Witches' Broom of Tea (New Disease)

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A few tea plants showing a typical witches' broom symptom were found for the first time at Tashiro-cho in South Kyushu in 1955. Since that time, the disease has spread gradually to neighbouring tea gardens and furthermore to distant areas, causing the crop damage that could not be ignored. As the cause of the disease was not clear, the author tried to find out reports on this particular disease, but no report was found even on a similar one.

This disease seemed to be a infections one from the observations on the spot. Then the author proposed the name "witches" broom of tea" for that disease and began to study to know the whole aspects of the disease in 1967. Results obtained up to the present are described briefly as follows.

This study has been carried out as the collaborative work between the authors' laboratory and the Kagoshima Prefectural Tea Experiment Station (Chief researcher, Toshiyuki Nonaka).

Symptom

At the first step of the disease, big buds appear on the infected plants in the spring. Young shoots developed from the abnormal buds are usually very big in diameter and are short in length, but sometimes these big shoots grow up longer than normal, showing a hypertrophic symptom. After a time, the basic parts of these abnormal shoots swell up, accompanied with a formation of galls at the parts. Since then, many adventitious buds are developed at the galls (Plate 1), and the young shoots which have developed out of the buds begin to get crowded, showing an apparent witches' broom symptom (Plate 2).

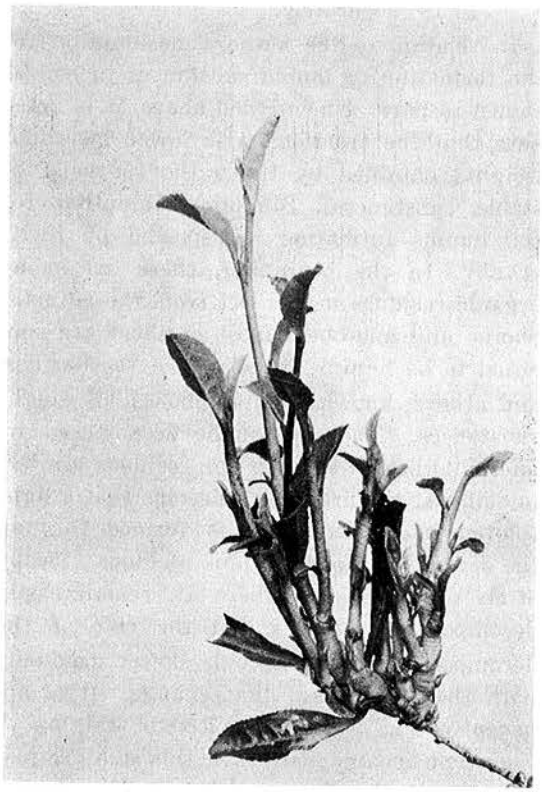

Plate 1. Abnormal shoots stemming from the gall

These parts die in winter, and hence the affected plants become weak gradually.

Isolation of causal organism

A crude sap of diseased tissue was inoculated by needle-puncture method[5] to healthy tea plant in the late autumn. Then, typical symptom appeared at the inoculated parts after several months. In order to know properties of the possible causal agent existing in the crude sap, the sap was treated with various methods and were inoculated to tea

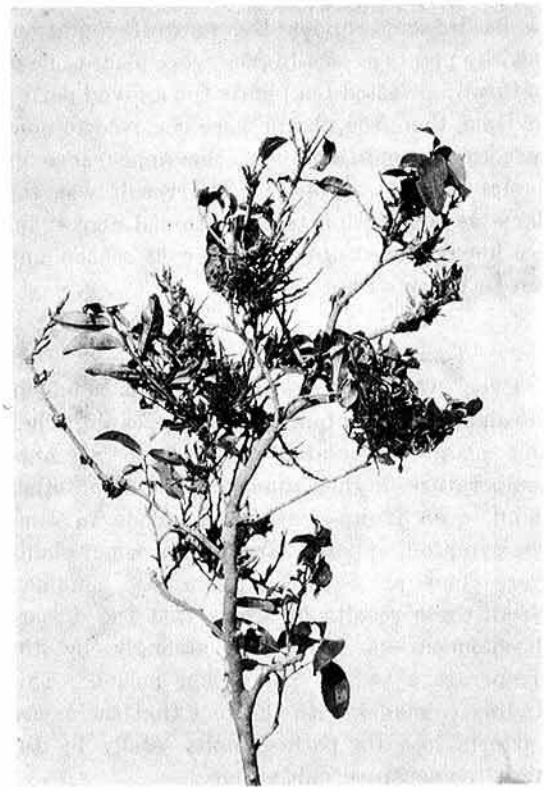

Plate 2. Characteristic symptoms of witches' broom

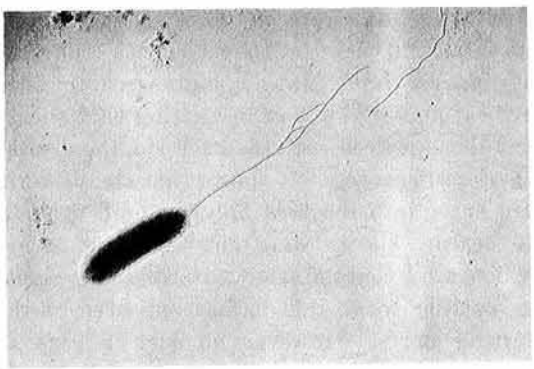

Plate 3. Electron micrograph of bacterial agent

plant. Based on the results, it was presumed that the causal agent is bacteria. Then, many bacterial isolates were obtained by the dilution plate method using potato dextrose agar (PDA) medium, and the pathogenicity of each isolate was examined by inoculation tests. After many tests were unsuccessful, the pathogenicity was recognized scarcely with some isolates. The reason why many isolation tests ended in failure was that the incubating temperature was too high for the isolates, that is, the bacteria lost the pathogencity when they were incubated at temperature higher than 20°C[6]. Since this fact was found, it has made possible to isolate the pathogenic bacteria easily as ordinally one.

The same bacteria were re-isolated from the diseased tissues produced by the inoculation of the bacteria, so that it was concluded that the bacteria were the pathogen of the disease.

Identification of causal bacteria

The bacterium is rod-shaped, having 2–5 fragella at mono- or dipolars, grow well on PDA medium and forms a white, smooth, domy and slimy colonies. The colony characters are similar to the crown gall bacteria: *Agrobacterium tumefaciens*. The physiological and biochemical characteristics of the bacteria were examined by means of routine techniques described in Manual of Microbiological Method[3] and others[2]. From the results obtained, it was concluded, by referring to the descriptions of Bergey's Manual[1], that the bacteria was a new species which belongs to Genus *Pseudomonas*, and it should be named *Pseudomonas tashirensis* Uehara et Nonaka, taking into account the name of the place, Tashiro, where the disease was discovered at first.

Factors affecting infection and disease development

1) Infection season

To find out the infetcion season of this disease, inoculation tests were carried out by needle-puncture method using crude sap of diseased tissue at every month in a year. The result was that plants inoculated in November and December showed high percentage of infection but those from May to August did not showed infection at all (Fig. 2). With every plant which received the inoculation and

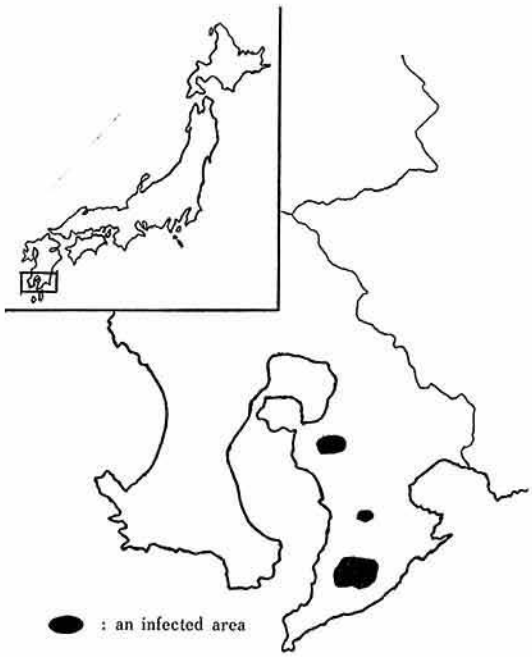

Fig. 1. Infected area of witches' broom

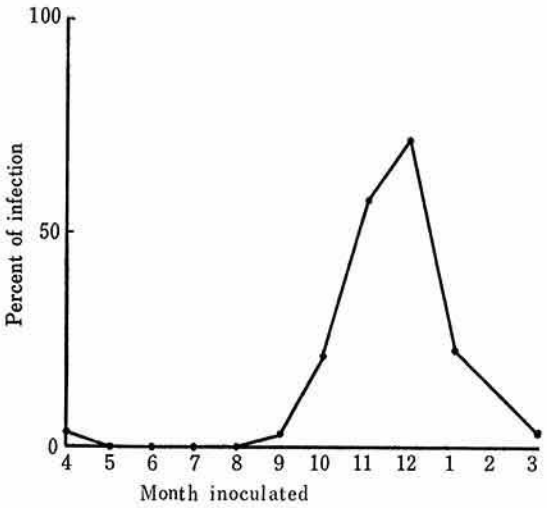

Fig. 2. Relation between month inoculated and disease development

developed the disease, the symptom apeared on new buds in the spring. Therefore, the incubation period varied by the month inoculated: in case of the shortest period, it was about two months and in the longest case about seven months.

To know the season when plants are liable to be infected under the natural condition, healthy plants grown in pots were placed under naturally infected tea plants for a given period of time, then, the plants were removed to non-infectious conditions and the appearance of symptom was examined. The result was the same as inoculation test mentioned above: infection occurred only in the cold season and not in warm or hot seasons.

2) Temperature

Even when the inoculation was done in autumn, the symptom did not appeared, when the plants inoculated were kept at high temperature, higher than 20°C. On the other hand, even if inoculation was done in June the symptom appeared in autumn when plants were kept at 5–10°C during the summer. From these results, it seems that the disease development is influenced strongly by the temperature at the incubation period. This finding coincides with the fact that the causal bacteria lose its pathogenicity easily by the high temperature cultivation.

3) Wound

Intact plants were not infected by merely spraying the bacterial suspension or crude sap of diseased tissue. But, if plants were wounded by beating with stick or by cutting with shears and then sprayed with the bacteria, the disease developed severely. It shows that the bacteria can enter into the host only through wounds. If healthy shoots were cut by using shears which were contaminated with diseased plants by cutting them, the disease appeared at the cutting parts. However no such a case as that the disease seems to be spread owing to tea picking was found. The reason may be that the tea picking is carried out in the season unsuitable for infection of the disease.

4) Typhoon

Relation between the spread of the disease and the typhoon attack was investigated using past records, and it was made clear that when typhoon came in autumn, the disease developed severly and furthermore spread to the distant

areas. From the results, it was concluded that typhoon was one of the most important agent for the disease dissemination.

5) Infection source

It seems that the causal bacteria do not survive longer than a month in soils.

Host range of this bacteria is very narrow: only three kinds of plants were recognized as the host up to the present, that is, tea plant (*Thea sinensis* L.), camellia (*Camellia japonica*) and sasanqua (*Camellia sasanqua* Thunb.). To find the infection source of the disease, those host plants grown in fields or forests in infected area were investigated, but the causal bacteria could not be found in not only these plants except tea, but also many kinds of weeds. Therefore, it was considered that the main infection source of the disease was the infected tea plants.

Control measures

This bacteria is almost inmobile in host tissues. Therefore, it seems that cutting-off of diseased tissues is the most effective method to control, primitive as it is. To demonstrate the practical effect of that control method, experiments were carried out with large scale, and which showed a distinct effect.

Moreover, it is desirabel to avoid the tea picking at a later season and to utilize windbreaks.

Important is to remove the infected plants completely at the early stage of the disease development in the virgin garden, because there is no other effective control methods.

References

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