

OBSERVATIONS ON „SPRAIN” (EISENFLECKIGKEIT?, INTERNAL BROWN SPOT?) AND „NETNECROSIS” OF POTATOES.

„Sprain” is an important disease on sandy soils and peaty soils rich in sand, where animal dung is used. It is known in Great Britain and Ireland (PETHYBRIDGE 1912) Germany and the Dutch East Indies. According to a letter received 1920 from Dr. W. A. ORTON (prec. paper p. 97) it seems not to occur in the United States; MC. ALPINE's book (1911) gives no proof of its occurrence in Australia.

Comparing the figures of „internal brown spot” described in a number of American bulletins (e.g. MORSE 1907, COONS and KOTILA 1923, GOSS 1923) with the typical „kringerigheid” of fig. 9—24 and PETHYBRIDGE's figures of „sprain” (1913) it remains doubtful whether these diseases are the same. Uncertainty exists also about the identity of „Eisenfleckigkeit” with „kringerigheid” in some cases. JONES (1905) however, considers „internal brown spot” and „sprain” as identical.

„Sprain” is contracted from the soil; it is not transmitted by seed-tubers; it is common in soils where on account of the low amount of lime *Actinomyces*-scab is absent. „Sprain” is often confounded with „netnecrosis” as illustrated by W. A. ORTON (1914). This last disease however, is transmitted with the seed tubers; it occurs in the United States and Australia (MC. ALPINE's illustrations) and Europe. Fig. 1—5 gives an idea of „netnecrosis”. It embraces the entire tuber, and as it is present, according to ATANASOFF (1926) as aucuba mosaic in the vines, it is a „systemic” disease. Fig. 6 illustrates a third type of internal brown spot: small stipples in the centre, which sometimes are found together with „netnecrosis”, but of which it is not sure, that they belong either to „net-necrosis” or „sprain”.

The attack of *Phytophthora infestans* is represented in Fig. 7. It is contracted from the soil as is clear when one cuts a diseased potato. In the same way „sprain” starts from some point at the surface of the tuber, it passes the vascular ring without being disturbed by it and it is not checked until somewhere in the

interior a corky barrier is formed in the potato parenchyma, which in cuts is seen as a ring (Dutch „kring”, disease: „kringerigheid”). Sometimes this barrier is penetrated and one or more new „kringen” surround the first. In some varieties the „kringen” are split up in small stripes (fig. 14, 15 and 16), sometimes they are broadened to small blotches (fig. 18), but always when enough material is cut the character of the „kringen” is found back in true „sprain”. In some varieties the „kringen” are seen at the surface (fig. 22 23 and 24); often they develop from places where second growth occurs (fig. 13) or from scars at the surface (fig. 21). Irregular form and „sprain” are often combined; further in big potatoes the „kringen” are more developed than in small ones. When pieces of the interior are cut off from respiration by a „kring” they die and cavities develop (fig. 19).

„Net-necrosis” increases as a rule during winter, while with „sprain” this is nearly not the case.

In cuts of tubers affected by either one of these diseases or by late blight dead parenchyma cells are found, surrounded by cells „blocked” by the formation of a brown deposit, which fills the intercellular spaces, impregnates the walls and accumulates on them. These cells in turn are surrounded by a continuous sheet of tabular shaped cork cells, closely joined together without intervening air spaces. The double barrier thus formed reminds one of the processes of healing of cut surfaces of the potato tuber described by PRIESTLEY 1923.

From APPEL's coloured plates it is clear that some cases of „Eisenfleckigkeit” or „Buntfleckigkeit” and also „Pfropfenbildung” are identical with „sprain”. It is not allowed to mix up „blotch” and „net-necrosis” with „sprain” to „internal rust spot” as PAINE does (1923).

Attempts made by WEHMER 1897, FRANK 1897 and JENSEN 1900, by myself and later by VAN DER LEK and ATANASOFF to isolate an organism, and to prove its relation to the disease have not led to any success. Sometimes bacteria, molds or yeasts occur as secondary organisms. The same holds good for „net-necrosis”. PAINE considers both diseases as one, this showing different types and ascribes both of them to *Pseudomonas solaniolens* n. sp. occurring in two strains but his infection experiments are not convincing. The present author is in agreement with JENSEN and ATANASOFF, that the organism responsible for „sprain” has not yet been seen nor isolated. MAYER ascribed „sprain” to lack of lime in the soil. Indeed it can be controlled to a certain extent by manuring the soil with lime but it could as well be ascribed to lack of potash since Dr. WILSON

of St. Andrew's University (according to MC. ALPINE) as well as the author observed, that the application of potassium salts as manure lessens the amount of sprain (Table 2). „Sprainy” soil can by „cured” by bringing it two hours in a stream of steam, in which it gets during one quarter of an hour a temperature of 90 centigrades, but the present author did not succeed in contaminating it again by mixing 20 potatoes cut in pieces through this disinfected soil (Table 1). Manure experiments with lime and potassium (Table 2) indicated that both seem to have the power of reducing the „sprain” infection. A mathematic controll of the figures of this table, however, shows that only the potassium at the rate of 15 and 20 gr. K_2O to a plant on the experimental field at Bennekom had undoubtedly this effect. Experiments during three years by CLEVERINGA, proved that substituting animal dung by a complete dressing containing nitrogen, potassium and phosphor has a greater effect in „restoring” the soil than addition of potassium to animal dung (Table 3 and 4). Observations in the field led to the conclusion that green manure also has a beneficial effect, whereas, the cultivation of turnips increases the diseased condition of the soil.

Some varieties are more liable to attack than others. When in experiments on „sick” soil varieties were planted a diffuse attack of some of them as a rule proved to be „sprain”, an attack restricted to certain „hills” of a variety, proved to be „net-necrosis”. In some varieties both diseases occur. In table V the occurrence of „sprain” is indicated as „kr”, slight or no affection is indicated as „w kr” and „n”. Besides Dutch varieties, some German, Polish, British and American varieties have also been tested.

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FIGUREN VAN PL. III.

- Fig. 1—5. „Netnecrose”: 1 en 2 Roode Star, 3 en 4 Paul Krüger, 5 Topas.
- Fig. 6. Stipjes in het merg, waarvan het onzeker is tot welke ziekte zij behooren.
- Fig. 7. *Phytophthora infestans*.
- Fig. 8—24. „Kringerigheid”: 8 Eigenheimer, 9 Alpha, 10 Roodeschoolsche Jam, 11 en 12 Roode Star, 13 en 14 Burbank, 15 Bintje, 16 en 17 Bravo, 18 en 19 Zeeuwsche Blauwe, 20 Pepo, 21 Opperdoesche Ronde, 22, 23 en 24 Director Johansen.

