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ANIMAL BREEDING AND GENOMIC – GENOMIC EDITING

IS016

Selection and conservation of *Apis mellifera* at the time of globalization

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Despite beekeeping in Italy is widely considered one of the most advanced in Europe from the management techniques point of view, as regards the genetics and conservation aspects is far away from an optimal setting. Selection is based only on the maternal side and breeding of the virgin queens (VQ) is almost totally left to uncontrolled field mating. Italy is the home country of a particular variety of Apis mellifera, well known all over the world for a number of excellent characteristics, the Ligustica variety. Ligustica and Carnica (or Carniolan) bees belong to a same cluster spread toward Europe after the end of the last Glacial Era. Ligustica is well adapted to the mild climate of the Peninsula, while Carnica has its homeland on the North-Eastern side of the Alps and is widely bred on the Alpine Arch. In Sicily, there are still some examples of the original Sicula breed close to the Intermissa subspecies, present in all the South side of the Mediterranean sea. Before the introduction of the nomadism practice, the conservation of the three breeds present in Italy did not represent a problem since their geographic distribution had limited overlapping areas.

Due to its excellent numbers, the Ligustica strain was exported all over the world since the XIX century and well selected abroad. An important example is the Buckfast Abbey Bee, selected and improved in UK by Brother Adam during the XX century. Brother Adam included in this Buckfast honeybee the best traits of Ligustica, Carnica, Caucasic, Anatolian and several other geographic subspecies using empirical but well focussed techniques of gene introgression. In the meantime, in the former area of the Austro-Hungarian Empire, Carnica breed was selected by modern additive breeding techniques based on the control of mating in numerous isolated stations and, in more recent years, by BLUP genetic evaluation.

Now, in a rapidly globalising world, the diffusion of new breeds is fostered by superior performances in terms of honey production, resistance to pathogens and parasites, docility, reduced swarming attitude and other important management traits. In this context we are presently facing in Italy a progressive diffusion outside the Alpine area of Carnica breed. More remarkably, in an overall yearly market of about 700,000 queens, more than 100,000 are Buckfast that spread rapidly for their superior characteristics. It is therefore easily predictable that drones produced by these queens mating with VQ of the original geographic autochthonous breeds will determine a progressive genetic erosion of our national germplasm due to the lack in Italy of a proper culture of mating control. In honeybees, selection and genetic conservation of local breeds, in addition to the possible development of new biodiversity, would take enormous advantage from the use of isolated mating stations. In the Alps and in some districts of the Apennine chain is quite possible to find small secluded valleys or highlands where beekeeping is absent due to the lack of sufficient pasture. The access to these areas should also be limited to the beekeepers involved.

In the last years, thanks to the BEENOMIX project funded by Regione Lombardia, we have developed a model for the use of these isolated stations (IS) both for selection and for conservation. The general idea is that a breeder or a small group of associated breeders should develop a selection scheme in which a number (e.g. 100) of colonies are phenotyped, possibly genetically evaluated, and the best 8/10 selected. From the top best family 15 drone-producing queens (DPQ) are raised and placed in a 'private' IS to saturate the area with top selected drones. From the other best selected families (queen-producing queens, QPQ) a new cohort of 100 VQ is raised and taken to the station for breeding. The scheme can be implemented by any professional breeder, on any breed or strain, on any selection objective. By the use of 15 sister DPQs that represent a dummy father of future bees, a pedigree file can be registered providing an additive relationship matrix for BLUP indexing of the animal.

An IS is thought just to maximise the response to selection of that breeder and to provide improved animals both by maternal and paternal path. For the production of commercial queens, a different type of isolated station is necessary: a breeding area

(BA). A BA is thought to provide drones of a particular breed or strain, to breed a large number of commercial queens. Drones may come from many DPQ, eventually certificated for their breed origin, non-necessarily sisters, enough in number to guarantee the natural mating of even thousands VQ. The DPQ should be provided by several breeders selecting that same breed and the BA should be accessible to single beekeepers willing to breed their VQ to those specific drones. Commercial beekeepers should renew their queens buying these marked queens mated in a BA, to minimise the number of VQ available for free random mating. Nomadism and breeding of different breeds in a same area became therefore possible without risk of genetic pollution while conservation of any local breed is assured by selection in IS and diffusion thorough pure queens mated in BA.

ANIMAL PHYSIOLOGY, HEALTH AND WELFARE – REPRODUCTION

IS017

Endocrine and physiological differences between bovine and buffalo females and their impact on assisted reproductive technologies

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The combined use of assisted reproductive technologies (ART), such as, timed-artificial insemination (TAI), superstimulation (SOV), ovum pick-up (OPU), in vitro embryo production (IVEP) and timed-embryo transfer (TET) has a great potential to improve reproductive outcomes and disseminate selected genetics, improving milk and beef production in bovine an in buffalo herds. Nowadays, our expanding knowledge regarding endocrine and physiological differences between bovine and buffalo ovarian function during the oestrous cycle has given new approaches for the precise synchronisation of follicular development and ovulation to apply consistently ART. Unlike bovine, buffalo is a seasonal reproductive species and becomes sexually active in response to a decreasing day length (short-days) in late summer to early autumn. However, in recent decades several therapies have been proposed for manipulating ovarian follicle growth and ovulation, regardless of reproductive seasonality or cyclicity in buffalo and bovine. Ovarian follicular dynamics in buffalo are similar to those in bovine. The 2-wave cycle is the most common and the follicle deviation occurs 2–3 days after ovulation. In cattle and in buffalo the number of waves in a cycle is also associated with the luteal phase and with the oestrous cycle length. However, the number of follicles recruited per follicular wave is lower in buffalo than in cattle. Artificial insemination (AI) has proven to be a reliable technology for producers to improve genetic progress and control venereal diseases in their herds. However, the traditional AI programme is impaired by the low oestrous detection efficiency due to the poor manifestation of the symptoms of oestrus and to operational difficulties to detect oestrus in bovine and in buffalo. Furthermore, buffalo presents lower frequency of homosexual behaviour compared to cattle, affecting more negatively the oestrus detection efficiency. Recent synchronisation protocols are designed to control both luteal and follicular function and permit fixed-time AI with high pregnancy rates regardless the cyclicity in bovine and during the breeding (autumn-winter) and nonbreeding (spring-summer) seasons in buffalo. Superstimulation for *in vivo* embryo production and ovum-pick-up (OPU) for in vitro embryo production (IVEP) can rapidly enhance genetics through both the female and male superior lineage. Unlike bovine, the *in vivo*-derived (IVD) embryo production has been shown to be feasible in buffalo and low efficiency and limited commercial application has been documented in this species. However, a series of recent studies have demonstrated the potential of *in vitro* embryo production (IVP) in buffalo, similar to that observed in cattle. Additionally, synchronisation protocols provide opportunities to fixed-time embryo transfer in bovine and buffalo recipients, facilitating the process at the farm and increasing the efficiency of ET. These endocrinology and physiology differences between bovine and buffalo reveal a number of key points related to the manipulation of ovarian follicular growth which must be taken into account to improve the efficiency of assisted reproductive technologies in these species.

ANIMAL PHYSIOLOGY, HEALTH AND WELFARE – ANIMAL WELFARE

IS018

Animal welfare assessment: towards a simplification

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The aim of the present study is the identification of current trends in the field of on-farm animal welfare assessment. The Animal Needs Index was the first on-farm welfare monitoring scheme developed in Austria and Germany in the eighties with the objective to provide data on the level of animal welfare of the farms claiming organic certification, when a specific legislation on organic farming was still missing at European level. That scheme, albeit feasible and reliable within and between observers, mainly relied on design characteristics and was not scientifically