Introduction of agricultural soil quality, soil inventory and soil testing in Japan

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Institute for Agro-Environmental Sciences, Advanced Analysis Center, Genetic Resources Center, Center for Seeds and Seedlings,
Introduction of NIAES

- NIAES is the only institution for developing national soil inventory (for agriculture) in Japan.
- We’ve provided the manuals for national soil survey projects.
- NIAES, as a national coordinating Institute, conducts a Proficiency testing (PT) program for soil organic carbon survey, which is funded by the Ministry of Agriculture, Forestry and Fisheries (MAFF).
- NIAES prepares standard soil samples and send them to the Agricultural Research Centers in Local Government Unit (47 Units in Japan) to maintain QA/QC.
- NIAES is a reference soil lab. of GLOSOLAN/SEALNET
Today’s topics

1. Soil Inventory and current status of agricultural soil quality in Japan

2. Introduction of the largest soil testing lab in Japan and the utilization of soil testing data in Hokkaido, as a case study
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1. Soil Inventory and Current status of agricultural soil quality in Japan

2. Introduction of the largest soil testing lab in Japan and the utilization of soil testing data in Hokkaido, as a case study
Developing the Japanese soil inventory

1. **Fundamental soil survey for soil fertility (1959-1978)**
   - The agricultural soil map (scale 1:50,000)

   - The database of average of physico-chemical properties in surface layer

3. **Developing the Comprehensive Soil Inventory of Japan (2007-2015)**
   - The Japanese soil map (scale 1:200,000)
   - The upgraded agricultural soil map (scale 1:50,000)
Developing the Japanese soil inventory

1. Fundamental soil survey for soil fertility (1959-1978)

   The 47 prefectures conducted soil survey (density; 500m), and they delineated cultivated soil maps (1:50,000)

   This project clarified the limiting factors for crop production and its spatial distribution pattern in Japanese cultivated land

Improper soil management could be a threat to decrease soil quality
Developing the Japanese soil inventory


About 20,000 monitoring sites, 5-year-interval

<table>
<thead>
<tr>
<th>Site information</th>
<th>Soil profile description</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Site</td>
<td>· Depth of horizons</td>
</tr>
<tr>
<td>· Latitude Longitude</td>
<td>· Color</td>
</tr>
<tr>
<td>· Soil type</td>
<td>· Structure</td>
</tr>
<tr>
<td>· Sampling date</td>
<td>others</td>
</tr>
<tr>
<td>· others</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity data</th>
<th>Soil properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Soil treatment</td>
<td>pH, EC, Soil texture, C and N content, Bulk</td>
</tr>
<tr>
<td>· Fertilizer application</td>
<td>density, available P, CEC, Ex-cations, pF,</td>
</tr>
<tr>
<td>· Crop rotation</td>
<td>Solid-liquid-gaseous phase, Hydraulic conductivity,</td>
</tr>
<tr>
<td>· Irrigation/Drainage</td>
<td>others</td>
</tr>
<tr>
<td>· others</td>
<td></td>
</tr>
</tbody>
</table>

Location of stationary monitoring sites.
Current status and changes of agricultural soil quality in Japan

Available Phosphate

Total Nitrogen

Available Phosphate

Total Nitrogen

<table>
<thead>
<tr>
<th>Year</th>
<th>Paddy</th>
<th>Upland</th>
<th>Orchard</th>
<th>Pasture</th>
<th>Greenhouse</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Available Phosphate (P2O5 mg/100g soil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>200</td>
</tr>
<tr>
<td>1984</td>
<td>600</td>
</tr>
<tr>
<td>1989</td>
<td>800</td>
</tr>
<tr>
<td>1994</td>
<td>400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Nitrogen content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1979</td>
<td>1.5</td>
</tr>
<tr>
<td>1984</td>
<td>1.0</td>
</tr>
<tr>
<td>1989</td>
<td>0.5</td>
</tr>
<tr>
<td>1994</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Current status and changes of agricultural soil quality in Japan

Sustainable soil management based on the checking of soil quality is important for Japanese agricultural land.
Developing the Japanese soil inventory

3. Developing the Comprehensive Soil Inventory of Japan (2007-2015)

NIAES developed the Comprehensive soil classification system of Japan (2011) to seamlessly evaluate agricultural soil, forest soil, other land use type.

New national soil map (1:200,000)

New cultivated soil map (1:50,000)
WEB-GIS program of soil inventory
(Since, April 2017)

URL: https://soil-inventory.dc.affrc.go.jp/

"Japanese Soil Inventory"
Total 70,000 visits in 15 months

"e-SoilMap II"
Total 5,500 installation in 15 months
Who are the users of soil inventory?

- National institutes: 40%
- National universities: 26%
- Unaffiliated private companies: 16%
- Government ministries: 6%
- Prefectural offices: 5%
- Agricultural cooperatives: 6%
- Private companies: 6%
Today’s topics

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2. Introduction of the largest soil testing lab in Japan and the utilization of soil testing data in Hokkaido, as a case study
Soil Testing in Japan

Number of soil testing laboratory: < 850
Implementation of soil testing: About 500,000/yr
   (Local Gov. 40 %, Private sector 60 %)

- At the private sector, ZEN-NOH (National Federation of Agricultural Cooperative Associations) has 427 lab. (including 9 soil analyzing centers), and they conduct soil testing more than 150,000/yr.

- However, the biggest soil testing lab. is the Tokachi Nokyoren, which is located on Tokachi district, Hokkaido.
Tokachi district is a most important food production base in Japan

Almost field are used as upland cultivation, and farming area per farm is more than 40 ha; it is about 20 times higher than the national average.
Agro-chemical Lab. Tokachi Nokyoren

Number of Lab. manager: 2 persons (Certificated Environmental measure)
Number of technician: 5 persons
Implementation soil testing: < 20,000/yr

① and ② are Agro-chemical Lab. of Tokachi Nokyoren, ③ soil sample, ④ reagents, ⑤ pH meter with auto sampler, ⑥ Atomic Absorption Spectrometry for trace elements, ⑦ Atomic Absorption Spectrometry for Ex-bases, ⑧ Autoanalyzer
Implementation of soil testing in Tokachi Nokyoren (1983~2011)

図 1 土壌分析点数の推移（昭和57年～平成23年）
General soil testing

- Soil pH, available P (Troug or Bray), phosphate absorption coefficient, CEC, Ex. Bases, Available N (hot water extractable N)
- Total N and soil organic carbon

: Determined by near infrared analysis

Optional soil testing

- Trace element
  - (Cu, Zn, Mn, B)
- Nitrogen
  - (NO3-N, NH4-N)
- Soil physical analysis
  - (pF, three phase system, saturated hydraulic conductivity)
- Soil biological analysis
  - (α-glucosidase activity, screening for soil disease and root lesion nematode)
Soil sampling procedures for farmers

土壌のサンプリング方法

①サンプリングに必要な道具
- 移植ぎれ
- サンプル袋
- 土壌分析申込書
- 筆記用具

②少なくとも圃場の5ヶ所以上から均等にサンプリングし、よく混ぜて1つのサンプルにします。

③サンプリングは、肥料の影響が少ない箇所で行って下さい。表面の有機物を除去し、深さ20cm迄の土を移植ぎれで採取します。

④サンプルは500g程度（握りこすし2つ分）必要です。サンプル袋は当社より配送致しますので、お申し付けください。なお、市販のビニール袋でも差し支えありません。

⑤サンプリングの時期は春耕施肥前か収穫後が望ましいのですが、肥料の影響が少ない箇所から採取すれば生育時期でも差し支えありません。

⑥申込書に必要事項を記入し、サンプル袋に貼り付けてお送りください。
（申し込み用紙がない場合、袋にマジックで直接記入し、サンプルの区別が出来るようにして下さい。）

申込書の下に付いているシールで貼りつけて下さい。

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Fertilizer calculation in the soil testing system of Tokachi Nokyoren is based on the “Hokkaido fertilizer recommendation 2015”.

©Tokachi Nokyoren
Hokkaido Fertilizer Recommendation 2015

Rice

(1) Standard fertilizer application

<table>
<thead>
<tr>
<th>窒素 (N)</th>
<th>リン酸 (P2O5)</th>
<th>カリ (K2O5)</th>
<th>ケイアル</th>
<th>スフェ（SiO2）</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.0</td>
<td>8.0</td>
<td>8.0</td>
<td>90〜120</td>
<td>80〜120</td>
</tr>
</tbody>
</table>

Fertilizer application based soil testing

下段：施肥窒素量（kg/10a）

<table>
<thead>
<tr>
<th>8.0以下</th>
<th>〜11.0</th>
<th>〜13.0</th>
<th>13.0以上</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.5</td>
<td>8.0</td>
<td>7.5</td>
<td>7.0</td>
</tr>
</tbody>
</table>

(2-P) 土壌診断に基づく施肥リン酸量
上段：土壌診断における有効態リン酸含量（P2O5 mg/100g乾土）
下段：施肥リン酸量（P2O5 kg/10a）

<table>
<thead>
<tr>
<th>5以下</th>
<th>5〜10</th>
<th>10〜20</th>
<th>20〜30</th>
<th>30以上</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>12</td>
<td>8</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

(2-K) 土壌診断に基づく施肥カリ里
上段：土壌診断における交換態カリ含量（K2O mg/100g乾土）
下段：施肥カリ量（K2O kg/10a）

<table>
<thead>
<tr>
<th>7.5以下</th>
<th>7.5〜15</th>
<th>15〜30</th>
<th>30以上</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>11</td>
<td>8</td>
<td>5</td>
</tr>
</tbody>
</table>

(2-Si) 土壌診断に基づく施肥ケイ酸量
上段：土壌診断におけるケイ酸含量（SiO2 mg/100g乾土、潜水温調安定法）
下段：施肥ケイ量（ケイアル kg/10a）

<table>
<thead>
<tr>
<th>10以下</th>
<th>10〜13</th>
<th>13〜16</th>
<th>16以上</th>
</tr>
</thead>
<tbody>
<tr>
<td>180〜240</td>
<td>120〜180</td>
<td>60〜120</td>
<td>0〜60</td>
</tr>
</tbody>
</table>
An on-going challenge of soil inventory

New data coordination between national soil inventory and prefectural fertilizer recommendation.

New data coordination will be able contribute to raise awareness of the economic and social significance of good soil management based on soil testing.
Thank you for your kind attention!

Conserve the Environment by Listening to Wind, Observing Soil, and Thinking of Our Future.