2010).

The aim of this article is to describe some the authors' practical experience and observations on the natural behaviour of jacks and the application of this knowledge to breeding management, in order to improve the success of using donkeys for natural service or semen collection. The authors' experience with breeding donkeys, as discussed here, was gained through work in Brazil on private study farms and in the Equid Breeding Center, Federal University of Viçosa. A significant amount of the work on donkey sexual behaviour has been carried out in Brazil and this will also be discussed in this paper (Henry *et al.* 1987a,b, 1991, 1998; Henry 1991; Morais *et al.* 1993; Gebers 1995; Lodi *et al.* 1995; Gastal *et al.*1996; Canisso 2008; Canisso *et al.* 2010).

Natural sexual behaviour of donkeys

Domestic jacks kept on pastures in free range conditions show the characteristics of a territorial, nonharem breeder both with jennies (Henry *et al.* 1991; McDonnell 1998; Canisso *et al.* 2008a) and mares (Lodi *et al.* 1995), as is also the case with some species of wild jacks (Klingel 1998). At pasture the jack spends most of the time within a specific

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area, its territory; which normally provides a source of water, shade and good availability of grass (Henry *et al.* 1991; Klingel 1998; McDonnell 1998). Jennies live in migratory groups and are attracted to the jack's territory when looking for water and feed where they remain while in oestrus, during which time they are courted and mated by the jack (Henry *et al.* 1991; McDonnell 1998). Jacks do not display herding behaviour (Henry *et al.* 1991; McDonnell 1998; Canisso *et al.* 2008a) as is typical for harem stallions (McDonnell 2003).

The sexual behaviour of jennies is different from that of horse mares (Clayton 1981; Henry *et al.* 1987; Henry 1991).

Fig 1: A group of oestrous jennies mounting one another in a sexually active group near a jack. The jenny being mounted is displaying signs of oestrus (clapping mouth) while a third female watches it (on the right). The male donkey to the left of the group appears disinterested. Photograph by Sue M. McDonnell (1998), Carlos Chagas, Minas Gerais, Brazil. (Canisso et al. 2009).

Fig 2: An oestrous jenny, showing typical signs of oestrus (ears back, clapping mouth etc.) in the presence of a teaser jack. Photograph by Igor F. Canisso (2006), Equid Breeding Center, Federal University of Viçosa, Viçosa, Minas Gerais, Brazil.

Jennies congregate into sexually active groups seeking out a jack when they are in oestrus. They play a conspicuously active role in courtship, displaying homosexual behaviour such as mounting each other (**Fig 1**), and intense heterosexual behaviour including clapping mouth, ears back against the neck, rhythmic eversion of the clitoris, urination in small drops, typical braying vocalisation and the mounting stance (Henry *et al.* 1987; Henry 1991) (**Fig 2**). The sexual interaction of the jennies in particular appears important in attracting the jack. Absence of this element of jenny sexual behaviour is likely responsible in large part for the poor response for in-hand breeding or semen collection of jacks with jennies or mares (Morais *et al.* 1993; Lodi *et al.* 1995; McDonnell 1998; Canisso *et al.* 2010).

In the presence of an oestrous jenny the jack's normal response is loud vocalisation, Flehmen response, and

Fig 3: Mounting without erection (in this case partial erection) commonly shown by jacks as part of courtship behaviour. Photograph by Igor F. Canisso (2006), Equid Breeding Center, Federal University of Viçosa, Viçosa, Minas Gerais, Brazil.

Fig 4: Sexually active group of jennies pursuing donkey jack that is masturbating. Note open mouth and ears toward back signs of oestrus on jenny to right of jack. Photo by Sue M. McDonnell (1988), Carlos Chagas, Minas Gerais, Brazil. (Canisso et al. 2009).

rolling in the soil, often followed by mounting without erection which on average is made at least once per mating episode, whether natural or in-hand mating or during semen collection (Henry *et al.* 1991; Lodi *et al.* 1995; McDonnell 1998; Canisso *et al.* 2010). During natural mating the jack typically teases the jenny, often mounting without erection (**Fig 3**), and then retreats (Henry *et al.* 1991; Henry 1991; Lodi *et al.* 1995; McDonnell 1998). Erection typically commences a few minutes after retreat while the jack appears disinterested, grazing and gazing around (**Fig 4**). Within another few minutes the jack typically returns to the jenny, teasing resumes and then culminates in successful copulation (Henry *et al.* 1991). The duration of teasing before copulation is variable between individual jacks. Young jacks in particular are slow breeders (Gebers 1995) and have been reported to have double the number of mounts without erection when compared to adults (Canisso *et al.* 2010). The authors' experience suggests that this may be due to a lack of coordination and confidence of young inexperienced jacks resulting in nervousness which is often manifested in abnormal interaction with the female. This often includes rushing to mate and vicious biting of the female's mane, which often provokes rejection by the female. These tendencies typically diminish as the jack's experience improves.

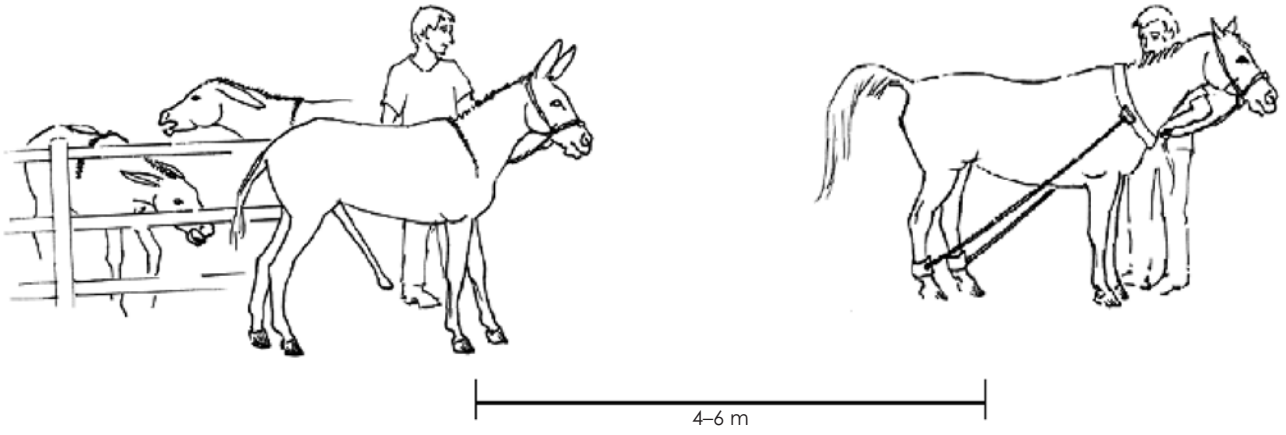
Knowledge of these typical behavioural characteristics is important for breeders, veterinary practitioners, and grooms in order that it can be applied to donkey stud management when breeding jennies or mares and for semen collection. The territorial nature of the jack is of particular importance when intensively managing breeding jacks. For example, the authors' personal experience suggests a shorter latency time to erection results if breeding or semen collection is always conducted in the same place as this may better emulate the donkey's natural territory. As a territorial animal the donkey is easily distracted by potential threats or intruders in its environment, especially the sight or sound of another donkey, which elicits territorial defensive behaviour. Breeding is usually most efficient when the environment is quiet, ideally with the same familiar handlers, minimal traffic of animals, agricultural machines or other distractions and away from other donkeys. Similar observations have been reported by Taylor and Mathews (1998).

In most mule farms the predominant breeding system is in-hand mating, although artificial insemination (AI) may be used (Canisso *et al.* 2008b). Jacks usually require some training to breed mares (Henry *et al.* 1998; Canisso 2008). Studies conducted by Lodi *et al.* (1995) on pasture breeding of mares by jacks reported a low effectiveness in mating behaviour with less than 40% of oestrous mares, as ascertained by teasing with a stallion, accepting the jack. Of those apparently successfully mated by a jack, conception rates were only 25–34%. It appeared that jacks were able to identify oestrus in the mares; however, the mare's response was muted, with only brief, less intense teasing interaction.

Several procedures have been suggested in attempts to overcome, or compensate for, the poor sexual behaviour of jacks when required to breed mares in-hand and during semen collection. Some of the procedures that have been tried in the field are discussed in the following sections.

Breeding management of jacks

Several strategies have been designed to improve efficiency of mating jacks in attempts to imitate the natural sexual interaction between jacks and jennies. One such strategy involves keeping the jack a short (5–6 m) distance away from the oestrous female after initial introduction and not allowing him near her until required. On the introduction of the jack to the female, teasing, followed by mounting without erection, is permitted (**Fig 3**). This system usually works well, and can be used not



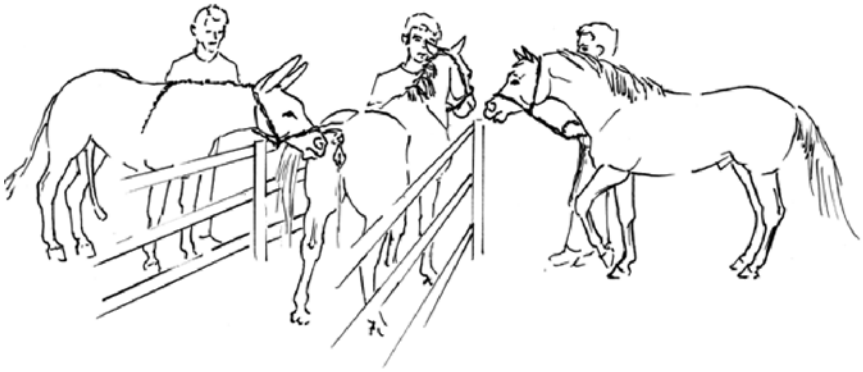
Drawing 1: An illustration of a breeding system used for semen collection or for in-hand natural mating of donkeys. On the right is a restrained mare deep in oestrus, in the centre is the donkey presenting full erection, kept at a distance (4–6 m) from and gazing at the oestrus mare, in the background to the left are a two oestrous jennies within visual contact of the jack so emulating the natural system and encouraging sexual behaviour in the jack (Canisso* et al. *2009).

only for in-hand mating but also for semen collection as it mimics the behaviour characteristic of normal courtship (Henry *et al.* 1991; Canisso *et al.* 2010). This is particularly helpful for young jacks (Canisso 2008). Another strategy is to employ 2 adjacent paddocks, with a group of oestrous jennies enclosed in one and a single female (jenny or mare) preferably in deep oestrus restrained in the other (with ropes/stocks) (**Figs 5** and **8b**). The jack is then allowed to tease the restrained female and mount without erection, he is then taken away a distance of 4–6 m, where visual contact can be maintained with the restrained female and those in the neighbouring paddock (**Fig 6, Drawing 1**). The jack is kept at a distance until complete and sustained erection is achieved when he is led back towards the restrained female and semen is then collected or in-hand mating occurs (**Fig 7**). If within a few minutes of teasing and possible mounting without erection, no sustained erection is achieved or the jack appears disinterested in the female a new attempt is made to tease the jack etc., if again the jack shows no interest in the female, he is returned to his stall and a new attempt is made later on that day or a subsequent day. In the authors' experience this is a very successful method and rarely do jacks have to be removed and reintroduced on a later day.

The procedure is meant to approximate the natural teasing behaviour rhythm of jacks at pasture, where the jenny is approached and teased, mounted without erection, retreat and then repeat with mounting with erection and insertion. The proximity of the other oestrous jennies mimics the remainder of the group of sexually active females, which would naturally be in the vicinity and appear to contribute to the stimulation of the jack (Henry *et al.* 1991; Canisso *et al.* 2008a). Greater efficiency is apparent if the procedure always takes place in the same area as this then additionally imitates the male's territorial environment. These techniques can be used effectively for in-hand mating of donkeys. However as discussed previously most mule studs do not keep jennies, necessitating the use of mares both for natural mating and semen collection. This presents particular challenges as mares only show mild signs of oestrus in the presence of a jack, especially if not experienced with jacks (Canisso 2008). This muted oestrus reaction probably contributes to the especially long reaction latency of jacks when presented with an oestrous mare for inhand covering or semen collection compared with jennies (Morais *et al.* 1993; Lodi *et al.* 1995; Canisso *et al.* 2010). Therefore the choice of mare is important and additional strategies are often required. Personal observation suggests that jacks are more vulnerable than stallions to suppression of sexual interest as a result of rejection by mares. If the mare kicks, bites or otherwise objects to the jack, it can seriously affect his response, often making mating or semen collection impossible. Bearing this in mind, it is important that only mares that are in deep oestrus, as determined by teasing with a stallion, are used and that these mares naturally show oestrus well to jacks. If the mare does not stand well for the jack, ideally another mare should be used. If a better mare is not available, twitching or restraint using hobbles or stocks such as those described in the following section may help.

A simple stocks described by Canisso *et al.* (2008c) that has been successfully used on Brazilian mule studs is constructed of wood or metal rails around a central pit. The floor can be concrete, though a simple earth or grass base would suffice (**Fig 8**) and should be constructed at a lower level than the surrounding ground. This difference in floor height as well restricting the mare's movements, also helps compensate for common differences in height between jacks and mares. Additionally, the stocks provide good stability for the jack, as the mare is restrained from excessive lateral sway as jack mounts. It also helps protect handlers from kicks (Canisso *et al.* 2008c).

Breeding jacks with mares at pasture is not only challenging due to the differences in the sexual behaviour of the 2 species and natural reduced interest in jacks by mares and *vice versa*, but also due to physical differences



Drawing 2: A drawing to illustrate a stimulatory breeding system that can be used in training to nonconditioned juvenile or elderly donkeys to mate with mares, or for adult donkeys with low libido that are required to breed mares. On the left the donkey jack being trained is allowed to approach the perineal area of the oestrous mare, which is in the centre, 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 oestrus. This oestrus behaviour encourages sexual behaviour in the jack (Canisso et al. 2009).

in height (Canisso *et al.* 2010). The authors observed 5 adult Pêga jacks (Brazilian donkey) that were acquired for mule production on a large farm in the Northern region of Brazil (Mato Grosso State). All jacks had been conditioned to breed mares on their former stud. The jacks were kept with a herd of 130 crossbred Quarter Horse mares throughout the year in a large paddock. However, the foaling rate was only 15%. Upon clinical investigation, it was determined that the jacks had difficulty in mounting the mares due to the limited number that accepted the jack's approaches, and difficulty ejaculating due to the differences in height. Additionally the authors observed that the jacks tended to have discrete specific territories within the paddock, with just the mares roaming across the paddock as a whole. Mares were investigated by the jack if they crossed his territory when in oestrus. If the mare showed hostility to the jack during his initial approach, despite being in oestrus, the jack immediately lost interest. It appears, therefore, that breeding mares at pasture is often unsuccessful (Lodi *et al.* 1995), even when using mating systems successful in breeding pure donkeys (Henry *et al.* 1991). An alternative programme is now practiced on this farm with greater success, where mares are teased by a stallion and if in oestrus immediately bred in-hand to a jack at 3 day intervals while in oestrus. Mares reluctant to accept the jack are restrained by twitching. The foaling rates with this system are much improved (approximately 65%). Free mating has been suggested as a possible breeding system, but although it is the authors' experience that conditioned donkey jacks interact most easily with, and are most likely to copulate with, mares if they are confined as a couple in a small paddock, fertility rates are still very poor. Work by Lodi *et al.* (1995) suggests that even under such conditions, conception rates are only 25–34%. This failure to mate was largely due to differences in height between the jack and horse mares, making the physical act of mating very difficult, as well as due to differences in sexual behaviour.

Fig 5: The strategy of using 2 adjacent paddocks to encourage jack sexual behaviour. A restrained oestrous jenny (in the foreground) along with a group of oestrous jennies (in the background) stimulate the adult or young jack for natural in-hand covering or semen collection. Photos by Igor F. Canisso (2006), Equid Breeding Center, Federal University of Viçosa, Viçosa, Minas Gerais, Brazil.

Fig 6: Jack kept at a distance within visual contact from a restrained mount jenny and a group of jennies in an adjacent paddock (in the background) until full erection is achieved ready for mating. Photos by Igor F. Canisso (2006), Equid Breeding Center, Federal University of Viçosa, Viçosa, Minas Gerais, Brazil.

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 accidental contact (**Drawing 2**). All 3 animals should be handled and arranged to allow the stallion to tease the mare conventionally, starting with head-to-head introduction. The jack is then positioned near the mare's perineal area. As the mare will show signs of oestrus to the stallion the jack becomes stimulated to mount the mare. Normally, within a few seconds the jack will demonstrate Flehmen response and loud vocalisation. This system results in a rapid interest in the mare along with attempts to mount regardless of whether the jack is conditioned to

Fig 7: Semen collection using an oestrous jenny. Photos by Igor F. Canisso (2006), Equid Breeding Center, Federal University of Viçosa, Viçosa, Minas Gerais, Brazil.

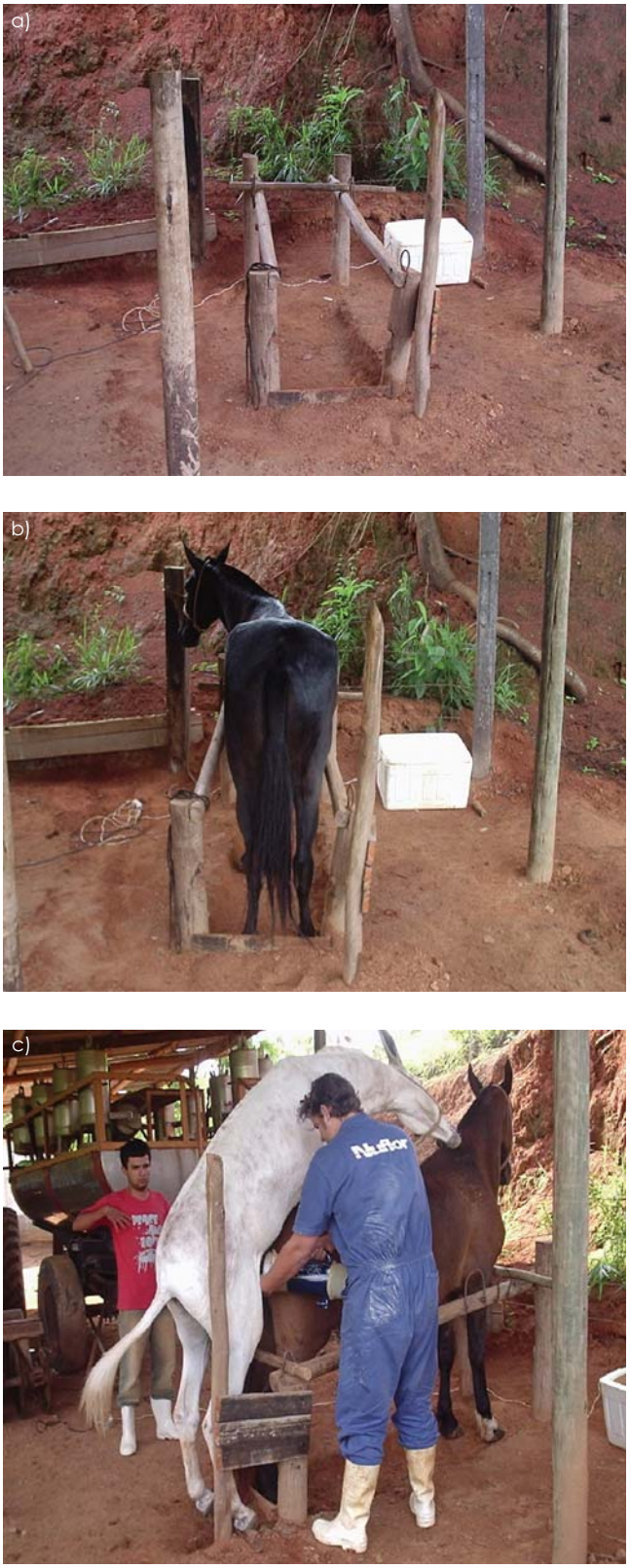


Fig 8: A typical stocks used to help mate mares in-hand to donkeys or for semen collection described by Canisso et al. (2008c). The stocks are made of a wooden frame around a central pit (a) in which the mares stands (b) allowing the jack to mount the mare for natural covering or semen collection (c). Photos by Igor F. Canisso (2007), Taruma Stud Farm, Guaraciaba, Minas Gerais, Brazil.

breeding mares or not. This procedure can be used not only to stimulate unconditioned adult jacks to breed mares but also young males during the learning process and jacks with low libido. Again, our experience suggests that some jacks perform better when they are kept with an oestrous mare in their stall and natural mating allowed or during the period of semen collection. One young jack known to the authors would naturally serve a mare or provide a semen sample within 10–15 min when kept in his own stall with the mare, compared to 40 min if taken out of his normal stall environment or easily distracted by anything near him such as wind, insects, noise etc.

Although mares generally become increasingly accepting of jacks to which they have been bred, pasture or in-hand breeding of mules remains challenging. Hence AI is often employed. Some practitioners use a dummy mount for semen collection, similar to that used with stallions, with mounting encouraged by the close proximity of an oestrous mare or jenny. In the authors' experience this is a successful, though time consuming process, with most jacks requiring up to 1 h per semen collection. An alternative reported by some practitioners is turning 2 or 3 jennies out together 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.* (1996) reported a similar system where just one oestrous jenny and one jack are turned out free in a small paddock (20 m^2), and semen is similarly collected by rapid intervention with an artificial vagina as soon as the jack is seen to mount the jenny with a complete erection. This method, though quite reliable, still involves a long reaction latency that can be problematic on busy studs.

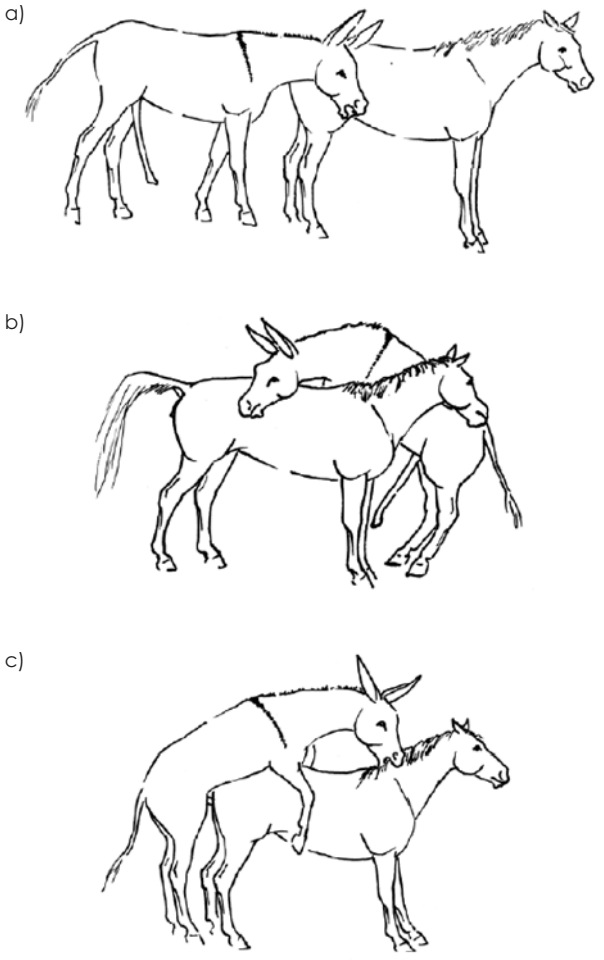
Training jacks to breed with mares

As discussed, most jacks are not naturally stimulated to breed with mares without some training and/or procedural modifications. There are several strategies that can be employed to achieve this. One such strategy, used with reasonable success by mule breeders in Brazil, is keeping jacks with fillies together from weaning to age 2 years. During this time all physical, visual and auditory contact with jennies should be avoided. It appears that if the jack is only bred with fillies from puberty onwards he becomes attracted, and so conditioned, to mate mares. If necessary, jennies can then be introduced for mating at an older age. The authors have observed that when jacks are turned out with fillies from before puberty, they demonstrate mounting without erection, following the female, Flehmen, penile relaxation with partial erection and masturbation; after puberty this is then followed by total erection, mounting and successful copulation.

Similar to using an oestrous jenny to encourage a jack to mount a dummy mount, an oestrous jenny can also be used to stimulate unconditioned jacks to mount mares. Some practitioners have reported good success by turning

out the jack with a deep oestrous mare into a small paddock for several hours during which time the jack may tease and hopefully successfully mount the mare. This may be successful immediately but may require repetition over several days (**Drawing 3**). In such a system, however, care should be taken to select a mare that accepts jacks and is free of a propensity to kick or bite.

The strategy of 2 adjoining paddocks as described above can also be useful for young jacks (**Figs 5 and 6; Drawing 1**). The young male is kept within clear visual contact, but with no direct physical contact, of the restrained oestrous mare/jenny or group of oestrous jennies. Similarly, jacks can also sometimes 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 oestrus (as described above) has also been used successfully to encourage young jacks.



Drawing 3: 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 oestrus mare (trained to mating with jacks) is inserted in the donkey's stall. a) the donkey, with full erection, approaching an oestrous mare, that is presenting typical passive oestrus behavior; b) the jack donkey mounting the mare, laterally; c) successful copulation (Canisso* et al. *2009).

In the authors' experience jacks conditioned to breed mares can be successfully re-conditioned to breed jennies when they reach mature age. However, if this introduction to breeding jennies occurs at too young an age jacks will lose interest in breeding mares. Providing the introduction to jennies occurs at a mature age interest in breeding mares, as well as jennies, can be maintained. As with all systems, however, there is significant variation between individual donkeys and a jack's interest in a mare is significantly affected by her acceptance of him. Donkey breeders in Brazil have reconditioned jacks to breed jennies as late as age 10 years. This reconditioning is not always successful and some jacks continue to show little interest or even violent rejection to jennies (Taylor and Mathews 1998). Re-introduction to jennies needs to be closely monitored and sometimes sedatives are advised to initially relax the jack in the presence of the jenny.

Some problems encountered with breeding jacks

The jack's sexual behaviour and breeding efficiency are affected by its 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 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 ever having visual and not physical contact. This evokes territorial defensive behaviour and can result in aggression, stall walking, failure to eat or other behavioural changes, as if preoccupied with trying to attack the other jack. In such cases simply changing the positions of the jacks can restore more normal behaviour. Occasionally jacks become inexplicably disinterested in breeding and semen collection despite previous success (Morais *et al.* 1993; Taylor and Mathews 1998). In the authors' experience, however, the majority of such cases result from a clinical problem, subclinical disease, laminitis or excessive confinement. Increased turn-out time and exercise typically appears to significantly improve libido.

In the authors' experience, the greatest libido problems occur in young and/or inexperienced jacks, which require greater than double the time to adults to successfully collect a semen sample, an observation also reported by Gebers (1995) and Canisso *et al.* (2010). Careful attention has to be paid to managing young jacks, particularly in respect to controlling inter-male aggressive behaviour which is not uncommon and can lead to a decrease in libido. On some occasions when jacks are continuously confined to stalls and away from females, they can display quite aggressive behaviour towards the female and handlers when mares or jennies are introduced. From the author's experience this appears to be a particular problem at the beginning of the breeding season. It is the authors' experience that with

increased turnout time, more frequent grooming, replacing carbohydrates with vegetable oil as a dietary source of energy, this tendency typically dissipates. In the most severe cases, it may take 45–60 days for the jack's general health status and social behaviour to improve and aggressive problems to diminish.

Conclusion

The natural sexual behaviour of jacks and jennies is distinctly different from that of mares and stallions. Knowledge of this natural courtship and mating behaviour is useful in implementing strategies to approximate more natural stimuli during intensive in-hand breeding of donkeys. A significant number of jacks are used for mule production via natural service or AI in the absence of jennies, which presents additional challenges largely due to differences in sexual behaviour of mares and jennies, but also due to differences in size. Young jacks typically require training to breed mares and specific management practices can be used to achieve this. Additionally, strategies which attempt to emulate the jack's natural breeding environment and behaviour can be employed to good effect, with both young and mature jacks, along with the use of specially designed stocks for mare restraint. AI is a further possibility for overcoming mating difficulties. For AI, similar use of strategies to emulate more natural stimuli can greatly improve semen collection efficiency, whether using a jenny or mare stimulus.

Acknowledgements

Line drawings were by Erlene Michener. The authors thank the American Association of Equine Practitioners for permission to use some images presented at the 55th Annual Convention in Las Vegas, Nevada, USA.

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