CORRESPONDENCE

Patents and plant breeding

SIR — In the United States a patent (No. 4,326,358 of 27 April 1982) has recently been granted to Agrigenetics Research Associates Ltd of Denver, Colorado for the use of tissue culture (micropropagation *in vitro*) for the multiplication of parental plants to produce hybrid seed of crop varieties. The patented procedure is intended for the rapid development, evaluation and commercial production of hybrid seed from pairs of parental plants chosen for their specific combining ability and uniformity of the hybrid between them irrespective of their degree of homozygosity. The specific example describes the application of the technique to tomatoes. It is understood that equivalent patents in other countries have also been sought.

Both public and private plant breeders must feel concern that this patent purports to give rights over the use of techniques that have been part of the stock-in-trade of plant breeders for some considerable time and have already been used commercially. We would therefore like to draw attention to the conditions governing the validity of patents on plant tissue culture in the United States, as well as to evidence in the scientific literature on the widespread use of tissue culture techniques by plant breeders before the US patent application was made.

Bagwill[1] has summarized the validity of patents on plant tissue culture techniques in the United States. Among the key points made by Bagwill are:

- A person shall be entitled to a patent unless — (a) The invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent. (b) The invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States.
- A patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

In the light of Bagwill's remarks it is pertinent to observe that: (1) The essential principles and techniques in the patent were known and practised by others well before the patent application was filed. (2) The practical value of the particular combination of pre-existing principles and techniques outlined in the application had been recognized previously by others. (3) The value of the approaches outlined in the application to variety development and production were already obvious to any person having ordinary skills in the relevant disciplines.

The case for patentability is based on a number of premises which merit comment: *Utilization of hybrid vigour in developing crop varieties*: The value of hybrid vigour in developing superior crop varieties has been recognized and exploited by plant breeders for more than 100 years. Beal was the first to recommend the use of hybrid varieties of maize; recognition of their commercial worth in other crops followed later. This principle is now universally acknowledged by biologists and is discussed in most textbooks on plant breeding[2].

Phenotype uniformity obtained from specific combination of heterozygous parents: The concept that first generation hybrids of acceptable phenotype can be obtained by crossing two heterozygous stocks has been known and used for a very long time. For example, varietal hybrids of maize were exploited commercially at least 150 years ago[3]. Controlled experiments on varietal hybrids of maize were reported in the 1870s[3] and interest in them was revived in the 1960s[4]. The difference between a varietal hybrid and the type of hybrid described in the patent is one of degree rather than of kind.

In the description of the patented procedure it is noted that some, but not all, hybrids of pair-crossed heterozygous plants are sufficiently uniform in phenotype to be acceptable as commercial varieties. This is not a new idea. Differences in uniformity for important traits were noted among double-cross hybrids of maize more than 40 years ago[5]. To any person with a knowledge of genetics it is obvious that if there are differences in phenotypic uniformity among double-cross hybrids, they would also occur among hybrids produced by crossing heterozygous single plants because the same genetical principles apply in both cases.

Progeny testing and specific combing ability: In the patented procedure, selection among potential parents of hybrids is based on the field performance of their hybrid progeny. It acknowledges that the best way to exploit specific combining ability is to make and test the hybrid that will eventually be released as a new variety. The concept of exploiting specific combining ability in this manner is not new. It was the basis of Hull's[6] recommendation that an inbred tester be used in developing new single-cross hybrids and is also an important feature of the full-sib selection systems developed by Hallauer[7], Lonnquist and Williams[8] and Hallauer and Eberhart[9] for maize. The only significant difference between these methods and the patented method is the manner in which selected heterozygous plants are propagated.

Seed yields from heterozygous parents: The principle that greater yields of good quality hybrid seed are obtained if the parents of a hybrid are themselves heterozygous has long been known to breeders of cross-pollinated crops. It was embodied in Jones'[10] proposal of 1918 that double-cross hybrids of maize should be used as commercial varieties. The same principle was later exploited in three-way cross hybrids and again in modified single crosses and sister line crosses[2]. It has also been used in the production of kale hybrids[11] and is a concept used in the breeding of hybrid Brussels sprouts[12] and onions[13].

Vegetative propagation: The vegetative propagation of heterozygous plants to provide adequate stocks of genetically identical plants for hybrid seed production is crucial to the procedure patented. However, the idea that cloning can be used to perpetuate and increase unique genotypes that cannot be maintained without genetic change by sexual methods of reproduction is common knowledge[2,14–17]. Its particular use in the production of hybrid seed has also been repeatedly recommended[2,11,14,18–25]. The special value of micropropagation *in vitro* as a potentially more efficient substitute for vegetative propagation *in vivo* is also generally acknowledged[14,15].

On the basis of our interpretation of Bagwill's paper[1] and the evidence presented here, we find it difficult as scientists to see how the conditions recited by Bagwill can have been satisfied in the process of obtaining this patent. We strongly urge the United States Patent and Trademark Office to re-examine this particular patent and if similar applications are made elsewhere to consult specialist opinion more widely before granting other plant patents that may similarly restrict the use of techniques and combinations of techniques that are common currency among plant breeders worldwide.

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