Québec 2010
AIPCR · PIARC

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WORLD ROAD ASSOCIATION
MONDIALE DE LA ROUTE
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Québec

SUSTAINABLE WINTER SERVICE FOR ROAD USERS

RESEARCH ON ENVIRONMENTAL IMPACT OF SPREAD DE-ICING SALTS

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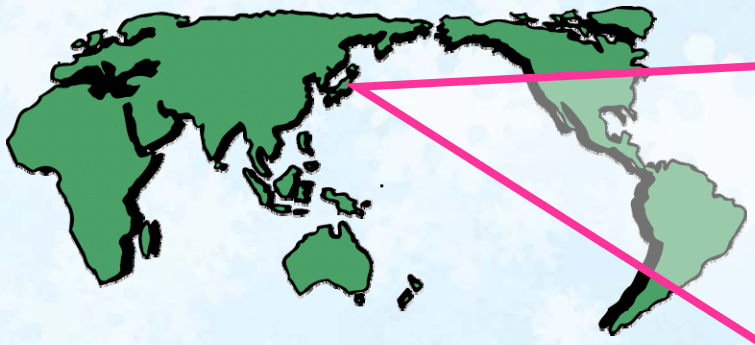
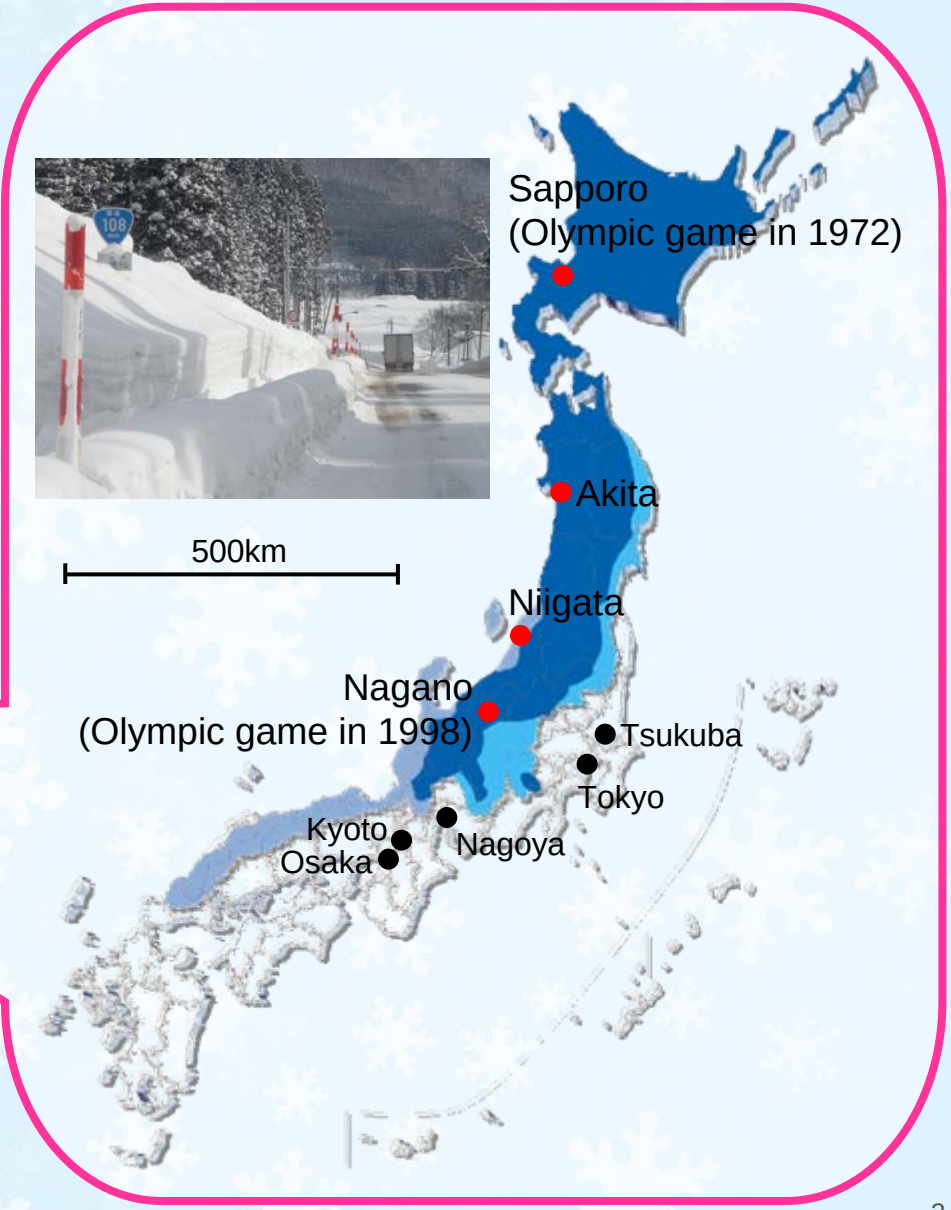
NILIM

1.1 Snowy Regions in Japan

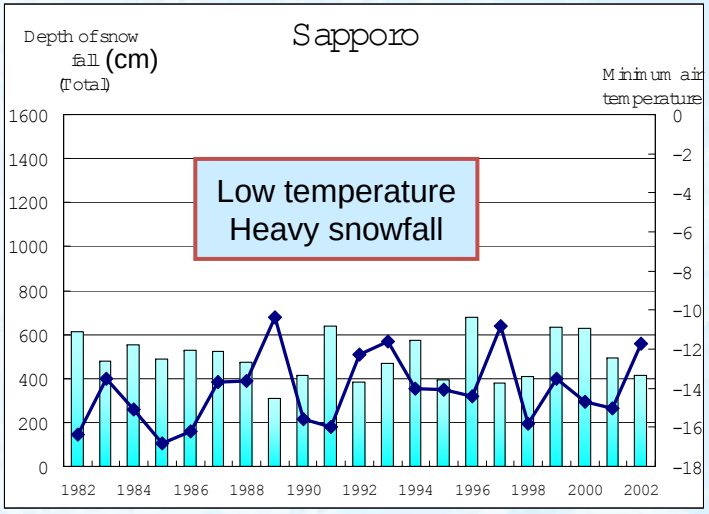
- 60 % of the area in JAPAN is in snowy regions.
- 25 % of people live in these regions.

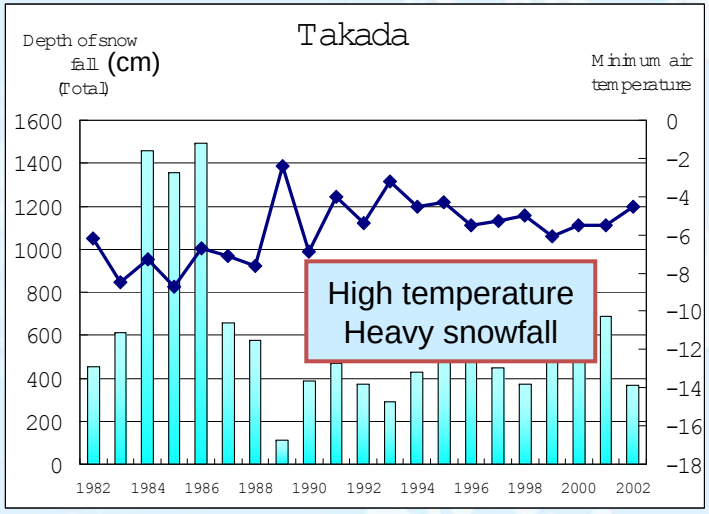


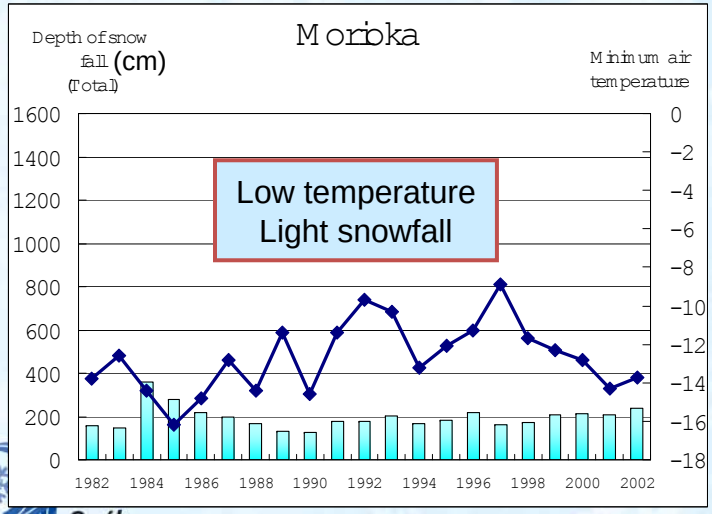


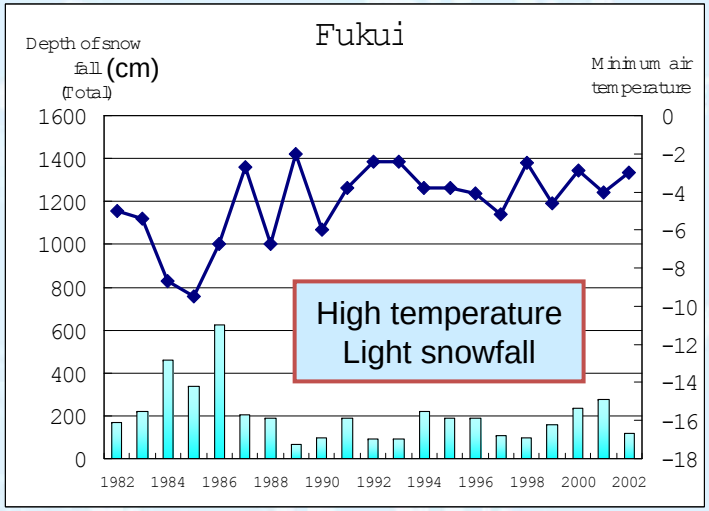
1.2 Temperature and Snowfall in Japan

- There is a lot of precipitation.
- Temperature is not very cold compared to north America etc .





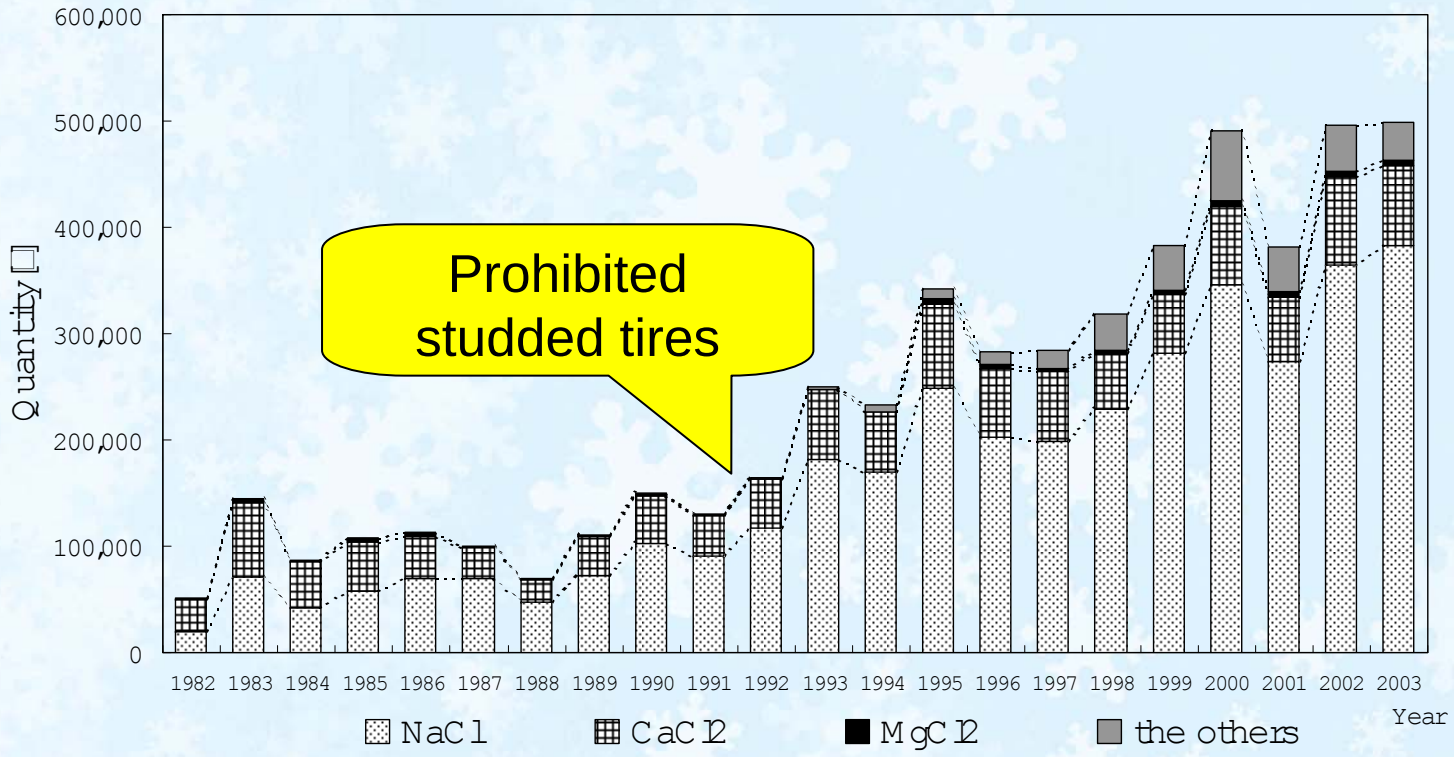




Reference . Japan Meteorological Agency

1.3 The Quantity of De-icing Salts in Japan

- The quantity of de-icing salts has increased every year since the use of studded tires was prohibited in 1993.



Quantity of de-icing salts in recent years

1.4 Purpose of this Research

Ascertain the relation between de-icing salts and their environmental impact.

Three sections of my presentation;

- Quantity of de-icing salts spread and the way they are scattered, their run off.
- Salinity of roadside soil.
- Growth of and damage to roadside plants

This study focuses on chloride type de-icing salts.

NaCl :sodium chloride

CaCl2 :calcium chloride

MgCl2 :magnesium chloride

2. QUANTITY OF DE-ICING SALTS SPREAD AND WAY THEY ARE SCATTERED AND RUN OFF

2.1 Patterns of Scattering and Run Off De-icing Salts

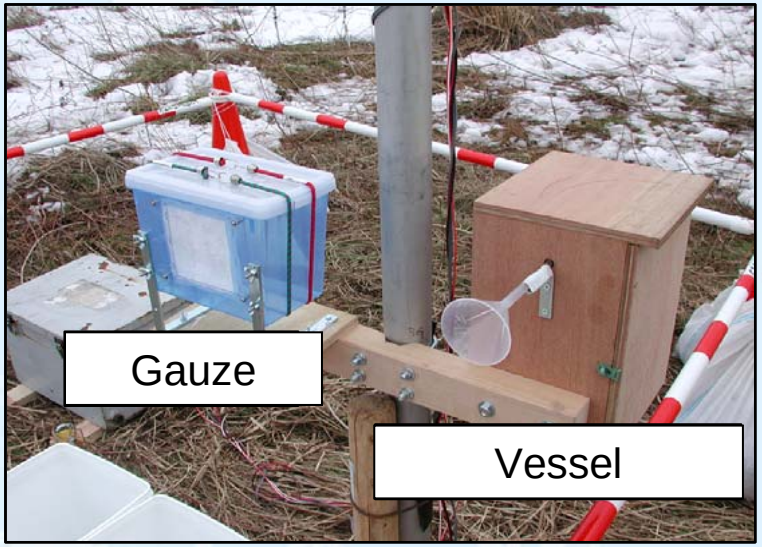
We tried to ascertain the relation between

- the quantities of de-icing salts spread onto the road
- the quantity that is scattered and run off from roads

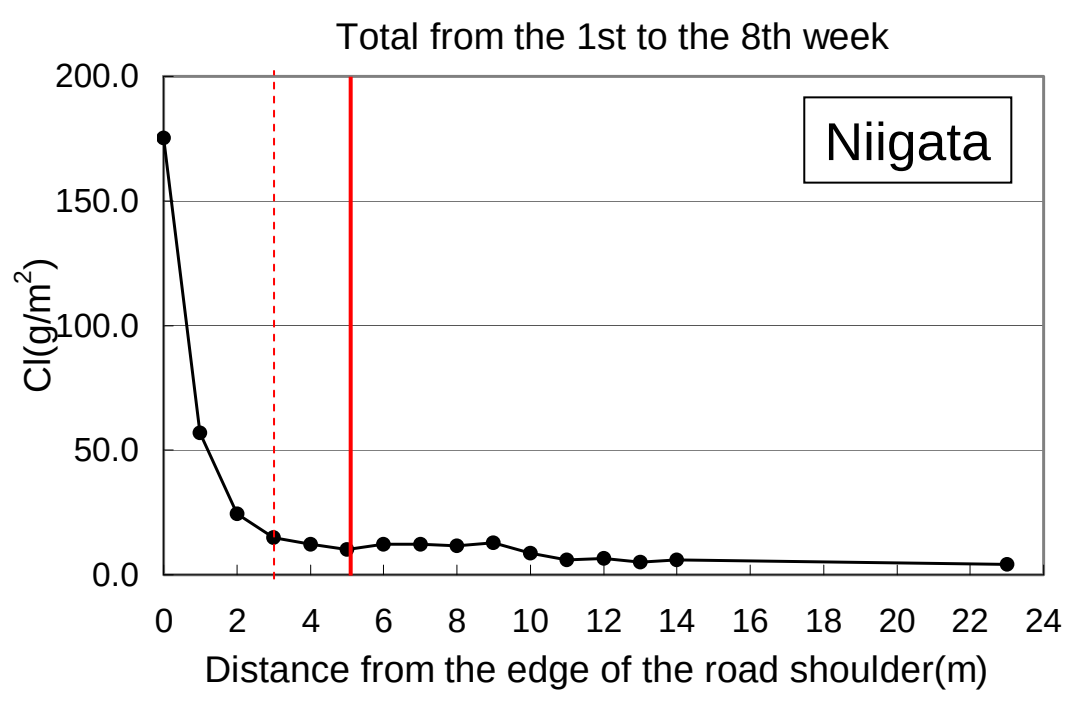
2.2 Survey of the Quantity Scattered

Survey location

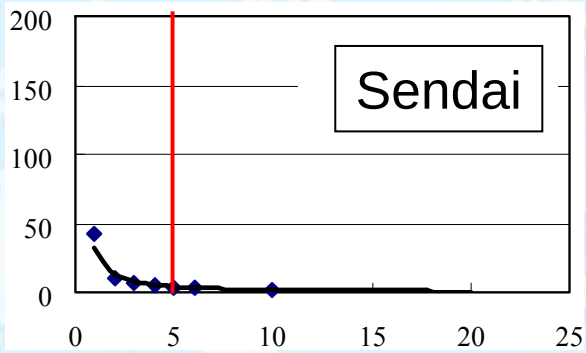
Tools of the survey



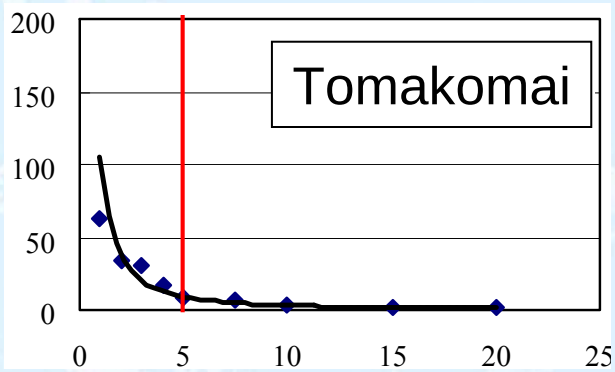
2.3 Quantities of De-icing Salts Scattered Outside the Roadway



1) solid



2) liquid



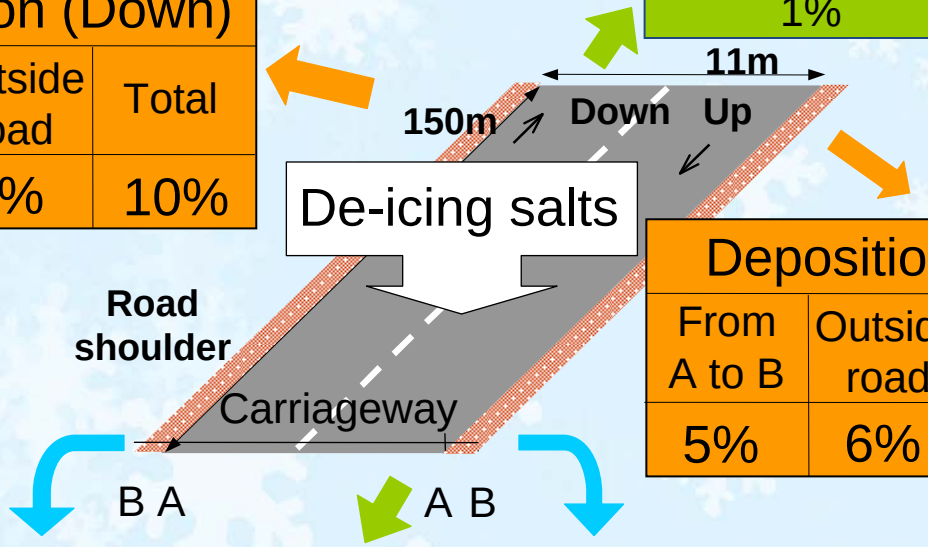
3) Mixed solid & liquid

2.4 Material Balance of De-icing S

Salt (total):656kg
Survey period:8week

Deposition (Down)		
From A to B	Outside road	Total
4%	5%	10%

Adhesion on vehicle (down) 1%



Deposition (Up)		
From A to B	Outside road	Total
5%	6%	10%

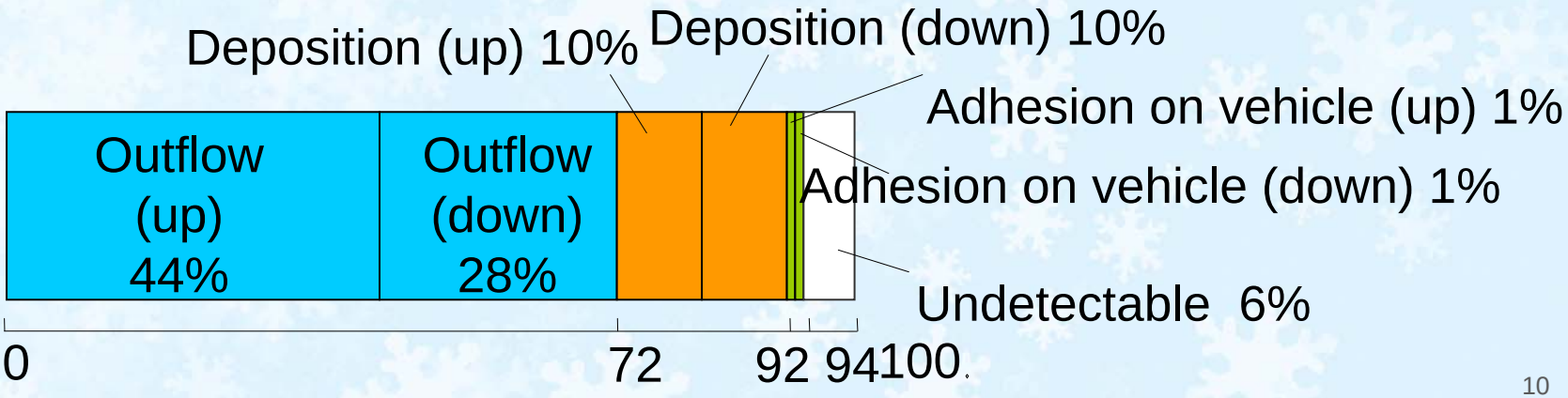
Spread de-icing salt (chlorine)

Outflow 72
Deposition 20
Adhesion to vehicle 2
Undetectable 6

Outflow (down) 28%

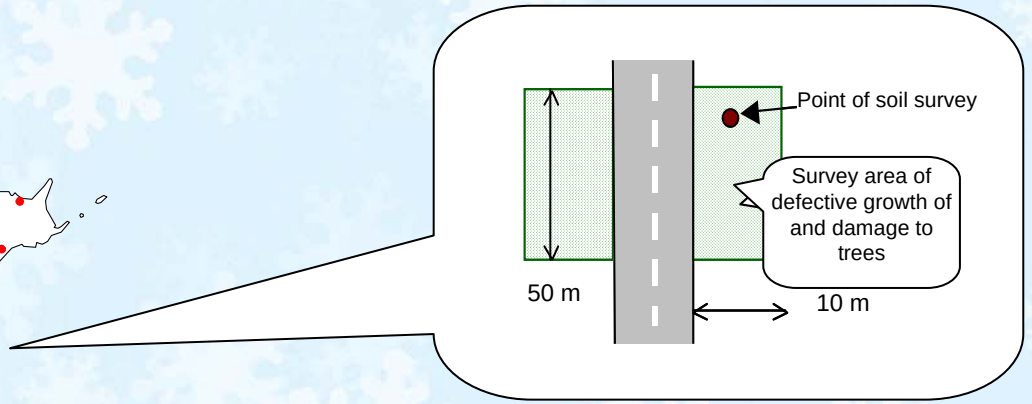
Adhesion on vehicle (up) 1%

Outflow (up) 44%



3. SALINITY OF ROADSIDE SOIL

3.1 Survey of Roadside Soil



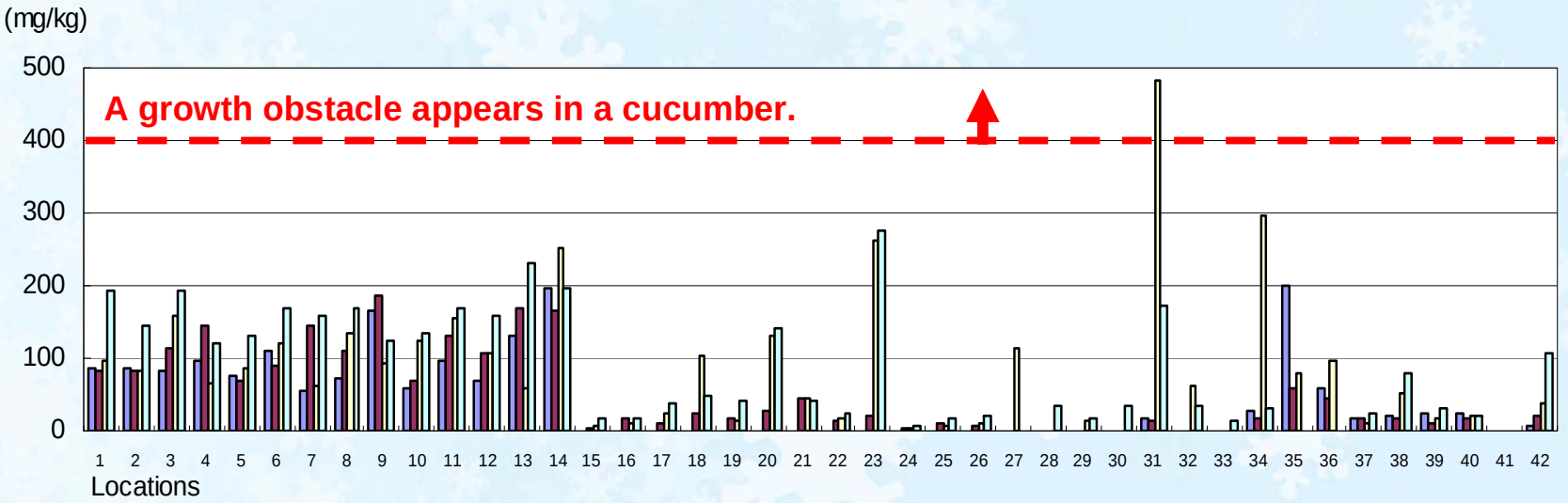
- Survey locations (42 locations)

Indicator	Threshold level	Influence when it over threshold level…
Density of chlorine	400mg/kg *	A negative influence on the growth of cucumbers
The ratio of "Na^+/CEC"	15% **	The water permeability of the soil gets worse. The soil hardens during the dry season.

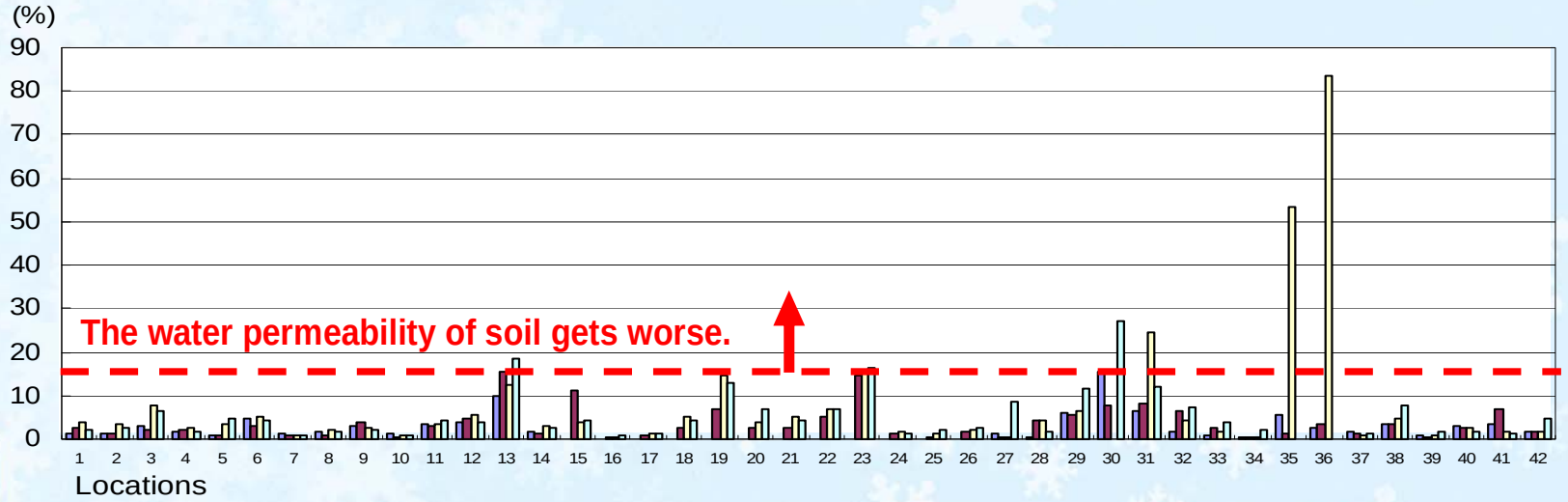
Reference;
*soil and food handbook
**Japanese Society of Soil Science and Plant Nutrition

CEC: Cation exchange capacity.
It is influenced by the characteristics of the soil

3.2 Survey Result

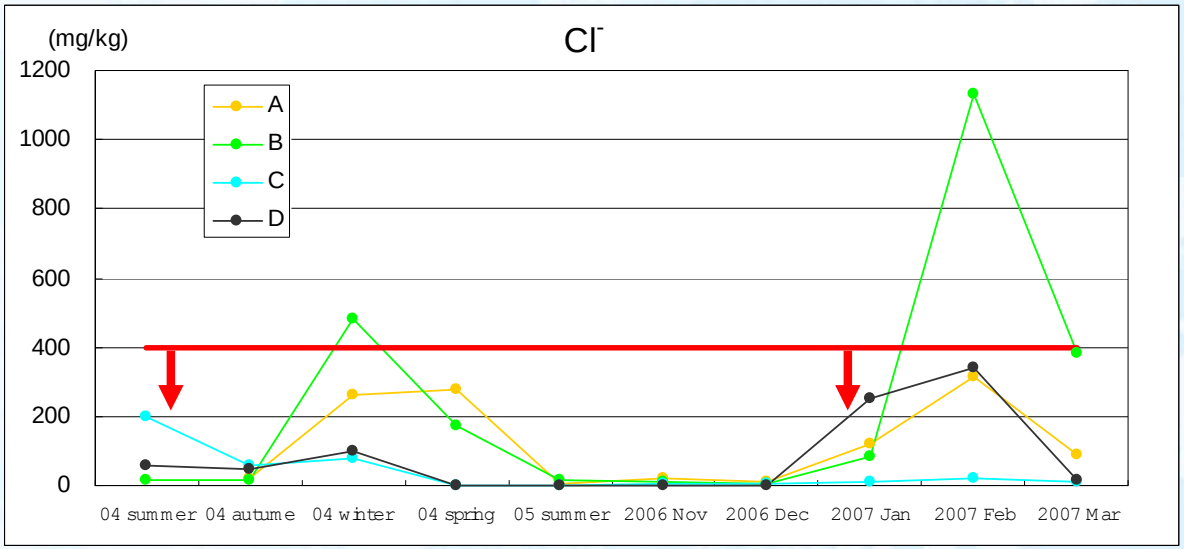


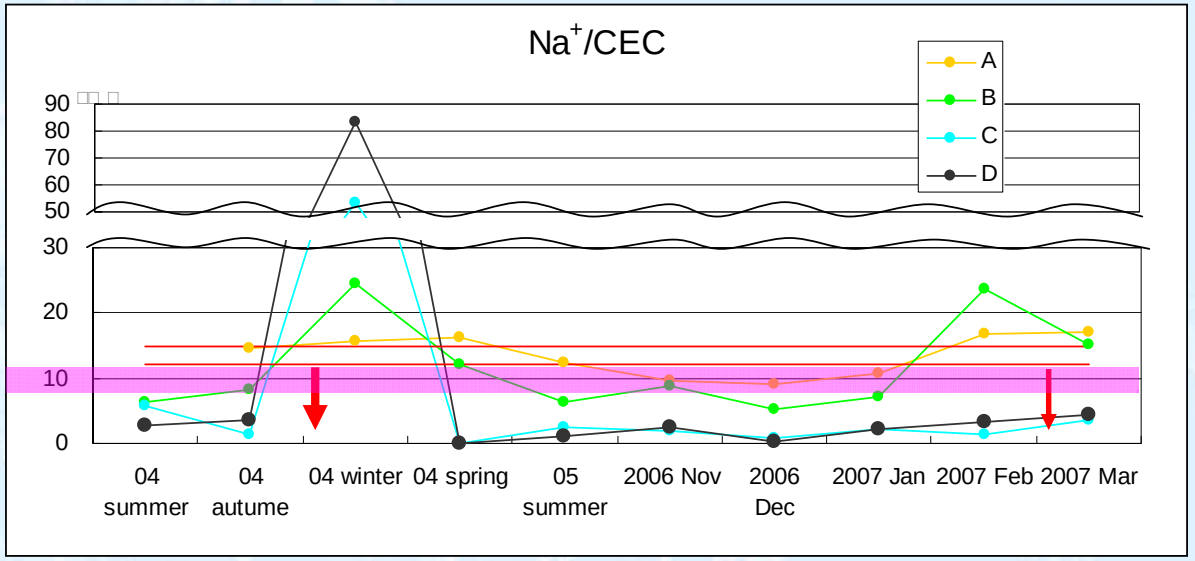
The concentration of Cl-



The ratio of Na+/CEC

3.3 Temporal Change





Salinity of the soil was washed out by rain etc, and does not accumulate.

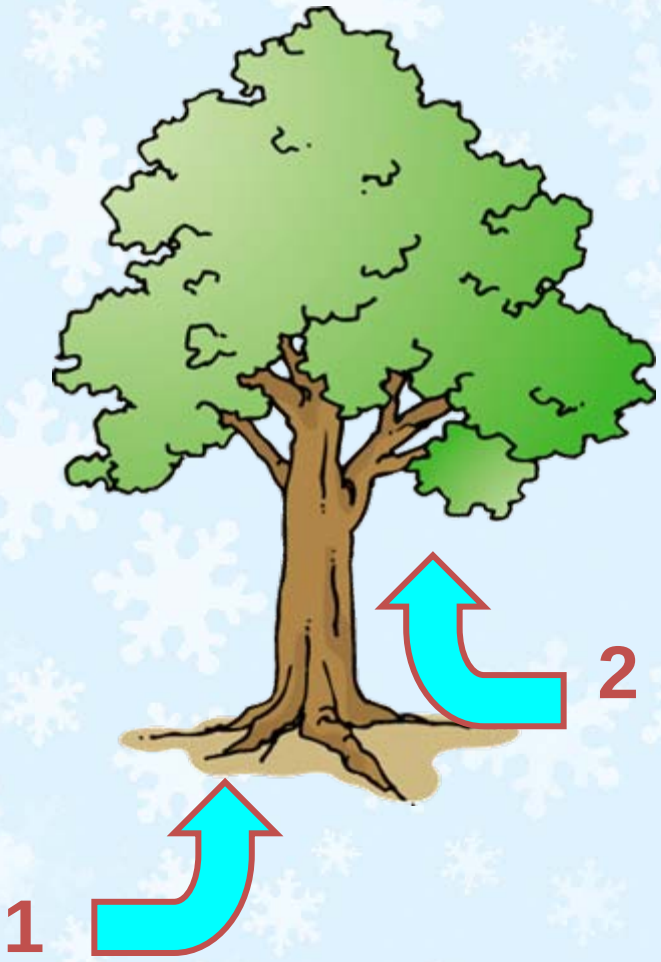
4. GROWTH OF AND DAMAGE TO ROADSIDE PLANTS

4.1 Vegetation Impact Process

Two processes

1. The absorption of de-icing salts deposited in soil.

2. The penetration of to vegetation de-icing salts.



4.2 Impact Investigation on Plant by De-icing Salts

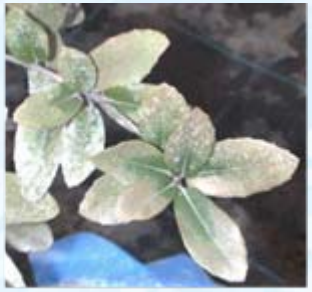
The elements related to impact

1. The quantity of salt adhering to leaves.
2. The penetration quantity.
3. The allowed salt penetration of the vegetation.

Objects of experiment

Japanese Spindle bush

Ubame oak



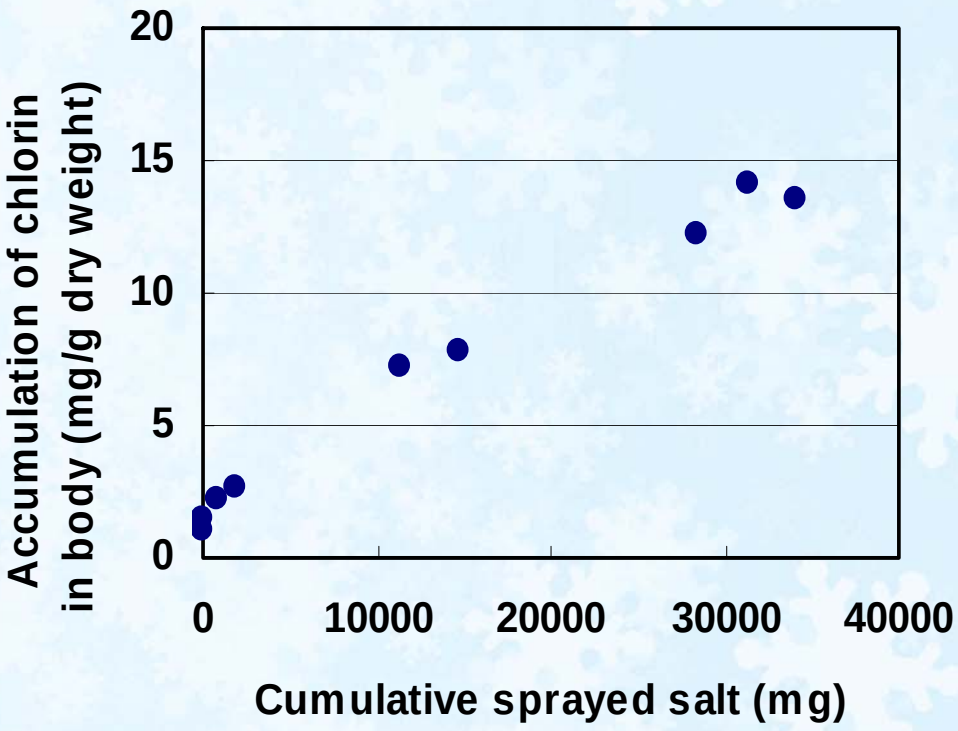
Lovely azalea

Japanese ceder

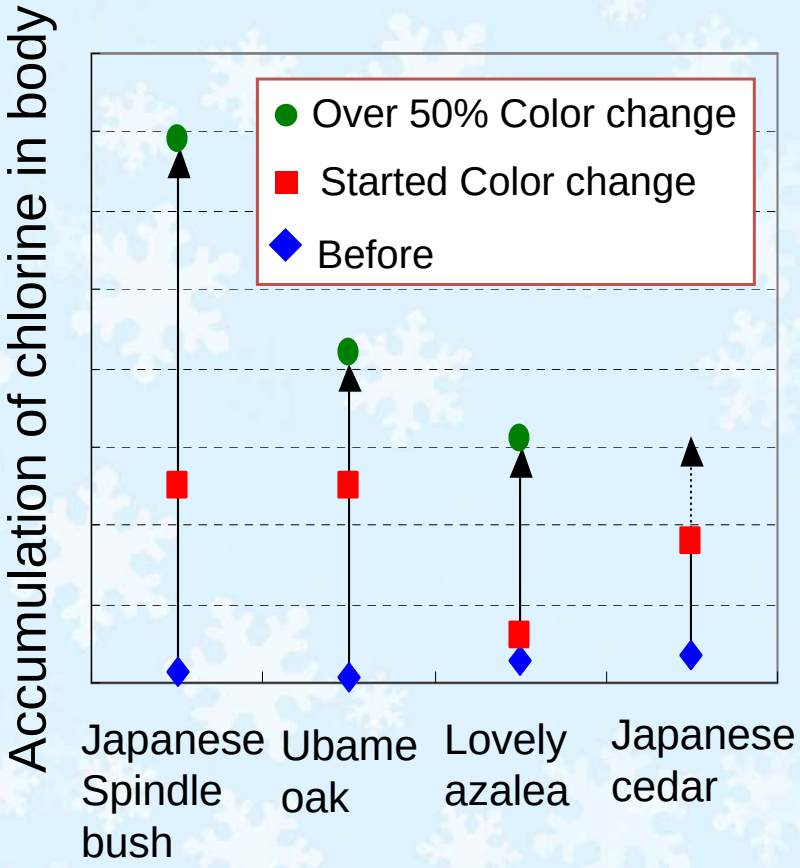
0.05%-8% ,50ml/m2
3times a day
for three months

Spraying saline in house

4.3 Salt in Body of the Leaves



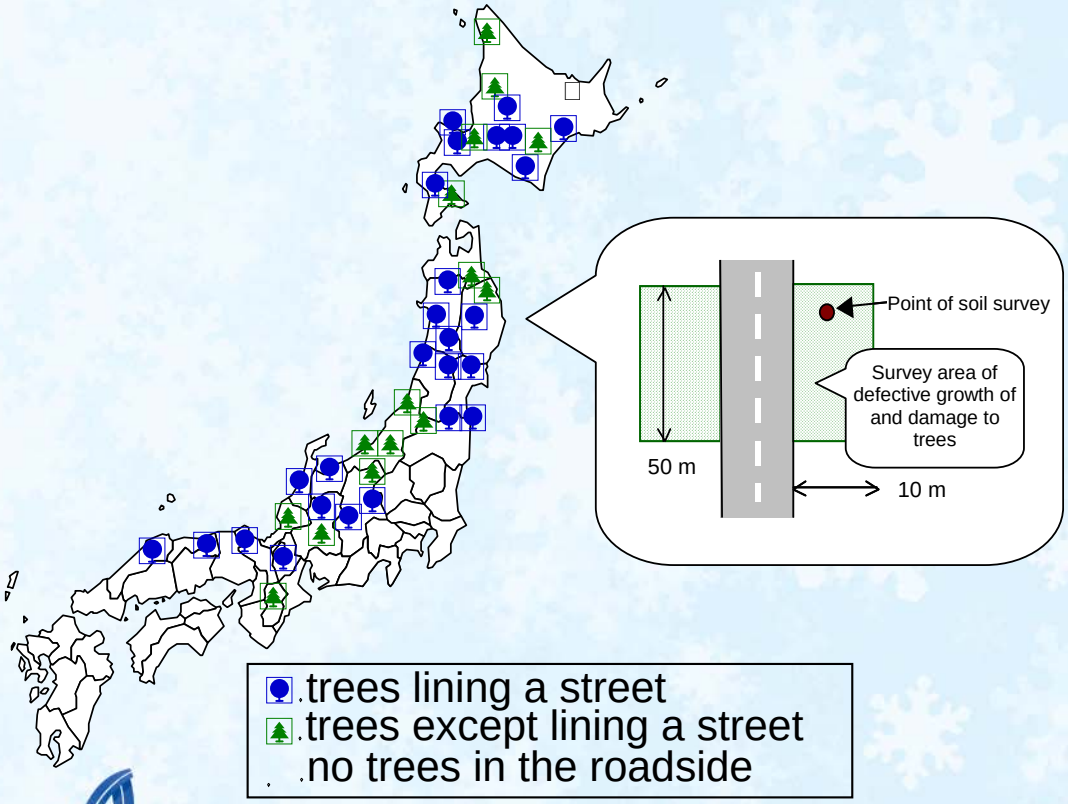
Example of the Relationship of Salt Spread with Salt in Body of Vegetation

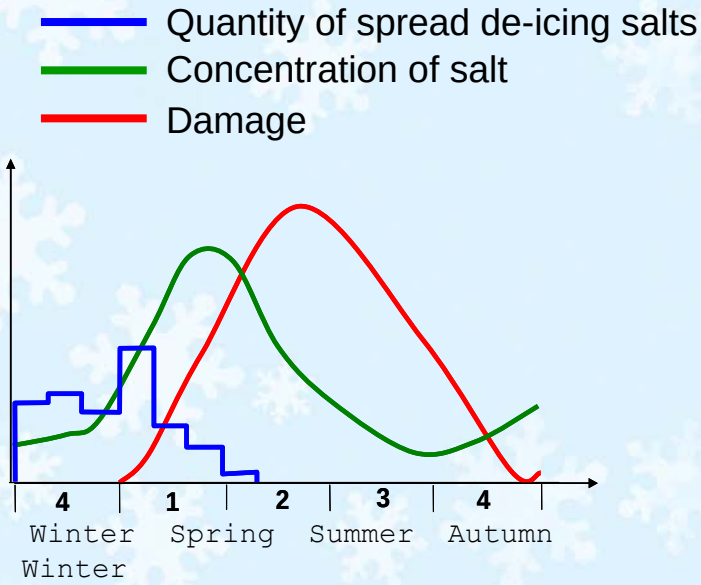


Salt in body and color of the Leaves

4.4 Defective Growth and Damages Survey

- We observed the growth of the trees and damage caused by de-icing salts of roadside trees in summer.
- Survey locations were the same as in the soil survey.





Reference.Data från Hautala & Kärenlampi, 1994, Finnra 49/1994

4.5 Items Studied in Defective Growth and Damages Survey

- Type of trees
- Location
- Distance from the road edge
- State of defective growth
- State of damage

Dead tips

Partially dead

Standing decayed

Defective Growth

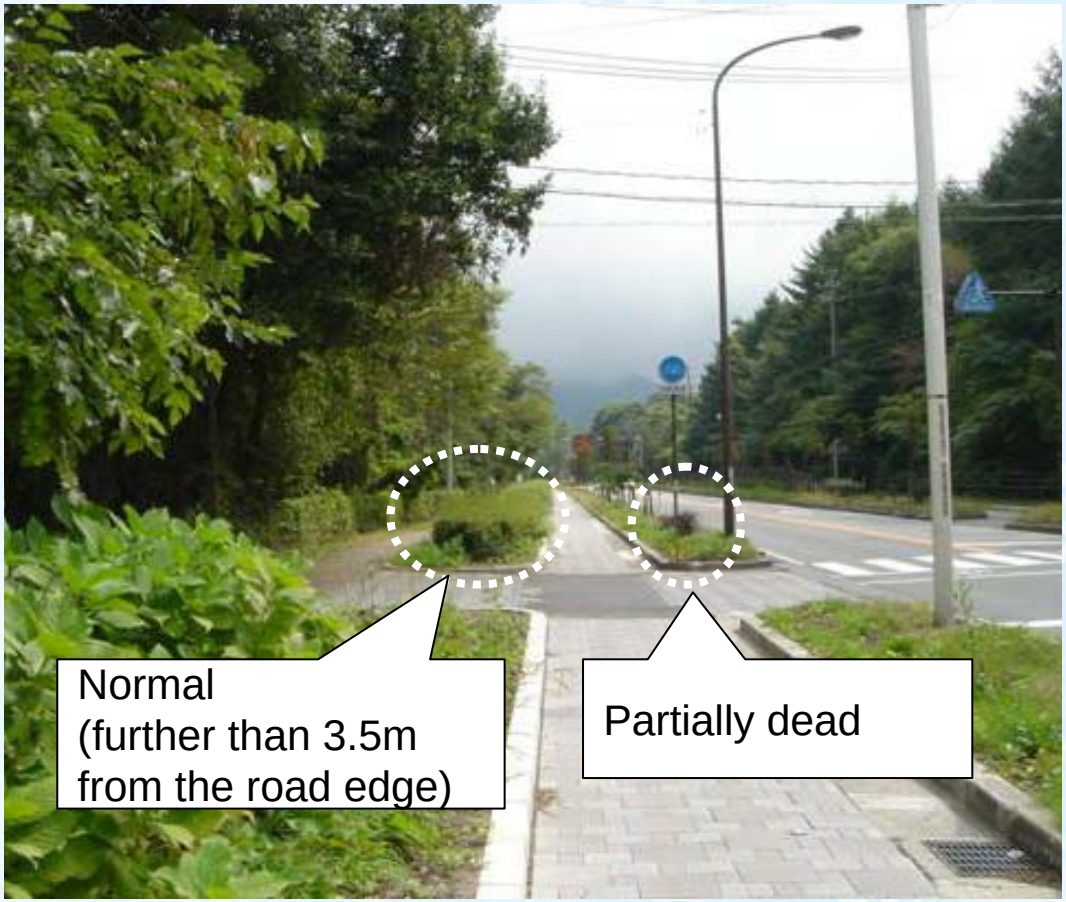
Branches breaking

Trunks bending

Damage to trunk

Damage

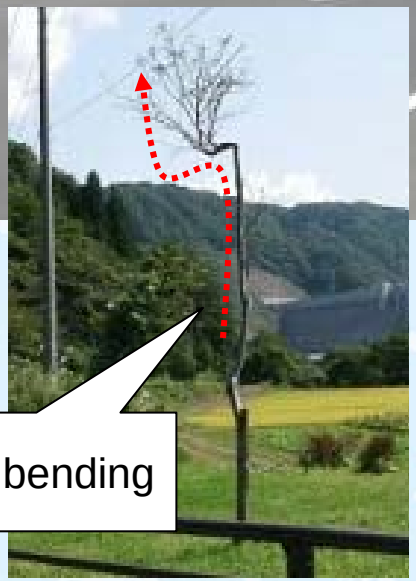
4.6 Examples of Defective Growth and Damage



4.7 Examples of Defective Growth and Damage

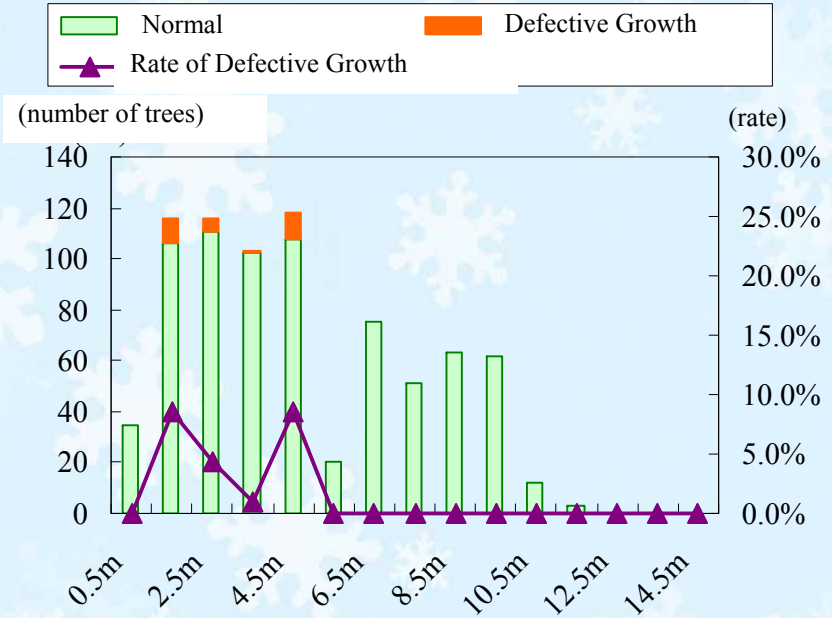
Standing decayed (immediate roadside has heavy damage)

4.8 Examples of Defective Growth and Damage



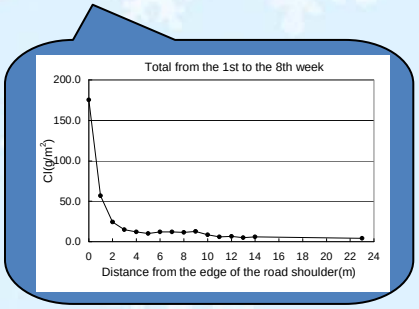
4.9 Defective Growth and Damage to Roadside Trees

Group	Number of trees		Number of locations	
Defective growth	26	71	7	13
Damage	5		2	
Both of Defective growth and Damage	40		4	
Normal (No abnormality)	748		27	
Total	819		40	



Number and Rate of Trees with Defective Growth (including distance from the road edge)

.normal
.damage
.defective growth
.damage & defective growth



4.10 Consideration

- The area within 5meters of road edge usually accumulates cleared snow.
- In this area, there are a lot of factors may lead trees to damage or defective growth such as;
  - *the method of afforestation*
  - *the species of tree*
  - *pressure of cleared snow*
  - *collision with a snowplow*
  - *vehicle exhaust emissions etc*
- We think defective growth which were observed are caused by a combination of these factors, the extent of influence on defective growth by de-icing salts is not clear.

Summary & Conclusion

- Material balance of de-icing salt spread
  72% was run off, 20% was scattered, 2% adhered to motor vehicles
- Of the scattered salts, 72.5% were deposited from the area between the road edge to 3 meters away.
- Salinity of the soil was temporary increased in winter, however, it seems does not accumulate.
- Defective growth of roadside trees was not observed in areas further than 5m from the road edge. It seems that defective growth are caused by a combination of these factors.

There is no definite impact on roadside environment caused by de-icing salts. (Impact is limited.)

Welcome to Japan pavilion (Stand 709)