

Environmental effect in expression of characteristics in DUS examinations

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Experience of measures to address the environmental effect on soybean

1. Breeding activities in Japan
2. Environmental impact on soybean in Japan
3. Experience DUS examination on soybean

Breeding activities in Japan

1. Breeding Objectives Vicissitude

Example	Breeding Objectives	(gene locus)	Breeding Method
Past scope	<ul style="list-style-type: none"> Improving yields Stable production Soil transmitted diseases resistance 		<ul style="list-style-type: none"> Hybridization breeding Mass selection Pedigree selection
Current 15 years scope	<ul style="list-style-type: none"> Pod dehiscence Diseases resistance (Mosaic virus) Insect resistance (Cyst nematode) Severe climate tolerance (Cadmium) Dominant gene for Pod color Dominant gene for Flowering time 	<ul style="list-style-type: none"> ➤ <i>qPDH1</i> ➤ <i>Rsv3, Rsv4</i> ➤ <i>Rhg1, 2, 4</i> ➤ <i>Cd1, Cda1</i> ➤ <i>I</i> ➤ <i>E1, 2, 3, 4</i> 	<ul style="list-style-type: none"> Pinpoint breeding by using molecular marker and back crossing. Genome editing. <p>Speedup breeding, reducible time and cost</p>

Demand of new plant varieties for agricultural production is increased, and plant breeding technology is improved to address such demand rapidly.

General Information on Climate of Japan



Four distinct seasons with a climate ranging from subarctic in the north to subtropical in the south.

Different climate condition between Pacific ocean side and the Sea of Japan side.

✓ Northern area: Warm summers and very cold winters with heavy snow on the Sea of Japan side and in mountainous areas.

cool

✓ Eastern area: Hot and humid summers and cold winters with very heavy snow on the Sea of Japan side and in mountainous areas.

✓ Western area: Very hot and humid summers (with temperatures sometimes reaching 35 degrees Celsius or above) and moderate cold winters.

Hot

✓ Okinawa and Amami area: A subtropical oceanic climate. These areas have hot and humid summers (with temperatures rarely reaching 35 degrees Celsius or above) and mild winters.

Environmental impact on soybean in Japan

- Elongated geography from north to south.
- Soybeans **growing in areas with difference in elevation**. Varieties are significantly differentiated relative to the production area.
- The **favorable temperature for growing as 25 - 30 degrees Celsius**.
- A minimum **accumulated temperature as 2000 degrees Celsius**.
- A **day average temperature more than 12 degrees Celsius, at least 120 days**.
- Detailed regional zone are established to select the most suitable varieties.
- The **critical day length is generally 12 to 14 hours**.
- If the **short-day conditions are less than 12 to 14 hours, flowering is progressed**.



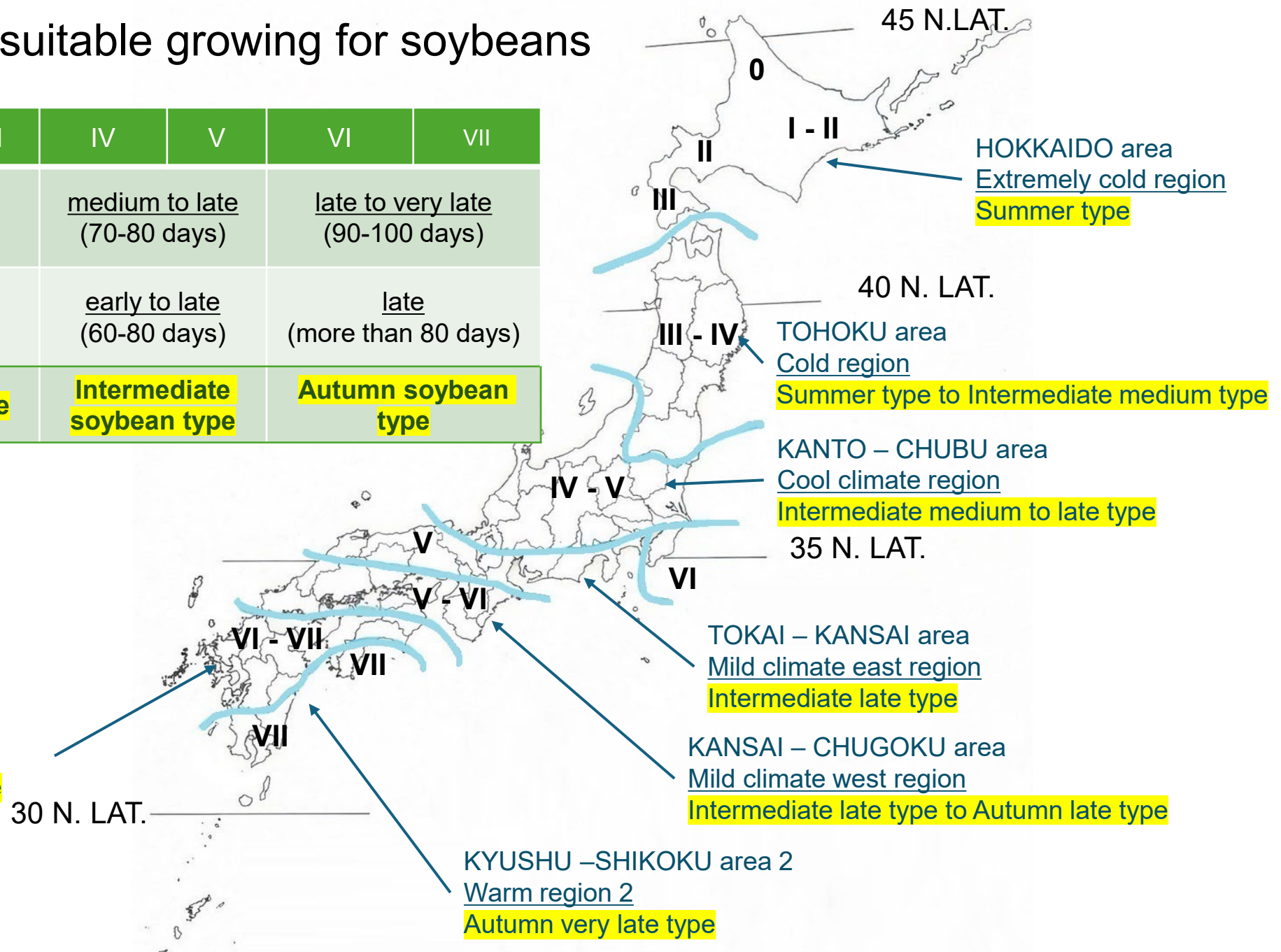
- Temperature sensitivity and light sensitivity are varied depending on the variety and regional zone.
- And most important point to select varieties according to northern latitude (day length) and temperature.

Categories: three ecotypes of soybeans to adapt to several climates in Japan

Ecotype	Feature	Risk of growing unsuitable area
<p>(1) Summer soybean type</p> <p>(Temperature sensitivity type for high latitude area)</p>	<ul style="list-style-type: none"> • Sensitive to the temperature. • Insensitivity short-day reaction for high northern latitudes area. 	<ul style="list-style-type: none"> • High temperature causes <u>too early flowering with meager plants.</u>
<p>(2) Intermediate soybean type</p> <p>(Intermediate sensitivity type)</p>	<ul style="list-style-type: none"> • Intermediate 	<ul style="list-style-type: none"> • Intermediate
<p>(3) Autumn soybean type</p> <p>(Light sensitivity type for low latitude area)</p>	<ul style="list-style-type: none"> • Sensitive to short-day reaction for low northern latitudes area. 	<ul style="list-style-type: none"> • Long-day condition causes <u>too late flowering with overgrowth plants.</u>

Ecotype categories of suitable growing for soybeans

Zone	0	I	II	III	IV	V	VI	VII
Flowering	<u>very early to early</u> (60-70 days)			<u>medium to late</u> (70-80 days)			<u>late to very late</u> (90-100 days)	
Maturity	<u>very early to medium</u> (60-70 days)			<u>early to late</u> (60-80 days)			<u>late</u> (more than 80 days)	
Ecotype	Summer soybean type			Intermediate soybean type			Autumn soybean type	



Experience DUS examination on soybean

- To optimize DUS examination on soybean, it was considered to set regional sets of example varieties for each growing zone. JP national TG divided by six(6) zones in national land with regional example varieties.

Characteristic	Note	Expression	Six(6) zone in Japan national land with regional example varieties					
			<u>Extremely cold region</u>	<u>North cold region</u>	<u>Cool climate region</u>	<u>Mild climate east region</u>	<u>Mild climate west region</u>	<u>Warm climate region</u>
Plant: height	2	very short to short						Hatsunagaha Kotoyutaka
	3	short	Toyomusume Yukishizuka					Sachiyutaka Tamahomare Suzukaren
	4	Short to medium			Osuzu Ryuho	Enrei	Sachiyutaka Tamahomare Ayakogane	Suzuotome Fukuhayate
	5	medium	Suzumaru	Ryuho	Enrei Suzuyutaka Tachinagaha	Tachinagaha Satonohohoem Sachiyutaka		Fukuyutaka Kurodamaru
	6	medium to tall			Nakasennari	Tamahomare Kurokojirou		Kurosayaka
	7	tall		Satonohohoemi Tachinagaha			Fukuyutaka	
	8	tall to very tall				Fukuyutaka		

Tending to larger in scale relative to latitude with moving example varieties to each zone

High N. LAT

Low N. LAT

Six(6) zones in Japan national land with regional example varieties

Characteristic

Extremely cold region

North cold region

Cool climate region

Mild climate east region

Mild climate west region

Warm climate region

Plant: height

Tending to larger in scale by latitude



High N. LAT

Long day-length
Warm summers



Low N. LAT

Short day-length
Very hot and humid
summers





Traditionally important Soybean Food Products



Thank you very much.

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