Cell fusion discovery could improve agricultural production

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Cell-to-cell fusion in plants is rarely seen due to their relatively tough cell walls,

according to the researchers. Credit: pakhnyushchyy

An international research team has observed cell fusion in flowering plants for the first time in more than a century. The discovery demystifies how plants prevent the attraction of excessive pollen tubes after a successful fertilisation.

Reproduction of flowering plants occurs within a plant's ovule by the fertilisation of both the egg and a larger central cell by two sperm cells. Sperm cells are carried into the ovule by a pollen tube and discharged into one of two "synergid" cells located next to the egg cell. During this process, the synergid cell dies and degenerates, and the sperm cells migrate to the egg and central cell. Once fertilised, the egg cell becomes the embryo while the central cell becomes the endosperm that nourishes the embryo.

Earlier research found that the role of synergid cells is to attract or prevent pollen tubes from reaching a plant's ovule. If the initial fertilisation fails, the second synergid cell attracts a new pollen tube for another attempt of fertilisation. In the case of a successful fertilisation, the second synergid cell – also known as the persistent synergid cell – is inactivated to avoid multiple pollen tubes entering the ovule. This prevents more than one sperm cell from fertilising the same egg, creating a genetic imbalance. However, the mechanism behind synergid inactivation remained unknown.

Led by Daisuke Maruyama of Nagoya University's Institute of Transformative Bio-Molecules, a team of international researchers from Singapore, Germany, Saudi Arabia and Austria has discovered that, following fertilisation, the persistent synergid cell fuses with the endosperm, triggering its inactivation.

Cell-to-cell fusion in plants is rarely seen due to their relatively tough cell walls, according to the researchers. Their study is only the third report of plant cell fusion being observed and the first observation since the initial reports in the late 1800s.

Using live imaging techniques, the team found that cell fusion, which is induced by the fertilisation of the central cell, rapidly dilutes the contents of the persistent synergid cell. Meanwhile, fertilisation of the egg cell activates its "ethylene signalling" pathway, which degrades the nucleus of the persistent synergid cell. As a result, the persistent synergid cell completely loses its ability to attract pollen tubes.

Dr Maruyama says their discovery could ultimately be useful for improving the success rate of plant fertilisation in agricultural production, for example. Optimising the fusion of synergid cells with endosperm, he explains, would reduce the chance for multiple pollen tubes to be accidentally attracted following a successful fertilisation.

Next on the team's agenda is to explore molecules that are involved in the fusion of synergid cells and endosperm.

Provided by Institute of Transformative Bio-Molecules (ITbM), Nagoya University