Classification of Paddy soil in Fertilizer Application Improvement Program

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Introduction

'Fertilizer Application Improvement Program', aiming at the increase in productivity of paddy soil in Japan, started in 1952. It consisted of soil survey, irrigation water survey, survey of fertilization practice and fertilizer experiments on main soil types.

Soil survey in this program was the first detailed survey of paddy field throughout Japan. Of 3 million ha. of paddy field in Japan, 1,250,000 ha. were surveyed by this project. The rest will be surveyed under the other project, 'Soil Survey for the Maintenance of Farmland Fertilility' which will cover all farmlands of Japan, 6 million ha. in total by 1973.

Method of Soil Survey

Various new methods were adopted for the first time in Japan in this soil survey based on the developed survey methods used in Europe and the United States, and also some of these methods were improved in the course of carrying out the project. These are:

1) Aerial photograph was used in this soil survey for the first time in Japan.

2) Soil profile study pits are excavated and detailed study was conducted every 25 ha. of paddy field and between these pits, soil profiles are studied by soil auger to certificate boundaries. The results were plotted on the topographic map (1: 50,000 scale) to make a soil map.

3) In soil survey pits, the following items were investigated: color, humus content, existence, size, and quantity of gravel, texture, mottlings, structure, plasticity, stickiness, distribution and color of roots, moisture content, and depth of soil-water level, and etc. Except for texture, the other characteristics are studied based on 'Soil Survey Manual'.[1]

Since the object is paddy field, the detection of mottlings and of gley horizon were made in detail, that is, color, shape, and quantity as well as manganese was determined by using Benzidine reaction. Active ferrous ion reaction by using $\alpha-\alpha'-$dipyridyl solution was applied to the detection of gley horizon.

Yamanaka's corn-shape penetrometer was used for measuring the compactness and the hardness of air dried soil samples.

For describing soil color, the standard color chips based on Japan Standard Color had been used. It was replaced by the Munsell system in 1958.[2] A soil color chart, including greenish and bluish gray colors, was prepared and put in practice.[3]

4) Laboratory analysis of samples from each horizon was also made. The analytical method was standardized for use in this soil survey. The developed methods were adopted for organic carbon, total, available nitrogen, base exchange capacity and etc. A new method, pipette analysis was developed to determine the particle size distribution. Ammonium which was used before as dispersing agent was replaced by Na-hexametaphosphate.[4]

Soil Classification

In Japan, soils of paddy field which is mainly located in alluvial plain was first classified by Yutaka Kamoshita.[5] He classified paddy soils as Groundwater soil types, which were classified into Bog soil, Halfbog soil, Meadow soil, Gray

lowland soil, and Brown lowland soil. Later, Nobuo Uchiyama[6] divided inorganic paddy soil into Blue reduced type, Gray eluvial type, Graybrown intermediate type, and Brown oxidic type.

Soil survey in Japan, particularly after World War II, has developed with the aim of increasing productivity of crop in each type of land use. And some of the classification system is only based on the productivity of special crop. In this program, however, classification was constructed based on the characteristics of soil profile which reflects the synthesized effects of various genetic factors. And it has another nature, not to be constructed to be used only for the paddy field.

Paddy soils are classified by the existence or absence of a specifical horizon between the bottom of plow layer and to the depth of 100 cm below the surface.[7]

a) Soils which have peat layer of more than 50 cm in thickness, or are more than 20 cm thick within a depth of 50 cm from the surface are grouped into A. Peat soils, and B. Peaty soils respectively. And soils which have a muck layer of more than 50 cm in thickness are grouped into C. Muck soils. (See Fig. 1)[8]

b) Soils which have neither peat layer nor muck layer, but have gley horizon (Bluish gray horizon, with or without mottlings) within 30cm depths are grouped into D. Strong gley soils, and soils having gley horizon within 50 cm depths are grouped into E. Gley soils. (See Fig. 1)

c) Soils which do not have any layers mentioned above, or have layers below the depths

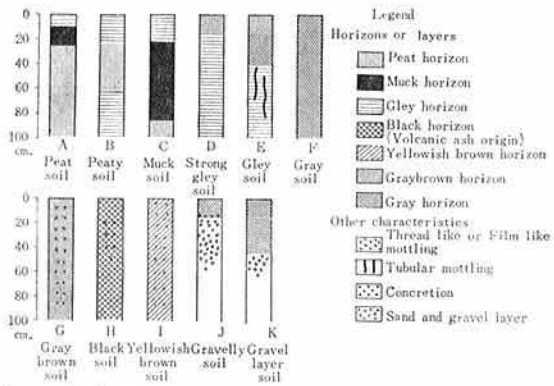

Fig. 1[8] Schematic Diagram Showing 11 group soils.

aforementioned, are classified according to the color of horizon or layer under the plow layer. These are F. Gray soils, which have neutral color or chromas less than 1, and soils which have hues as red as or redder than 10 YR and chromas 2 or less are grouped into G. Graybrown soils, and soils which have black subsurface color, or andic paddy soils are H. Black soil. And I. Yellowish brown soils are almost equivalent to Brown lowland soils. (See Fig. 1).

d) Soils which spread along old river bed, where gravel layer is located near the soil surface: J. Gravelly soils which have gravel layer within 30 cm from the surface, and K. Gravel layer soils which have gravel layer within 30 to 60 cm from the surface. (See Fig. 1)

Great groups are classified into 51 soil types by the texture, structure and kind of mottlings etc., The 11 great groups and 51 soil types are shown below.[8]

Great Groups	soil types
A. Peat soils	1. Peat soils
	2. Heavy clay peat soils
	3. Clayey peat soils
	4. Loamy peat soils
	5. Sandy peat soils, sand dune type
B. Peaty soils	10. Heavy clay peaty soils
	11. Clayey peaty soils
	12. Loamy peaty soils
	13. Sandy peaty soils, sand dune type
C. Muck soils	20. Heavy clay muck soils

	21. Clayey muck soils
	22. Loamy muck soils
D. Strong gley soils	30. Heavy clay strong gley soils, reduced type
	31. Heavy clay strong gley soils, mottled type
	32. Clayey strong gley soils, reduced type
	33. Clayey strong gley soils, mottled type
	34. Loamy strong gley soils, reduced type
	35. Loamy strong gley soils, mottled type
	36. Sandy strong gley soils, reduced type
	37. Gravelly strong gley soils, reduced type
E. Gley soils	40. Heavy clay gley soils, structured type
	41. Heavy clay gley soils, manganese type
	42. Clayey gley soils
	43. Loamy gley soils
	44. Sandy gley soils
F. Gray soils	50. Clayey gray soils, structured type
	51. Clayey gray soils, manganese type
	52. Loamy gray soils
	53. Loamy gray soils, manganese type
	54. Sandy gray soils
G. Graybrown soils	60. Heavy clay graybrown soils, structured type
	61. Clayey graybrown soils, structured manganese type
	62. Loamy graybrown soils
	63. Loamy graybrown soils, manganese type
	64. Sandy graybrown soils
	65. Sandy graybrown soils, manganese type
H. Black soils	70. Clayey, humic volcanic ash black soils
	71. Loamy, humic volcanic ash black soils
	72. Clayey humic black soils
	73. Loamy humic black soils
I. Yellowish brown soils	80. Heavy clay yellowish brown soils, manganese type
	81. Heavy clay yellowish brown soils
	82. Loamy yellowish brown soils, manganese type
	83. Sandy yellowish brown soils
J. Gravelly soils	90. Mottled gravelly soils, pan type
	91. Clayey gravelly soils
	92. Sandy gravelly soils, river bed type
K. Gravel layer soils	93. Loamy gravel layer soils, manganese type
	94. Sandy gravel layer soils, pan type
	95. Loamy gravel layer soils, manganese type (gravel layer below 93)

Proportional area occupied by each group of soils is as follows:[9]

A	Peat soils	3.2%
B	Peaty soils	1.1
C	Muck soils	5.0
D	Strong gley soils	16.8
E	Gley soils	14.1
F	Gray soils	26.8
G	Graybrown soils	25.9
H	Black soils	7.7
I	Yellowish brown soils	8.2
J	Gravelly soils	5.0
K	Gravel layer soils	6.2

Further Development of Glassification of Paddy Soils.

Although paddy soils had been divided into 51 types, it was subdivided according to the new definition of soil series which was first applied to upland farmland soil in 'Upland Farmland Soil Survey' which started later in 1962. The new definition leads us to establish consisting of 81 soil series for paddy soil. (1963)[12] The number of soil series is increasing and turned out more than 100 in 1968.

Soil survey reports, including a colored 1:50,000 scale soil map, were published by each prefecture and summarized by the Ministry of Agriculture and Forestry in 1957, 1960, 1963 and 1964..[8]

Further attempts[13] to use ABC horizon nomenclature to the paddy soils in Japan were persued based on the 1962 revised 'Soil Survey Manual'.[13]

Closing Remarks

The Fertilization Improvement Program took us 10 years, from 1952 to 1961, to be accomplished. The soil survey method used in this program, I believe, is the first nationwide soil survey applying the methods modern pedology.

And soil classification in this program, although aiming at the increasing productivity of rice, the classification system of soil, the first principally scientific one.

Although I admit many further investigations must be done. I believe this program laid the foundation for the attempts to the studies of the paddy soils based on the soil survey.

It will, I hope, be used as an example of soil survey in the rice area.

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