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Conference paper

WHEN WILL ALL THE LIVESTOCK IN AUSTRALIA BE ONE CLONE?

A. E. McClintock

There are a number of reasons why it seems unlikely that there will be just one clone per species, at least for the foreseeable future.

Emergence of specialist genotypes for niche markets

There are so many different production systems and markets that it seems likely that we will see genotypes that have been selected for optimal performance within each. The gains to be made during the first few years of selection will be substantial but will make further efforts comparatively less rewarding.

Dangers of "monoculture"

Those that are worried about loss of genetic diversity, tend to object to the cloning of livestock because they imagine that animals will be bred in rather the same way as plants. In the case of plants they point to cases where diseases have wiped out crops (e.g. the Irish Potato Famine). It seems that the immune systems of cattle are likely to be more adaptable than that of the potato. However I would not be comfortable to advise a farmer to rely on less than say 4 clone lines. No doubt there would be farmers who would not be interested in using clones.

Gene banks

Why have we been so slow to set up frozen banks of germ plasm for domestic livestock? The technology is available to store semen embryos and oocytes at minimal cost, yet how many countries can claim to have an extensive gene bank. Organisations such as Genetics Australia have kept semen samples from virtually every bull over the last 30 years, but this is not

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A. E. McClintock, Genetics Australia, Bacchus Marsh, Vic 3340.

the same as having a national resource. Helen Newton-Turner unsuccessfully tried to initiate a Gene Bank as part of the Australian Bicentennial Program. Her vision was to eventually extend this gene bank to make it an international resource in a country that was politically and seismologically quite stable.

Impact of public perception

We have already seen the rejection of some new technologies (e.g. BST in Europe). There is a distinct nervousness in Japan concerning the use of transgenic plants. It is not difficult to imagine a situation where dairy products made from milk from transgenic cattle were not acceptable in certain markets. It would be very easy for technologies such as cloning to become confused with transgenics, in the media and in the mind of the public. In a species such as cattle where it takes many years to replace the national herd, farmers would be reluctant to do anything that would cause major markets to become inaccessible.

Impact of technology issues

Cloning is possible now, but it is not a commercially viable prospect:
– Conception rates are far too low.
– Family sizes are too small.
– Cloned embryos are too expensive.

If cloned embryos could be produced very cheaply then it would be possible to circumvent low conception rates by transferring several embryos into a recipient cow at one time.

Small family size is a serious problem. How many dairy sire progeny test programs would be successful if each bull was limited to, say 100 doses of semen? A family size of 100000 would be large enough to encourage thorough testing of the family before its release. With family sizes of a million there would be a danger of lack of diversity.

It is essential to be able to suspend a family line, while some representatives are undergoing a thorough testing program. The team at Monash University, led by Alan Trounson, has demonstrated the viability of frozen cloned embryos.

If cloning became practicable using nuclei derived from cell cultures, then family size, and storage of frozen material should be overcome eventually.

If cloned embryos cost $30, and had a 50% pregnancy rate, it seems very likely that they would be attractive to most dairy farmers. Cloned replacement females could be F_1s. Cows not needed for breeding replacements could be used to carry cloned embryos for other purposes.

At $300 per embryo, farmers might be more inclined to use cloned females to breed replacement cows. In this situation, there would be little advantage in producing F_1, clones. At this price it would still be economical to breed beef bulls.

At $3000 per embryo, then there would be relatively limited scope for cloning. If it were possible to produce adult cloned embryos for $3000, then there would be a number of niche markets, particularly for male clones or females from show winners.

Impact on genetic improvement programs

If the use of cheap cloned embryos became accepted in the dairy industry, it would become more difficult to keep the present progeny testing systems running for dairy bulls. It seems likely that this would also be happening in most countries around the world at the same time. As a result, continued genetic improvement would cease unless there was some sort of nucleus breeding program that incorporated the best genetics from around the world. These programs would be at a genetic disadvantage relative to the commercial cloned animals. The sires used would probably not be at the same genetic standard has the females. In addition, much of the superiority of the cloned females would be due to non-additive gene effects that would be lost in the next generation.

If an elite, tested adult bull could be cloned for, say, $2000, there would be a market for such bulls in both the dairy and beef industries, for use as natural service bulls.

Impact on production systems

The ability to clone dairy cows cheaply, and with satisfactory conception rates, would allow dairy farmers to breed sufficient replacement cows with a relatively small proportion of their herd. The remaining cows could be used to carry embryos of a different breed. For example complementary beef breeds might be used to produce cloned F_1, females with good maternal traits. Alternately male cloned embryos could be used to breed terminal sires for use as beef bulls in commercial beef herds.

Loss of genetic variation

The establishment of Gene Banks in a variety of countries should be done now. Farmers should not be expected to be the custodians of living museums.

Lack of genetic diversity?

The simultaneous use of a number of elite families in each of the many production environments, will ensure sufficient diversity. In addition, if cloning were cheap enough, we would expect to see F_1, clones being adopted for dairy production. Far from leading to inbreeding problems, dairy cows would be more heterozygous than they have ever been.

KADA ĆE SVA STOKA U AUSTRALIJI BITI JEDAN KLON?

Sažetak

Ima više razloga zbog kojih izgleda nevjerojatno da će postojati samo jedan klon po vrsti, barem u predvidivoj budućnosti.

Postoji toliko različitih proizvodnih sustava i tržišta da izgleda vjerojatno da ćemo dočekati genotipove selekcionirane za najbolju performancu unutar njih samih. Koristi što će se postići tijekom prvih nekoliko godina selekcije bit će znatne ali će dalji pokušaji biti manjeg uspjeha.

Oni koji su zabrinuti zbog gubitka genetske raznolikosti obično su protiv kloniranja stoke jer misle da će životinje uzgajati na gotovo isti način kao biljke. U slučaju biljaka oni pokazuju slučajeve gdje su bolesti uništile usjeve (npr. irski krumpir). Izgleda vjerojatno da će otporni sustavi goveda biti prilagodljiviji od sustava krumpira. Međutim, ne bi trebalo savjetovati farmera da se pouzda u manje od, recimo, četiri linije klona. Bez sumnje, bit će farmera koje neće zanimati upotreba klona.

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