38. Notes on the Propagation of Sweet Potato, *Ipomoea Batatas* Lam. II. On the Purple Pigment, with Special Reference to its Relation to the Cell Nucleus.

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The appearance of the purple pigment in a localized part of the root of *Ipomoea Batatas* as is well known indicates the region which develops to be the root-tuber, but as far as I know the cytological as well as the chemical inquiries of this pigment have not been made yet. The following description concerns chiefly to the distribution and the formation of the purple pigment in the cells and tissues, especially in the nucleus. In 1941 I have reported the findings on the extrusion of the nuclear granules which relate to the formation of cell vacuoles and the crystal formation in the vacuoles, and considered about its relation to the growth of the cells¹⁾. The purple pigment formation takes place also in the nuclear granules and their extrusion into the cytoplasm also occurs. This is another example which shows the direct relation of the nuclear activity and the expression of genetic characters.

Observation.

The intensity and the distribution of the purple pigment in the cells and tissues in *Ipomoea Batatas* are different in different races, clones, and even in one and the same kind of tissue in an individual plant under various conditions.

The purple pigment in the root-tuber. Just before the formation of cork cambium in the cortex of the root the small granules coloured with the purple pigment appear first in the nucleus of the subepidermal cells and in certain cases also in the nucleus of the epidermal cells; then the purple granules extrude from the nucleus and gather around the surface of the nucleus; and later the granules migrate into the cytoplasm, finally reaching the outer surface of the protoplast where the pigment accumulates for a while. With the degeneration of the cell-plasm as the cork cells develop the pigment accumulated on the surface of the protoplast passes through the cell membrane and is distributed homogeneously on the outer surface of the latter, so that the cork cells are thoroughly covered with the purple pigment, giving the appearance as if the middle lamella in the cork tissue is stained. Often we can recognize the coloured residue of the degenerating nucleus

1) Yasui, K. 1941. On the extrusion of 'nuclear granules' and their reversible swelling in plant cells, with special reference to the vacuole formation in the cytoplasm. *Cytolygia*, 11: 83-95.

in the cork cell for a while after the cytoplasm degenerated. The same process continues so long as the cork formation is going on. Thus the purple colouration of the root-tuber is the result of the accumulation of the purple pigment in the cork tissue.

The appearance of the cork cambium in the cortex generally takes place at the same time with the appearance of the cambium inside the stele. This leads to the beginning of the storage tissue formation, i. e. the root-tuber formation. This cork-cambium formation and the pigment formation are induced probably by the accumulation of the

Fig. 1. *Ipomoea Batatas*. A part of the epidermis of the lower surface of the leaf of a clone (Zakimi). *a*, guard cell of the stoma, with chlorophyll grains, but no purple pigment; *b-d*, subsidiary cells of a stoma, having neither purple pigment nor chlorophyll grains; *es*, cells belonging to the case 4) no nuclei being shown in the photo; *f*, the same cell as that shown in Fig. 2. Fig. 2, a cell belonging to the case 3), the coloured nucleus is situated in the center of a group of the purple granules, though it is not clearly shown in the photo. Fig. 3, a collenchyma cell, belonging to the case 2); *n*, nucleus having rich pigment; arrows indicate the small purple granules in the cytoplasm. Fig. 4, epidermal cells after the treatment with ethyl alcohol; *ns*, nuclei, the small grain in the central part of each nucleus is the nucleolus still retaining the pigment; *ps*, purple granules. Fig. 5, subepidermal cells in the petiole of a leaf of a clone (Aka-genji), after extraction of the pigment with ethyl alcohol; *ns*, irregular-shaped deeply stained nuclei; other granules in the cells are chlorophyll grains containing starch grains. ca. $\times 900$.

reserve material or sugar which is probably due in turn to the suppression of the conductivity. The further account on this point will be given in another place.

The purple pigment in the tissue of other organs. Generally speaking this pigment is distributed in almost all organs of the plant except the fibrous root; and there are five different cases concerning the formation of the pigment: 1) the case where the purple pigment is produced neither in the nucleus nor in the cytoplasm (Fig. 1, *a-d*), 2) the pigment is formed first in the nuclear granules, then the latter are extruded from the nucleus and gather around the latter (Fig. 3), 3) the small purple granules are found in the nucleus and several purple granules of larger sizes are found in the cytoplasm (Fig. 2), 4) the purple pigment is distributed homogeneously on the surface of the large central vacuole, here the nucleus has also the purple granules (Fig. 1, *es*), 5) the purple pigment is distributed on the surface of the cell membrane as in the case of the cork cells mentioned above.

The purple granules or vacuoles are not solid masses of the pigment, but the pigment is distributed on the surface of the granules or vacuoles. In some cases the granules or vacuoles consist of several small secondary granules; even in such cases the pigment is distributed only on the surface of each secondary granules. Although the exact chemical nature of the pigment is not known yet, it is insoluble in water and also in chloroform but dissolves well in ethyl alcohol as well as in acetone. Therefore when we treat these coloured cells with ethyl alcohol the pigment is extracted first from the vacuoles or granules in the cytoplasm, while it is usually retained for a longer time in the nucleus (Figs. 4 and 5).

Purple coloured nuclei were also met with in the root of *Rhaphanus* sp. from North China.

The detailed description and the discussion about the nuclear activity will be given in a later occasion.

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