Bulletin of Government Forest Experimetal Station, Tokyo. vol. 280:1-28

Classification of Forest Soil in Japan (1975)

Forest Soils Division

Summary

The soil survey of forest land in Japan was started in 1947 in order to get basic knowledge for the execution of an expansive plantation plan just after the end of World War II. OHMASA's soil types[19] were adopted for the forest soil classification and the soil survey at that time by the Forestry Agency. OHMASA proposed the name of 'Brown Forest Soil' for the soil which is widely found in the temperate zone in Japan and has brown colored B horizon. The soil types for the brown forest soil were categorized by the kind of soil structure and the extent of its development. The soil types were designated Dry brown forest soil (steep slope type) (B_A), Dry brown forest soil (gentle slope type) (B_B), Weakly dried brown forest soil (B_C), Moderately moist brown forest soil (B_D), Slightly wetted brown forest soil (B_E), and Wet brown forest soil (B_F). He also named the soil types for Podzolic soils and Gley soil.

These soil types are not only well appreciated for classifying the forest soils which are in the mountainous area, but also they are well correlated to the forest types and the growth of planted trees.

The soil survey of forest land has been progressively achieved and the soil survey project for the 1 : 20,000 soil maps of the national forest is almost completed. The survey for the 1 : 5,000 soil maps of the selected private forest was finished, and the survey for the 1 : 50,000 soil maps of the private forest land has been continued in many prefectures. These large scale soil maps now cover more than half the forest land in Japan.

The results of the forest soil surveys for more than 20 years have been contributing to the improvement of forest management. With the development of the soil survey, the study on forest soils has progressed greatly, and many temporary soil types have been proposed. The soil survey for subtropical regions has become necessary after the retrocession of Okinawa and Ogasawara islands. Several new kinds of soils have been found and they are not conformable with the soil types heretofore in use. These circumstances necessitate the setting up of a new system of classification of forest soils in Japan.

Received August 12, 1975

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The newly proposed classification system for forest soils in Japan

This classification system follows the way of natural systematic classification and certain categories are defined. The categories are divided into lower level or are unified to the higher level of the system stepwise. Four category levels, soil group, subgroup, type, and subtype, are proposed in this classification system.

Category of the classification

The soil groups are the assemblage of the soils which have similar sequence and characteristics of the diagnostic horizons in soil profiles. The soil group corresponds to 'Bodentyp' of West Germany[9], 'Почвенный тип' of USSR[1], and Marbut's Great soil group in the USA[7].

The subgroups are the subdivision of the soil groups. The subgroups of a soil group consist of the typical one which has the characteristics representing the soil group, soils which are influenced by the soil formation process of another soil group, and soils which have the intermediate characteristics of one soil group and another. The subgroup corresponds approximately to 'Subtyp' of West Germany[9] and 'Подтип почвы' of USSR[1].

The soil type is a unit member of the subgroup. It is classified according to the developing grade of diagnostic horizons or the difference of soil structure. The soil type is the suitable unit for classification of forest soils in complicated topography in Japan, and is used as a mapping unit of large scale soil maps. The soil type approximately corresponds to 'Varietät' of West Germany[9] and 'Вид почвы' of USSR[1].

The subtype is the subdivision of a certain soil type which has a wide range of natural variance. The subdivision is done according to the characteristics which are used for the soil type division such as soil structure. For example, Moderately moist brown forest soil (B_D type) has a wider range variance of its nature than the other types of the Brown forest soil, especially of soil structure. And, the soils which have weakly developed loose granular structure or granular structure in A horizon, moderately developed nutty structure in upper B horizon, or rather thick deposit of A_0 horizon such as F layer, are morphologically drier than the standard B_D type. They are subdivided as the drier subtype of Moderately moist brown forest soil, $B_D(d)$.

Although the categories are not defined for the level lower than the subtype, the soil type and the subtype are subdivided appropriately according to parent material, texture, mode of deposition, or the amount of chemical components.

Naming of soils and classification by parent material

In this system, attention is paid not to change, if possible, the soil names which have been used in Japan. Although many names of the soil groups have color names, this classification is not merely the mechanical classification by the soil color. For example, among the soils belonging to the soil group of Brown forest soil, some soils have yellowish gray brown or dark gray color reflecting the color of parent material. These soils can be subdivided by parent material if it is necessary.

The division by parent material is the lower category of this classification system in general. Volcanic ash which covers widely in Japan often produces large amounts of allophane in its weathering process and the allophane is considered to cause the high humus content, water holding capacity, and phosphate absorption coefficient. The soils derived from volcanic ash are included in the Black soil in this system. But volcanic ash does not always form Black soil, and other soil forming factors such as podzolization or gleyzation quite often excel

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the characteristics of volcanic ash. Therefore, the division only by parent material such as volcanic ash is placed at the lower category. However, dark red colored soils are formed from the parent material of limestone, serpentine, or ultrabasic rocks, and most of these soils have high base saturation percentage. They are classified as Dark red soil in the higher category of this system because of the unusual occurrence in rainy climate of Japan.

Classification of soils which have intermediate characteristics

In this classification system, subgroup is newly proposed and the soils which have intermediate characteristics as the result of the combination of the soil forming factors of two different kind of soils, are placed in the subgroup. Therefore, in general, most of the forest soils in Japan can fit in the new system. However, the soils which still cannot fit these subgroups are located to a certain soil type in this classification system by deciding what soil forming factor is prevailing. Then the subordinate soil group name is put as an adjunct and a soil can be given the name and symbol as follows;

A soil which is the Moderately moist brown forest soil but has very dark color in the lower A horizon and retaining the remnant of Black soil, is named and expressed as, (B*l*)-B$_D$, Black soil like Moderately moist brown forest soil.

Among the soils which have the intermediate characteristics, some soils have the possibility in the future to be given the new subgroup name for them as the result of the development of the soil genesis study.

General description of Groups and Subgroups

1. Podzol

The soils of the Podzol group have well developed A_0 horizon, eluvial horizon, and illuvial horizon. Their acidity is very strongly acid. In general, the soils are developed in cool and moist regions in Japan.

The Podzols are subdivided into three subgroups, Dry podzol, Wet iron podzol, and Wet humus podzol.

The Dry podzols are distributed mainly in subalpine and alpine zones, but they can also be found in mountainous regions of temperate zone. They are distributed at the relatively dry site such as mountain tops, ridges, upper convex slopes or the edge of plateau. At these dry sites, litter is poorly decomposed, A_0 horizon is well developed, and organic acid is released. Consequently, the soils are disposed to be podzolized. Besides the topographic features mentioned above, acidic parent material, sandy texture, and a certain vegetation such as *Thujopsis dolabrata* or *Sciadopitys verticillata* accelerate the podzolization.

The horizon sequence is well developed A_0 (F) horizon, A or H-A, A_2 (eluvial), B_1 (illuvial), and B_2 horizon.

The soils of Wet iron podzol subgroup are formed from the clayey and compact parent material at gentle ridge, peneplain, or plateau of volcanogenous mud flow. The soils are distributed in temperate or subalpine zone under the vegetation of natural forest of *Picea glehnii, Abies mariesii, Pinus parviflora, Thuja standishii, Chamaecyparis obtusa*, or *Fagus crenata*.

Although the Wet iron podzol are classified as the member of the Podzol group, the surface gleyzation, which is indicated by high ferrous iron contents in A_0 and A_1 horizon, is considered to be the major characteristics of this subgroup. The horizon sequence is well developed A_0 (H), A or H-A, A_2-g, B_1 or B_1-g, and B_2 horizon. The soils have massive structure, and some of them have the iron pan in upper B horizon.

The soils of Wet humus podzol are strongly influenced by surface gleyzation and have high ferrous iron content in H and A horizons. The sola of the soils are not so compact as those of Wet iron podzols, and humus penetrates deeper into the sola. The soils have thick greasy H horizon, thick A horizon which is rich in humus, and darker B horizon. They have gray or dark gray portion in A horizon accompanied by dark rust colored iron rich portion underneath.

The soils are distributed in upper temperate and subalpine zone under the vegetation of the forest of *Picea mariesii*, *Abies veitchii*, *Picea hondoensis*, *Chamaecyparis obtusa*, *Thuja standishii*, *Betula ermanii*, or *Fagus crenata*.

2. Brown forest soil

The soils of the Brown forest soil group have the horizon sequence of (A_0)-A-B-C, have no eluvial or illuvial horizon, have brown colored B horizon, and have acidity of moderately or slightly acid.

The Brown forest soils are distributed in rather wider ranges of temperate and warm temperate zone in humid (high precipitation) climate. The soils are zonal ones which are formed between the zones of Podzols and Red and Yellow soils. The soils have wide variety of characteristics or maturity and some are influenced by the soil formation process of another soil group. Consequently, the soils of this group are classified into five subgroups. The subgroups are Brown forest soil which are the typical Brown forest soil, Dark brown forest soils which are distributed close to the Podzol zone and have the features similar to the Wet humus podzol, Reddish brown forest soils and Yellowish brown forest soils which are accompanied and influenced by the Red and Yellow soils, and Surface gleyed brown forest soils which are influenced by surface gleyzation.

3. Red and Yellow Soil

Widely accepted concept for the genesis of the Red and Yellow soils is that the soils are the zonal ones and formed in subtropical region under moist climatic condition. However, as the result of the recent pedological survey and research, the Red soils in Japan are considered to be the relic soils and formed during the warm period of the geological era. The Yellow soils are distributed in the same area as the Red soils and accompanied by the Red soils. Some have yellow topsoil and red subsoil in a profile, and some others have yellowish orange color reflecting the red colored weathered material in yellow colored sola.

Although Red soils and Yellow soils are supposed to have a quite close relationship, the relationship and the difference of the genesis of the two soils have not yet been clarified. In Okinawa, the southernmost and subtropical region of Japan, the Yellow soils are commonly found in mountains, and some consider that the soils are formed in the present climatic condition. Therefore, the Yellow soil will be placed at the independent soil group in the future.

The soils of this group are subdivided to the three subgroups by soil color and surface gleyzation.

4. Black soil

The soils of the Black soil group have thick black or brownish black A horizon. The boundary of A and B horizon is distinct. Their bulk density is low, water holding capacity and base exchange capacity are high. The Black soils are separated into two subgroups according to the degree of black color of A horizon.

Opinions are divided on the genesis of the Black soil and they have not yet been unified.

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The Black soils are distributed mainly on grass lands. They are scarcely distributed in the areas that supposedly have been covered by forests for a long time. On the other hand, the black color of the topsoil of the Black soil in grass lands is faded after the repeated plantation of forest trees. These facts suggest that the vegetation of grass land is one of the very important factors for the formation of the Black soil.

The Black soil has a thick black colored A horizon which has very high humus content. The parent material of volcanic ash, which has much allophane, has been regarded as the humus bearer of the Black soil. And most of the Black soil is derived from volcanic ash. However, the volcanic ash is not always the parent material of the Black soil. Some Black soils contain little or very little volcanic ash, and some are considered to be formed by the accumulation of organic residuum under the submerged condition.

5. Dark Red Soil

Some soils of Dark red soil group are formed from the limestone, serpentine, and ultrabasic rocks. These soils have commonly high base saturation, and the percentage of base saturation gets higher in deeper horizons. The other soils which are formed by hydrothermal process of volcanic activities and the soils which are formed from the basic rocks and have not so high a base saturation are included in this soil group.

The genesis and base saturation of the soils of this group vary very much, and they are divided into three subgroups, Eutric dark red soil, Dystric dark red soil, and Volcanogenous dark red soil.

6. Gley

The soils of this group have the gleyed light gray or bluish gray colored horizons, which are formed by the influence of ground water, in the relatively upper part of the sola.

This soil group includes the soils which are influenced by the podzolization process simultaneously, and the soils which are gleyed by the seasonal stagnant water.

The soils of this group are separated into the three subgroups, Gley, Pseudogley, and Podzolic gley. Gley subgroup soils are influenced by the ground water and have gleyed horizon in the 1 m depth sola. Pseudogley soils are influenced by the seasonal stagnant water and have the gleyed horizon in the 1 m depth sola. Podzolic gley soils have eluvial horizon or eluvial portion in the profile by the podzolization, and also have the gleyed horizon by the gleyzation.

7. Peaty Soil

The soils of the Peaty soil group are the organic soils which are formed by the accumulation of plant residue which is not decomposed and deposit at marshes or swamps where the water stagnates.

Peat soil, Muck, and Peaty podzol are the subgroups of this soil group. Peat soils have more than 30 cm thick peat layer at the top of the sola. Muck soils have more than 30 cm thick muck layer at the top of the sola.

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Soil Group　Subgroup　Type　Subtype

Podzolic soils ····· P
- Dry podzolic soils ····· P_D
  - Dry podzol ····· $P_{D\,I}$
  - Dry podzolic soil ····· $P_{D\,II}$
  - Dry slightly podzolic soil ····· $P_{D\,III}$
- Wet iron podzolic soils ····· $P_W(i)$
  - Wet iron podzol ····· $P_W(i)_I$
  - Wet iron podzolic soil ····· $P_W(i)_{II}$
  - Wet iron slightly podzolic soil ····· $P_W(i)_{III}$
- Wet humus podzolic soils ····· $P_W(h)$
  - Wet humus podzol ····· $P_W(h)_I$
  - Wet humus podzolic soil ····· $P_W(h)_{II}$
  - Wet humus slightly podzolic soil ····· $P_W(h)_{III}$

Brown forest soils ····· B
- Brown forest soils ····· B
  - Dry brown forest soil (loose granular structure type) ····· B_A
  - Dry brown forest soil (granular and nutty structure type) ····· B_B
  - Weakly dried brown forest soil ····· B_C
  - Moderately moist brown forest soil ····· B_D
    - Moderately moist brown forest soil (drier subtype) ····· $B_D(d)$
  - Slightly wetted brown forest soil ····· B_E
  - Wet brown forest soil ····· B_F
- Dark brown forest soils ····· dB
  - Moderately moist dark brown forest soil ····· $d B_D$
    - Moderately moist dark brown forest soil (drier subtype) ··· $d B_D(d)$
  - Slightly wetted dark brown forest soil ····· $d B_E$
- Reddish brown forest soils ····· rB
  - Dry reddish brown forest soil (loose granular structure type) ····· $r B_A$
  - Dry reddish brown forest soil (granular and nutty structure type) ··· $r B_B$
  - Weakly dried reddish brown forest soil ····· $r B_C$
  - Moderately moist reddish brown forest soil ····· $r B_D$
    - Moderately moist reddish brown forest soil (drier subtype) ····· $r B_D(d)$
- Yellowish brown forest soils ····· yB
  - Dry yellowish brown forest soil (loose granular structure type) ··· $y B_A$
  - Dry yellowish brown forest soil (granular and nutty structure type) ····· $y B_B$
  - Weakly dried yellowish brown forest soil ····· $y B_C$
  - Moderately moist yellowish brown forest soil ····· $y B_D$
    - Moderately moist yellowish brown forest soil (drier subtype) ····· $y B_D(d)$

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Soil Group　Subgroup　Type　Subtype

Slightly wetted yellowish brown forest soil ……*y*B$_E$

Surface gleyed brown forest soils ……*g*B

Dry surface gleyed brown forest soil (granular and nutty structure type)……*g*B$_B$

Weakly dried surface gleyed brown forest soil……*g*B$_C$

Moderately moist surface gleyed brown forest soil……*g*B$_D$

Slightly wetted surface gleyed brown forest soil……*g*B$_E$

Red and Yellow soils ……RY

Red soils ……R

Dry red soil (loose granular structure type)……R$_A$

Dry red soil (granular and nutty structure type) ……R$_B$

Weakly dried red soil……R$_C$

Moderately moist red soil……R$_D$

Moderately moist red soil (drier subtype)……R$_D$(d)

Yellow soils……Y

Dry yellow soil (loose granular structure type) ……Y$_A$

Dry yellow soil (granular and nutty structure type)……Y$_B$

Weakly dried yellow soil ……Y$_C$

Moderately moist yellow soil……Y$_D$

Slightly wetted yellow soil ……Y$_E$

Surface gleyed red and yellow soils……*g*RY

Strongly surface gleyed red and yellow soil……*g*RY$_I$

Weakly surface gleyed red and yellow soil ……*g*RY$_{II}$

Strongly bleached red and yellow soil……*g*RYb$_I$

Weakly bleached red and yellow soil ……*g*RYb$_{II}$

Black soils ……B*l*

Black soils ……B*l*

Dry black soil (granular and nutty structure type) ……B*l*$_B$

Weakly dried black soil……B*l*$_C$

Moderately moist black soil ……B*l*$_D$

Moderately moist black soil (drier subtype)……B*l*$_D$(d)

Slightly wetted black soil ……B*l*$_E$

Wet black soil……B*l*$_F$

Light colored black soils……*l*B*l*

Dry light colored black soil (granular and nutty structure type)…*l*B*l*$_B$

Weakly dried light colored black soil ……*l*B*l*$_C$

Moderately moist light colored black soil ……*l*B*l*$_D$

Moderately moist light colored black soil(drier subtype)…*l*B*l*$_D$(d)

Slightly wetted light colored black soil ……*l*B*l*$_E$

Wet light colored black soil……*l*B*l*$_F$

Dark red soils……DR

Eutric dark red soils ……*e*DR

Dry eutric dark red soil (loose granular structure type)……*e*DR$_A$

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Soil Group　Subgroup　Type　Subtype

Dry eutric dark red soil (granular and nutty structure type) ……*e*DR$_B$
Weakly dried eutric dark red soil……*e*DR$_C$
Moderately moist eutric dark red soil……*e*DR$_D$
Moderately moist eutric dark red soil (drier subtype)…*e*DR$_D$(d)
Slightly wetted eutric dark red soil……*e*DR$_E$
Dystric dark red soils……*d*DR
Dry dystric dark red soil (loose granular structure type) ……*d*DR$_A$
Dry dystric dark red soil (granular and nutty structure type)……*d*DR$_B$
Weakly dried dystric dark red soil ……*d*DR$_C$
Moderately moist dystric dark red soil……*d*DR$_D$
Moderately moist dystirc dark red soil (drier subtype)…*d*DR$_D$(d)
Slightly wetted dystric dark red soil……*d*DR$_E$
Volcanogenus dark red soils ……*v*DR
Dry volcanogenus dark red soil (loose granular structure type) …*v*DR$_A$
Dry volcanogenus dark red soil
(granular and nutty structure type)……*v*DR$_B$
Weakly dried volcanogenus dark red soil ……*v*DR$_C$
Moderately moist volcanogenus dark red soil ……*v*DR$_D$
Moderately moist volcanogenus dark red soil
(drier subtype) ……*v*DR$_D$(d)
Slightly wetted volcanogenus dark red soil ……*v*DR$_E$
Gley soils ……G
Gley ……G
Gley ……G
Pseudogley ……psG
Pseudogley ……psG
Podzolic gley ……PG
Podzolic gley ……PG
Peaty soils ……Pt
Peat soil ……Pt
Peat soil ……Pt
Muck soil……Mc
Muck soil……Mc
Immature soils ……Im
Immature soil……Im
Immature soil……Im
Eroded soil ……Er
Eroded soil ……Er