TARC Notes

Differences in actinomycete flora between tropical and Japanese upland farm soils

Among the constituents contributive to soil fertility and hence to crop production, the most important one is the nitrogen content either in upland farm soils or in paddy soils, irrespective of climatic zones. There is also a parallelism between nitrogen and carbon contents of soils.

The nitrogen contents in tropical upland farm soils are generally low compared with those in Japanese soils. This fact has been thought to be due to high temperature prevalent in the tropics. The decomposition of organic matter which is enhanced by high temperature, progresses at a much faster pace in the tropics than in Japan. However, it is also considered that the microflora related to the decomposition of organic matter might be different between tropical and Japanese soils. The actinomycete flora in tropical upland farm soils was compared with that in Japanese soils, because actinomycete is the most important agent responsible for the decomposition of organic matter in upland soils.

Among the main upland soil types in Thailand, 28 soil samples were taken from the plow-sole during the period of crop cultivation. The method of investigation of the actinomycete flora was the same as that in the previous report[1]. Since all of the soil samples from the tropics belonged to the non-volcanic

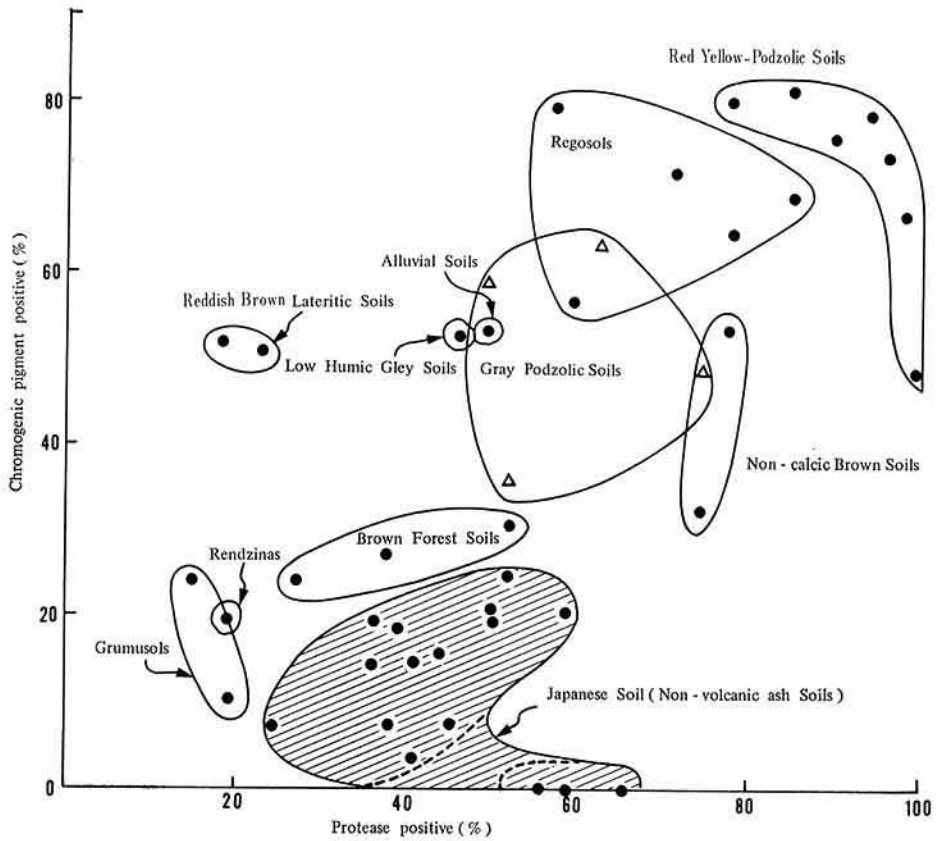

Fig. 1. Actinomycete flora in the tropical and Japanese upland farm soils, shown on the basis of chromogenic pigment and protease production.

ash soil, data of non-volcanic ash soils of Japan were used for comparison.

Physiological properties to produce chromogenic-pigment and protease are stable criteria for identification of actinomycetes. Ratios of chromogenic-positive or protease-positive actinomycetes to the total number of actinomycetes isolated from each soil sample were plotted in Fig. 1. From this figure, a significant difference in the actinomycete flora between the tropical and Japanese soils, and moreover marked differences among major tropical soil groups can be recognized. Ratios of chromogenic or protease-positive actinomycetes to the total actinomycetes were markedly higher in the tropical soils than in the Japanese ones, especially the ratio of the chromogenic-positive actinomycetes was significantly higher in the tropical soils.

On the other hand, it was found that organic carbon contents in the tropical soils were low, although some variations were noted. Therefore, the correlation between carbon contents in soils and the ratios of chromogenic actinomycetes to the total actinomycetes was examined as shown in Fig. 2. A high correlation significant at the 1% level was obtained, showing that the chromogenic actinomycetes were a dominant group especially in soils with low carbon content.

From the above data, it was presumed that the chromogenic actinomycetes may possess a strong ability for decomposing organic matter. Subsequently, colonies isolated from the tropical soils were separated into two groups, chromogenic and non-chromogenic, and then their physiological properties to produce protease and cellulase were examined. As shown in Table 1, ratios of each of protease- and cellulase-positive colonies to the total number of colonies were higher in the chromogenic group than in the non-chromogenic group. It was also noticed that the chromogenic group contained high percentage (70%) of colonies positive to both protease and cellulase, in contrast to the non-chromogenic group (24%) as shown in Table 2. These data suggest that the chromogenic actinomycetes are capable of decomposing various components produced in the course of organic matter decomposition. The percentage of cellulase-positive actinomycetes was also markedly higher in the tropical soils than in the Japanese ones.

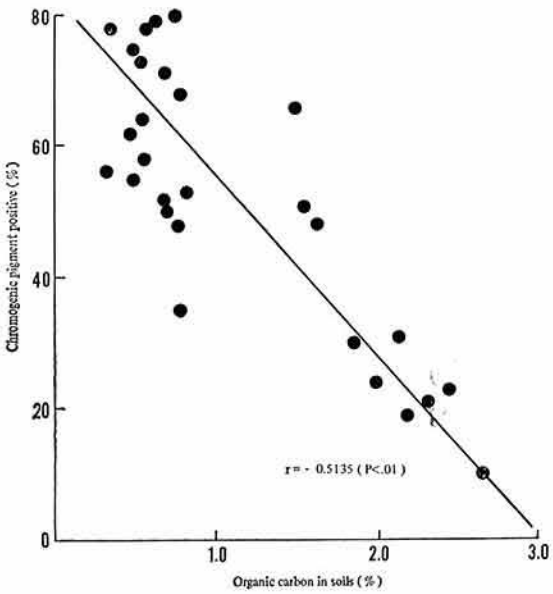

Fig. 2. Correlation between carbon contents and the ratio of chromogenic actinomycetes to the total number of actinomycetes in tropical upland farm soils.

These results indicate that tropical soils contain predominantly chromogenic actinomycetes with strong protease and cellulase

Table 1. Percentage of colonies positive to protease or cellulase production in chromogenic and non-chromogenic actinomycetes

	Total of colonies	Protease positive	Cellulase positive
Chromogenic actinomycetes	674	516 (76.5%)	596 (88.4%)
Non-chromogenic actinomycetes	606	257 (42.4%)	404 (66.5%)

Table 2. Percentage of colonies positive to both protease and cellulase production in chromogenic and non-chromogenic actinomycetes

	Total of colonies	Both protease and cellulase positive
Chromogenic actinomycetes	674	475 (70.4%)
Non-chromogenic actinomycetes	606	148 (24.4%)

activities and this trend is particularly evident in soils with low carbon content. As shown in the previous report[1], the composition of actinomycetes in soils was effected only slightly by cultivations and seasons, so that the characteristic actinomycete flora seen in Fig. 1, is regarded as specific to each soil group.

In conclusion, the organic matter in tropical soils is decomposed very rapidly under high temperature by the strong decomposing activities of chromogenic actinomycetes predominantly contained in tropical soils. Even when organic matter is applied to the soils, it will be decomposed rapidly with a result of low contents of carbon and nitrogen in soils.

1) Araragi, M. & Ishizawa, S.: Actinomycete flora of Japanese soils, *Bull. Nat. Inst. Agr. Sci.* (Japan), B, No. 23 (1972) [In Japanese with English summary].

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