

**Effects of Segment of 1RS of Rye on Root
System of bread wheat Pavon
Translocation 1RS.1BL**

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Ways Plants Survive Drought

- **Drought Escape**
 - crop earliness



- **Drought Resistance**

Dehydration Avoidance

- maintenance of water uptake (Root System)

- reduction of water loss

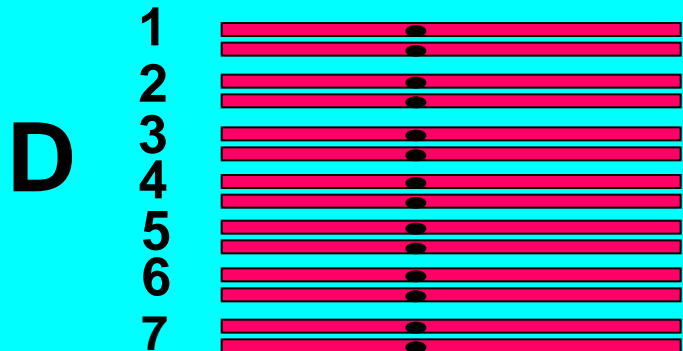
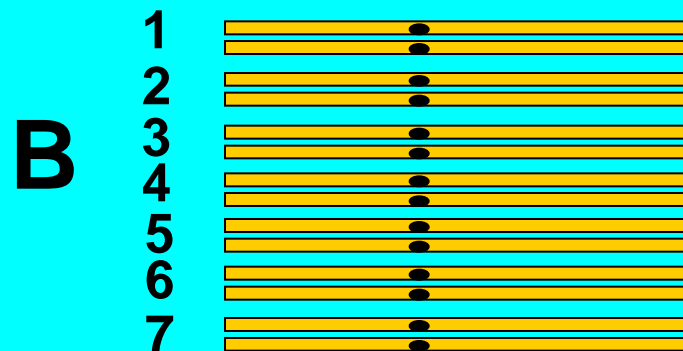
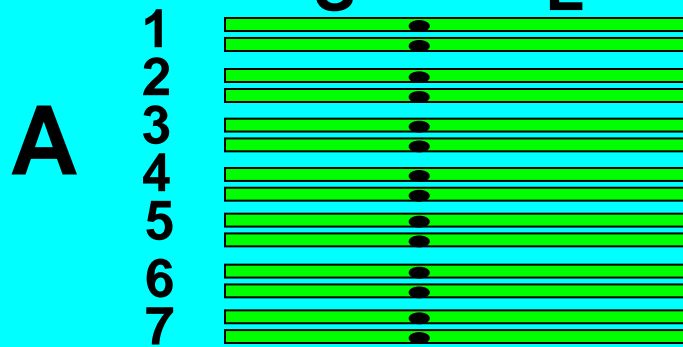
- changes in tissue characteristics

Dehydration Tolerance

- protoplasmic tolerance

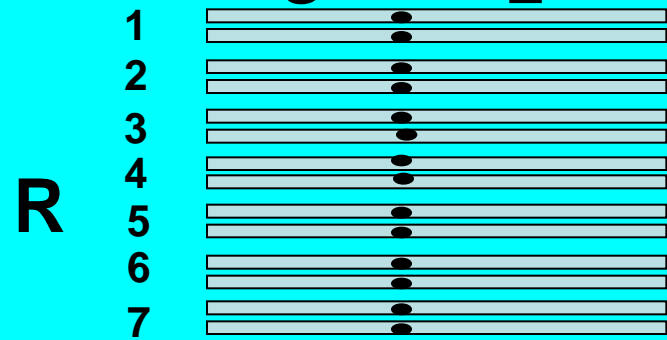
Bread Wheat

S L

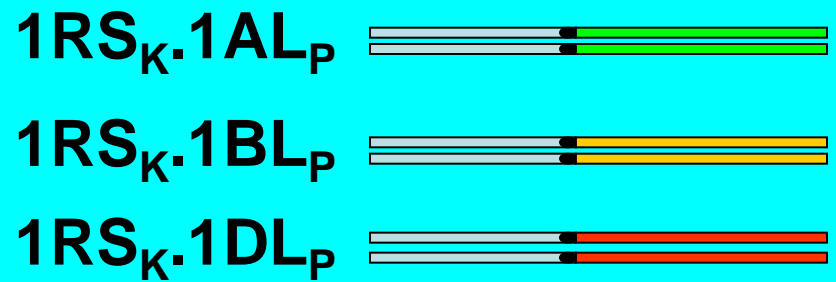


Rye

S L



Pavon Wheat



Why 1RS?

- Carried resistant genes to several pathogenes.
- On average, increased grain yield by 7% in certain cultivars.
- Increased adaptation and stability in stressful environments.
- No physiological basis for improved grain yield performance or better adaptability was given.

Pavon and its 1RS translocations



Pavon



1RS.1AL



1RS.1BL



1RS.1DL





Small white label with handwritten text, possibly a date or identifier, attached to a wooden post on the left side of the greenhouse.

Small white label with handwritten text, possibly a date or identifier, attached to a wooden post on the left side of the greenhouse.

Vertical wooden post with the handwritten text "W 1 1 W" visible on its side.

1RS : Short arm of chromosome 1 of Rye in Pavon wheat

Increase in Root Bio.
1RS.1AL 28%
1RS.1BL 11%
1RS.1DL 22%

Positive correlation between root biomass and grain yield in wet (0.66) and dry (0.89) pot conditions

Increase in GY in field
1RS.1AL 20%
1RS.1BL 11%
1RS.1DL 14%

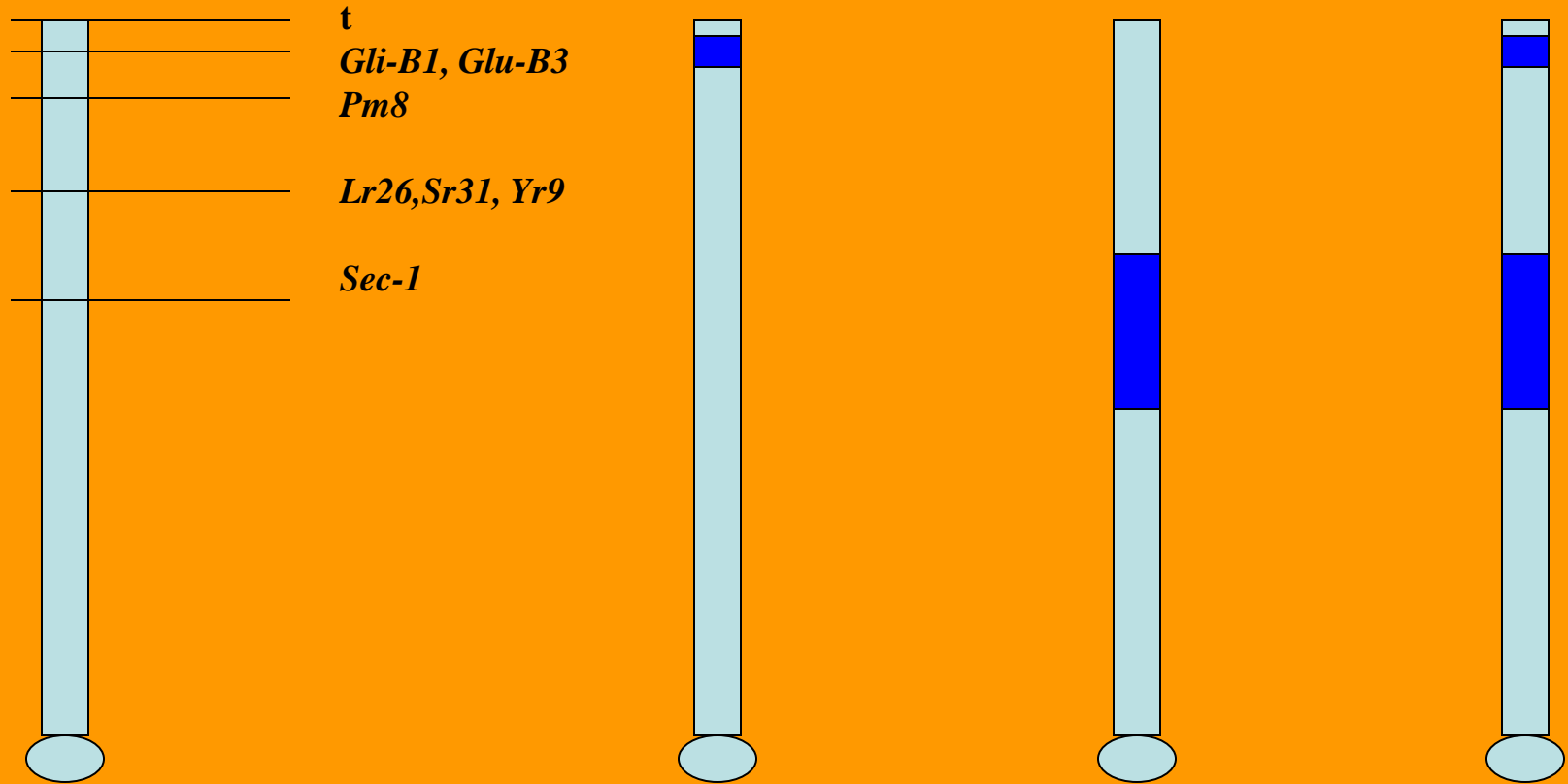


Disadvantage of 1RS

- Carries *Sec-1* gene with negative effects on end-use quality.
- Lacks *Gli-B1* and *Glu-B3* genes with positive effects on end-use quality.
- 1RS.1BL lines are not used as commercial cultivars where bread quality is important.
- In China 50% and in Bulgaria 54% of the commercial bread wheat cultivars are of 1RS.1BL type.

Modified 1RS

(segments of 1BS colored blue)

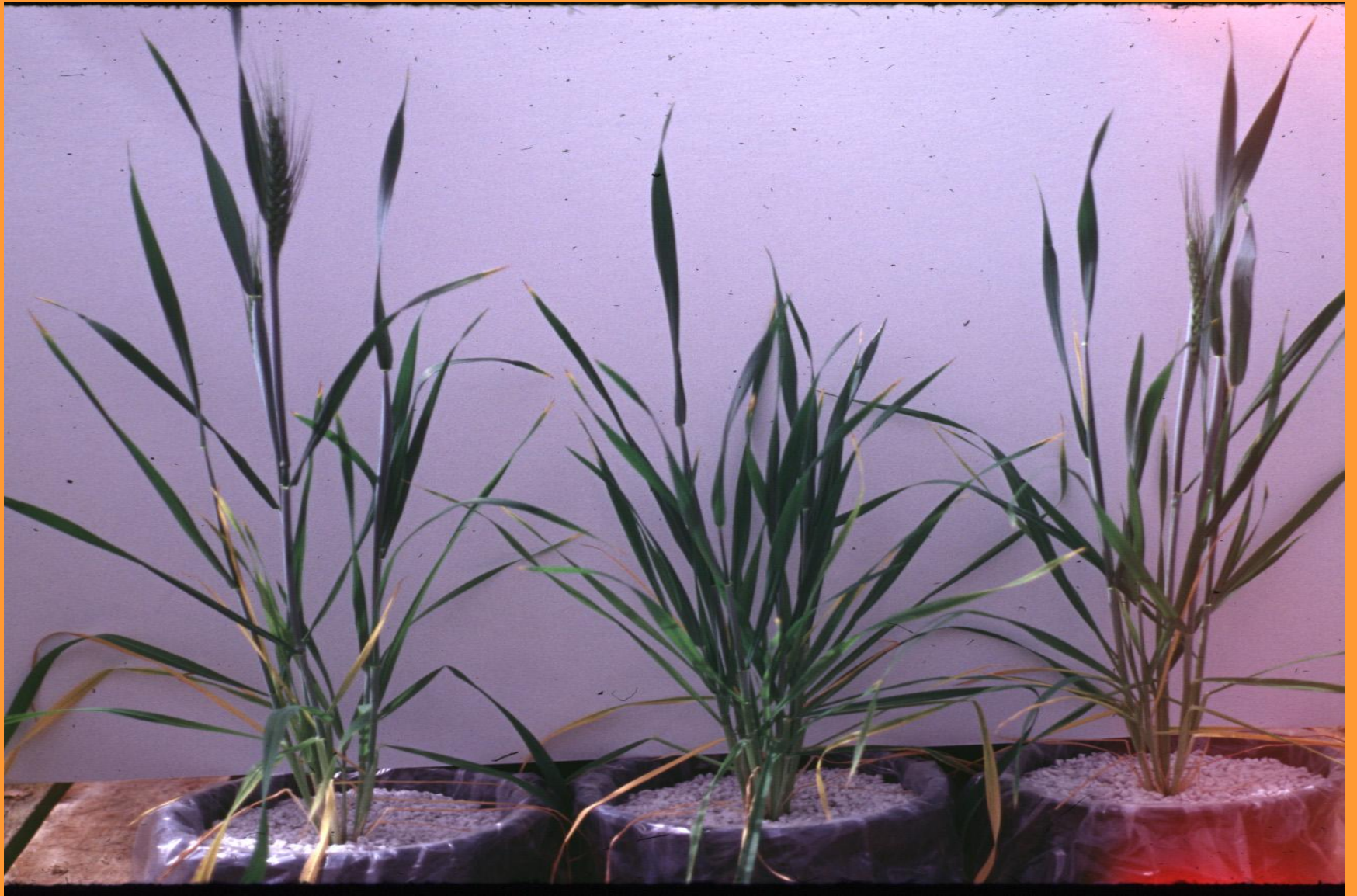


**1BS and 1RS
arms**

**1RS with
*Gli-B1/Glu-B3***

**1RS without
*Sec-1***

**1RS
desired**



Pavon

m1RS.1BL

1RS.1BL

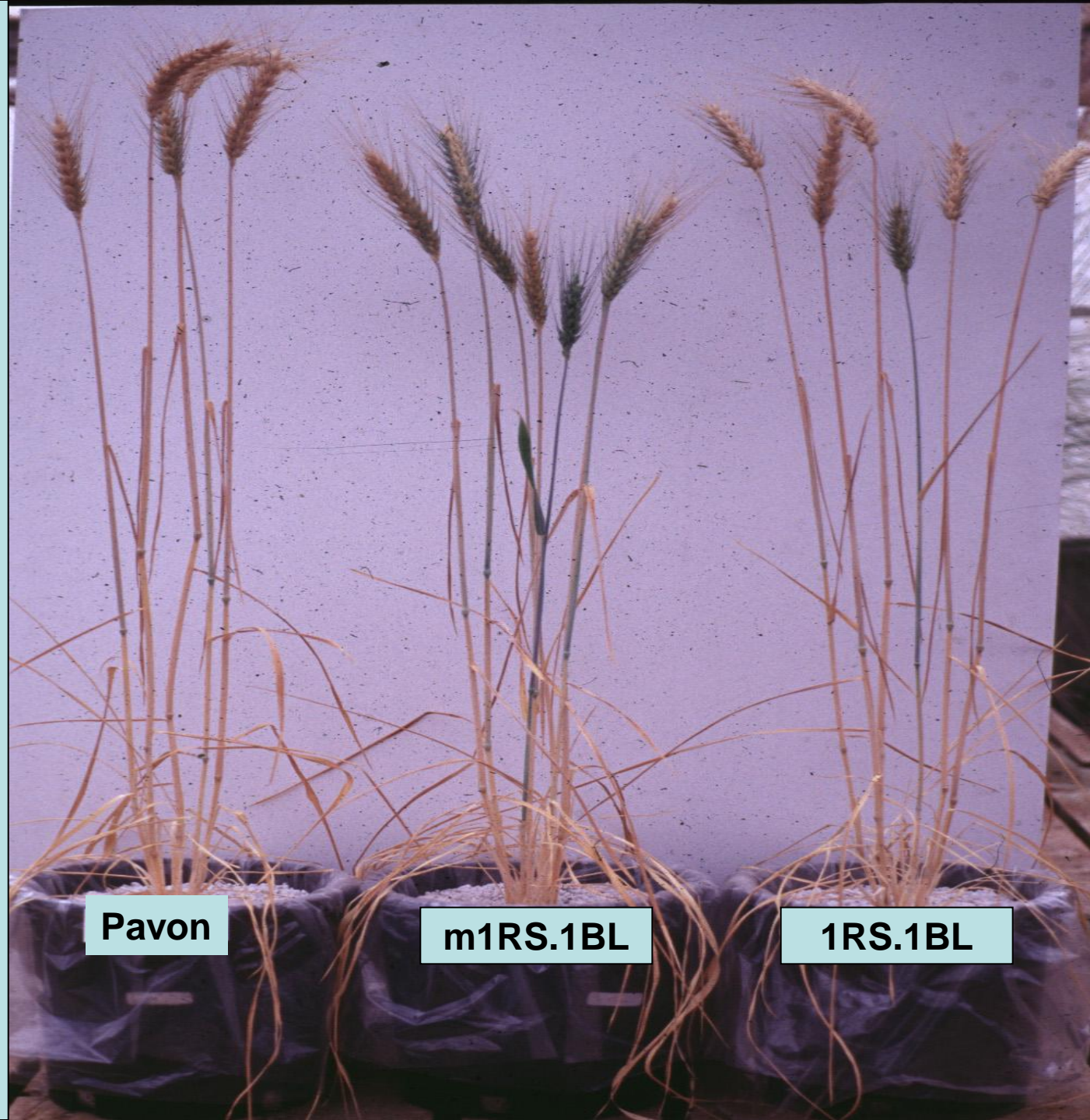


**Mean Plant
Height
(cm)**

Pavon	93
1RS.1BL	90
m1RS.1BL	78

**Mean Days to
Maturity**

Pavon	121
1RS.1BL	126
m1RS.1BL	132



Pavon

m1RS.1BL

1RS.1BL

**Root Biomass
g/plant**

Pavon 3.86

1RS.1BL 5.27

m1RS.1BL 5.26

**Grain yield
g/plant**

Pavon 14.5

1RS.1BL 15.6

m1RS.1BL 15.5



Pavon



1RS.1BL



m1RS.1BL

10 %

51 %



Pavon

1RS_A.1AL

1RS_K.1AL

General Conclusions:

- Presence of 1RS in spring bread wheat increases root biomass in some 1RS.1BL.
- Location effect indicates interaction between wheat genetic background and 1RS
- Source of 1RS is important.
- Physiological basis of improved grain yield and adaptation may be due to larger root system in 1RS.1BL cultivars.

A larger root system would enhance water and nutrient uptake, which might contribute to increased shoot biomass and grain yield.

**Wheat has two types of roots:
Seminal roots,
Nodal roots.**

The **seminal roots** are important for establishment of wheat seedling early in plant growth.

The **nodal roots** appear 4-5 weeks after germination and furnish most of the water and nutritional requirements of the plant **under optimum conditions**.

As water depleted from the tope layers of soil, **seminal roots** become more important to explore and furnish water from deeper soil layers.

Deep **seminal roots** were associated with drought resistance through avoidance mechanism.

In CIMMYT wheats, **70%** of total root length is found in the top 30 cm soil layer, where nutrients are concentrated in most agricultural soils.



Pavon

1RS.1BL

1RS.1AL

14 Days After Sowing

Pavon

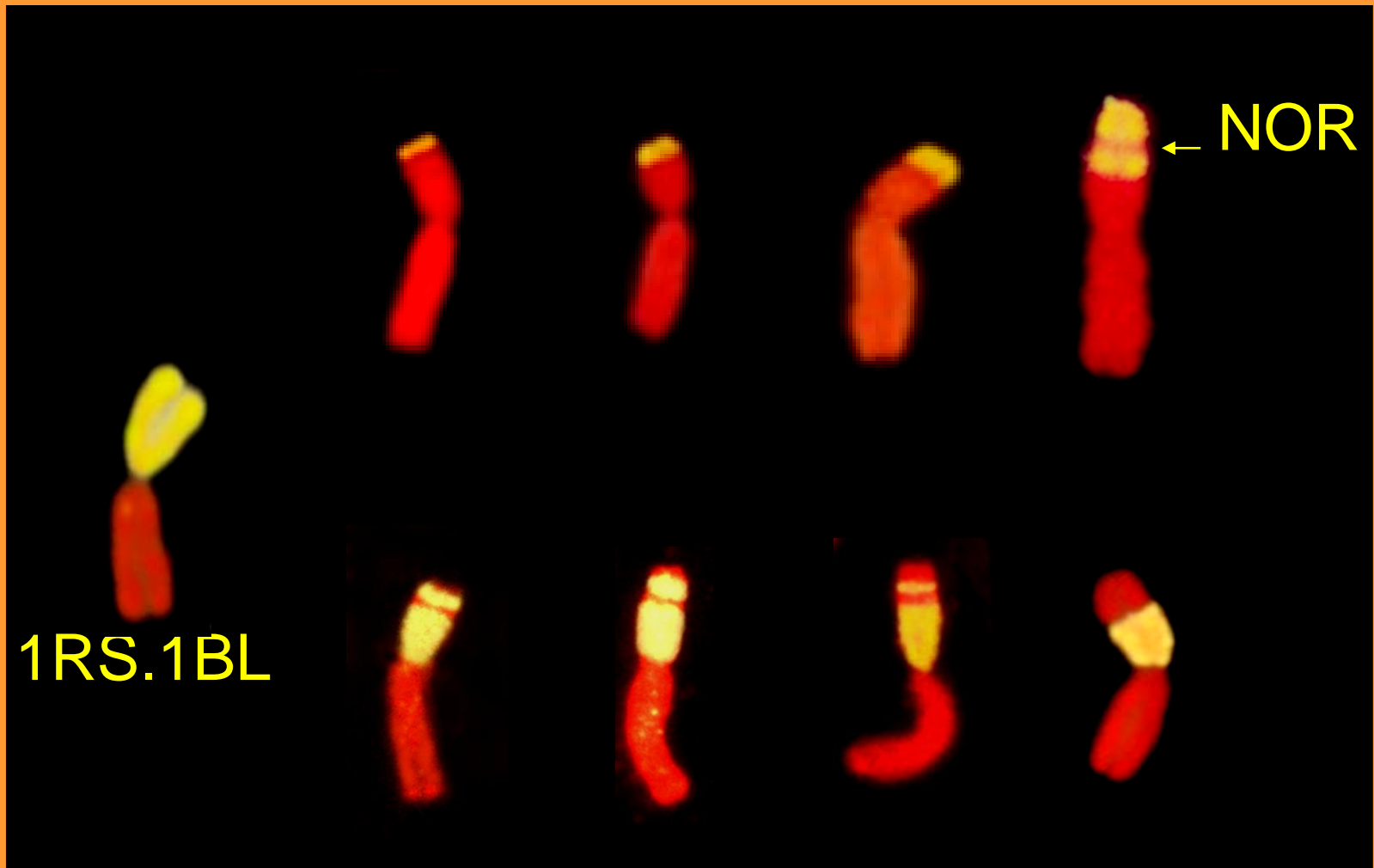
1RS.1AL

1RS.1BL

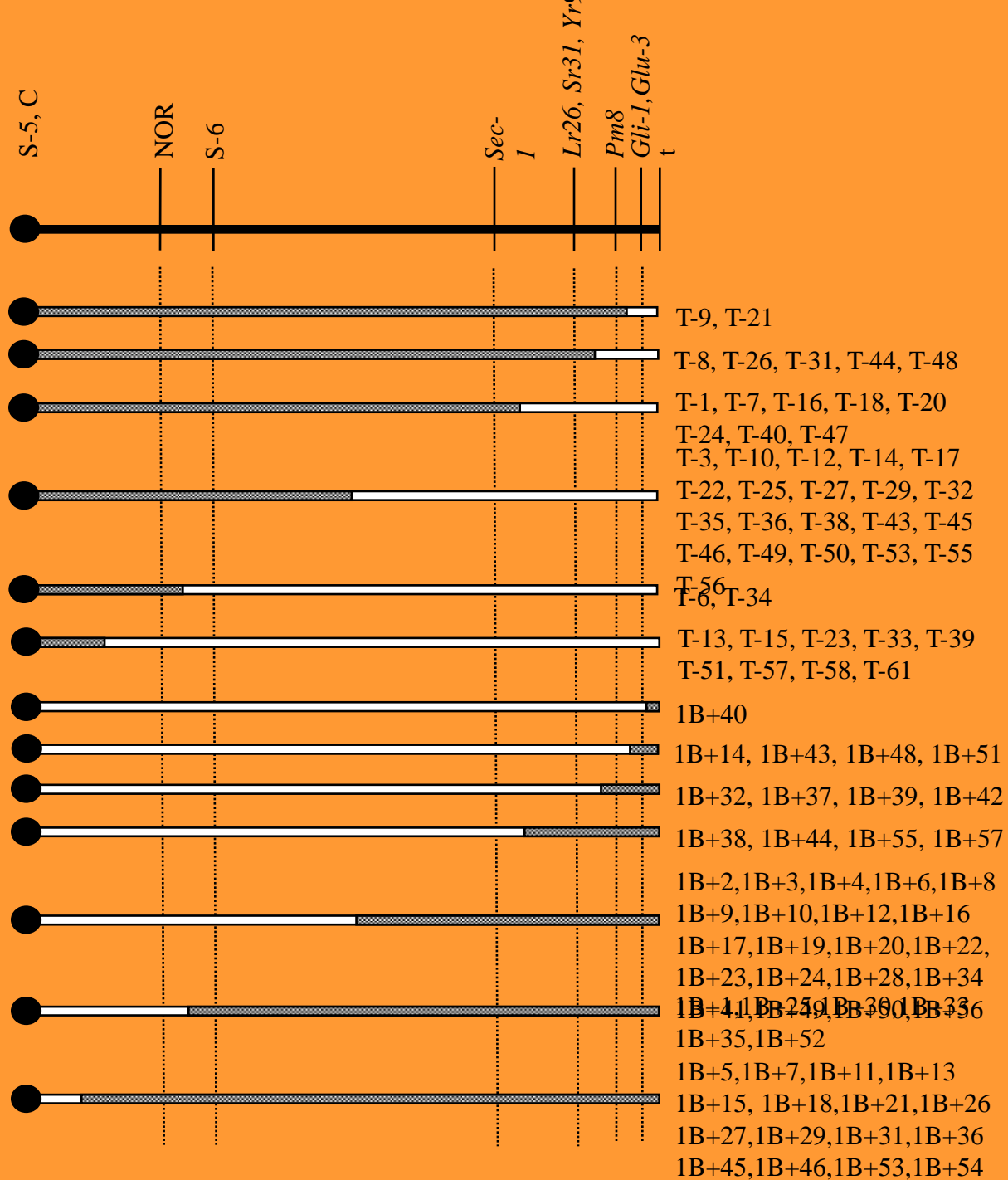


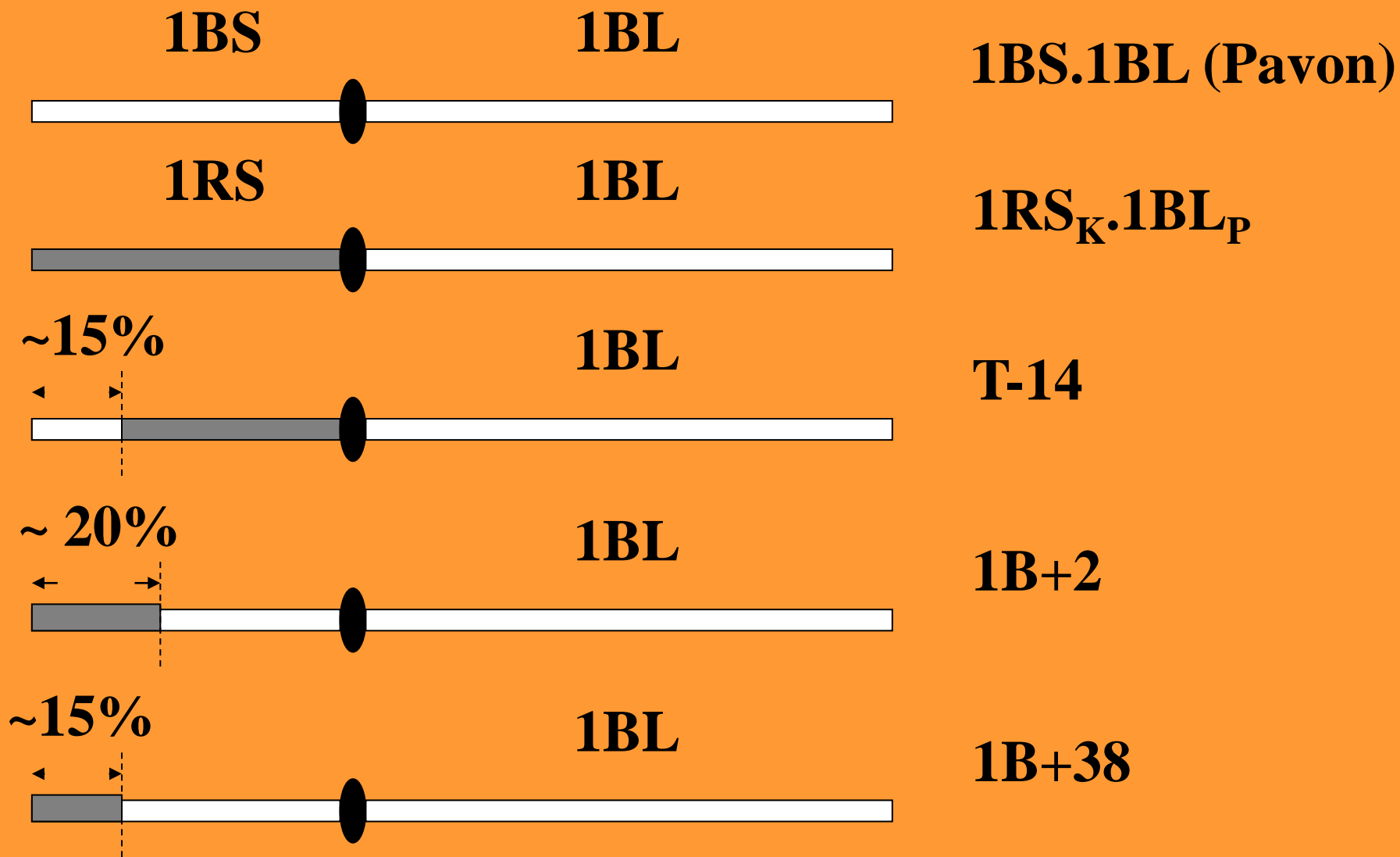
Questions:

- What segment (s) of 1RS carries gene (s) influencing root system?**
- How 1RS affects root system?**
- What is the genetic basis for 1RS variation?**



The centric translocation 1RS.1BL and so recombinants of 1RS with wheat chromosome arm 1BS.



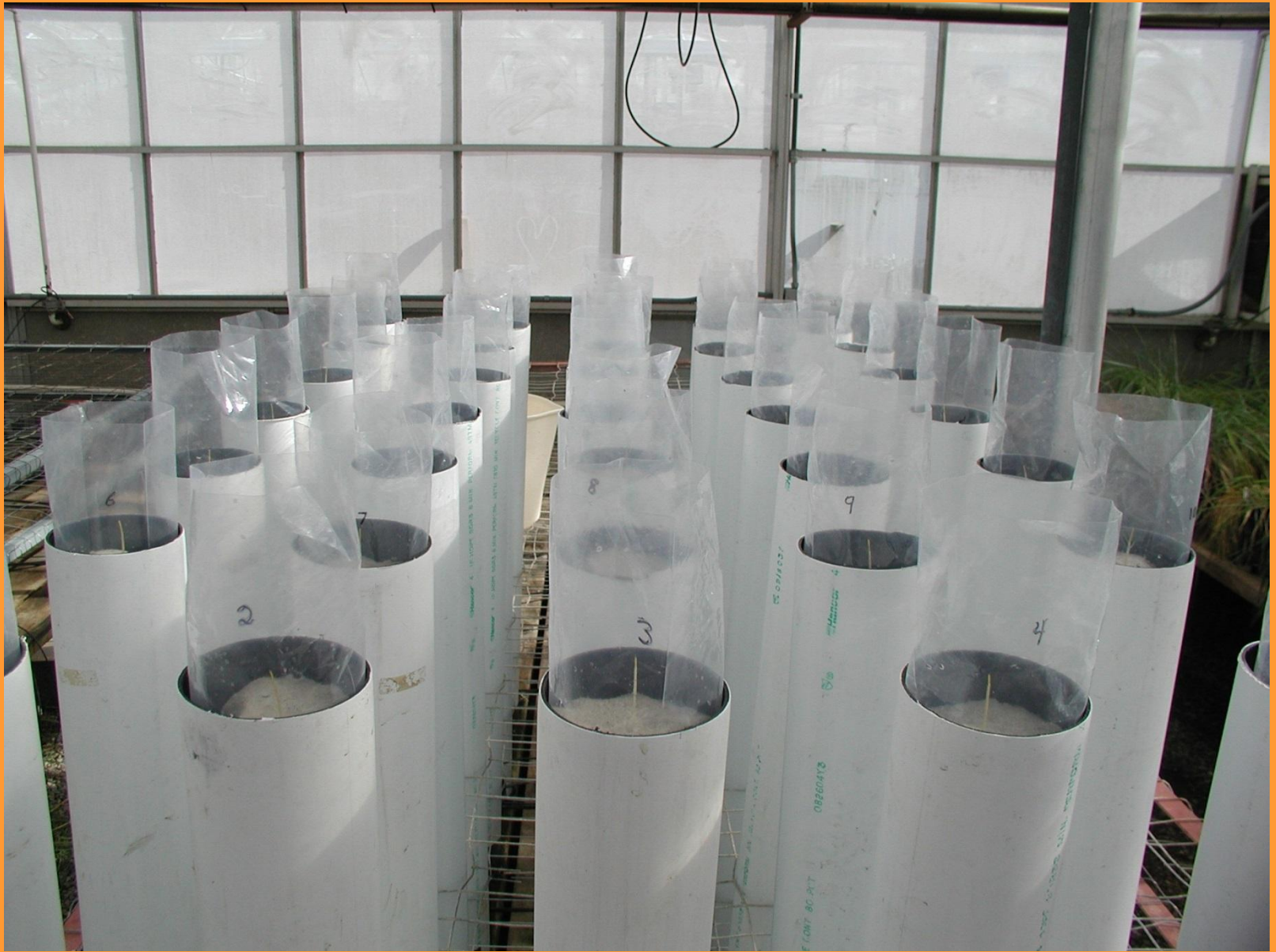


Tube experiment











Waines



1RS.1BL

T-14

1B+38

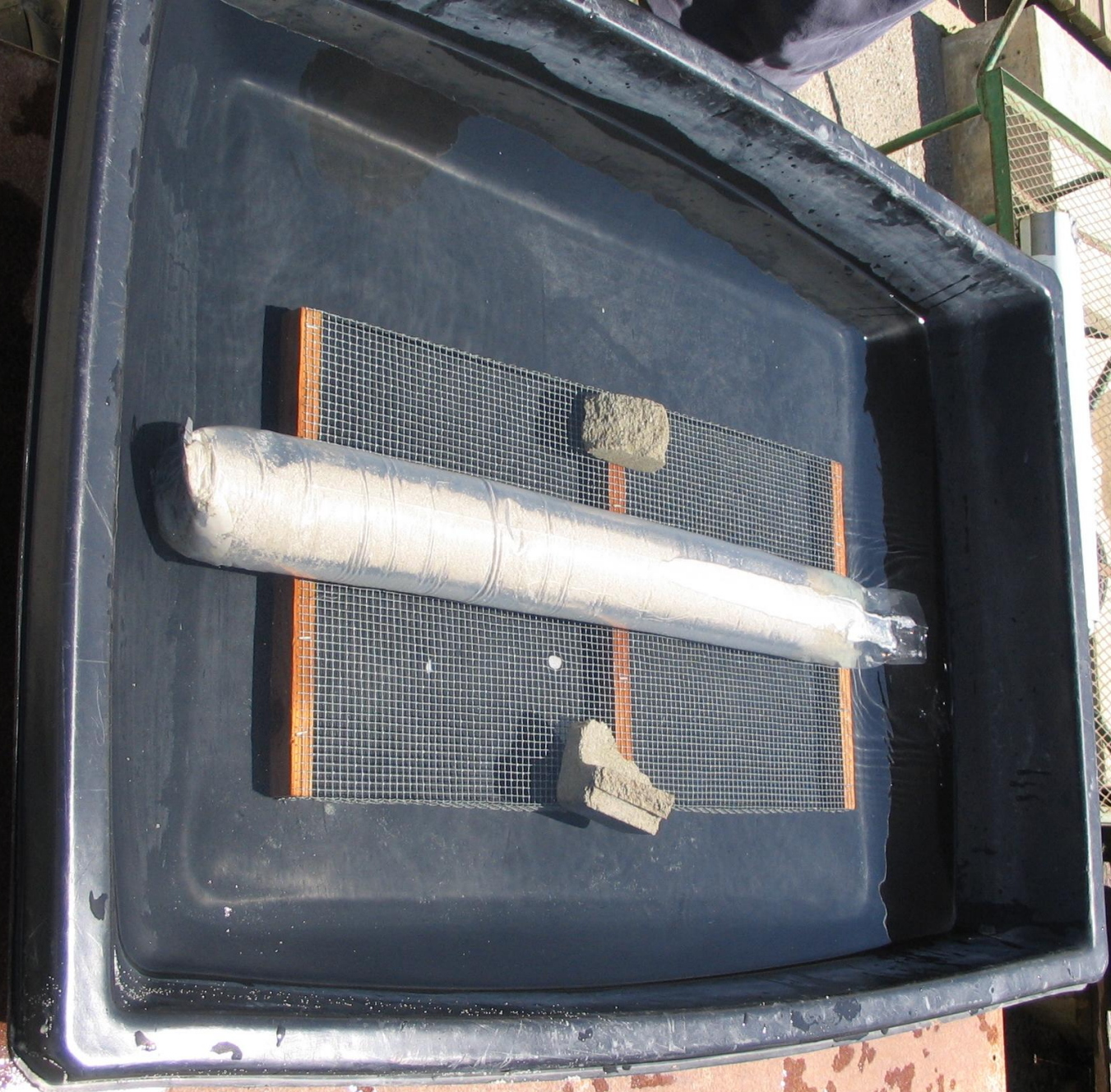
1B+2

Pavon







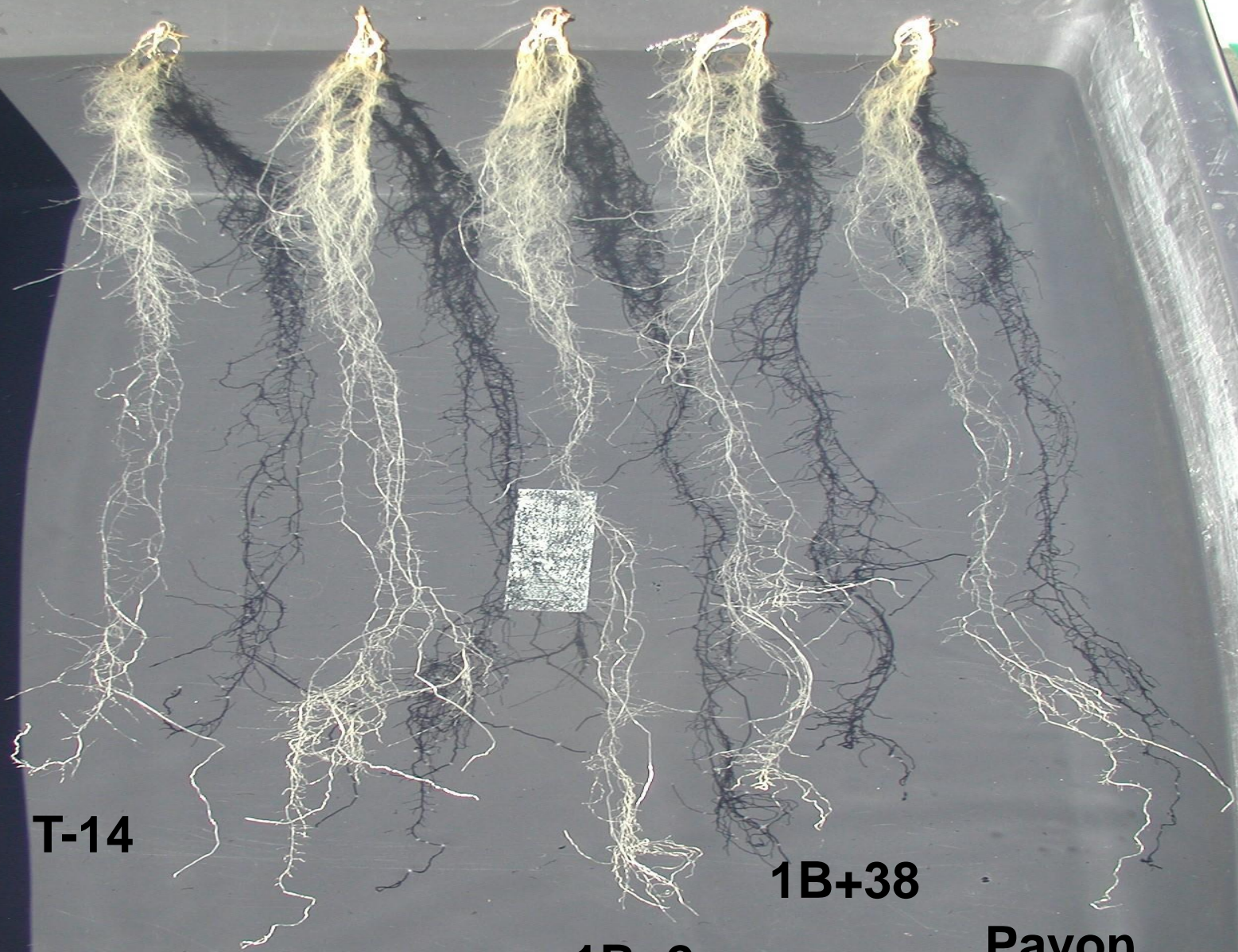












T-14

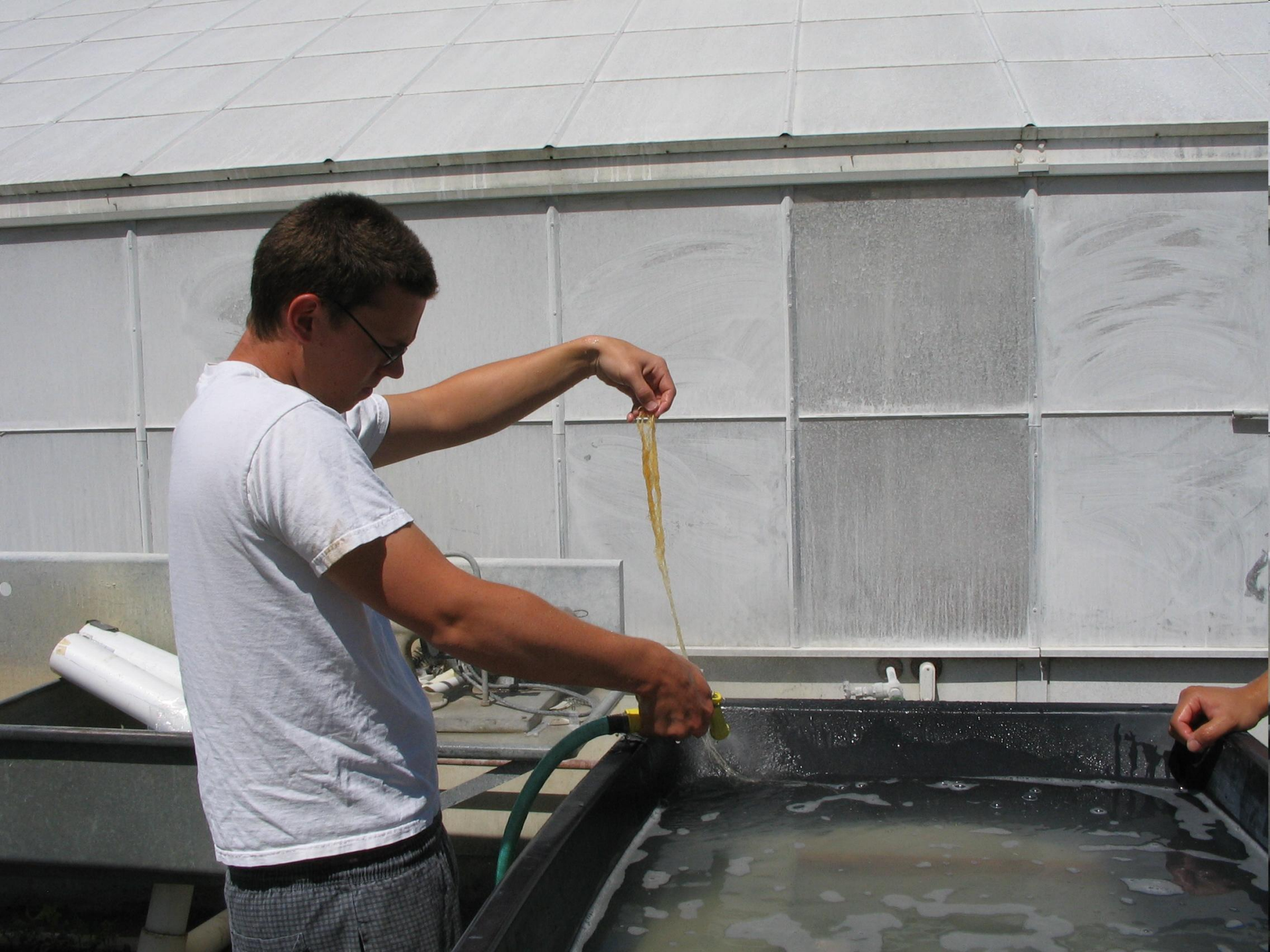
1RS.1BL

1B+2

1B+38

Pavon

Tube Exp. 2005 (45 DAS)













Genotype	Plant height	No. of tillers	Leaf blade width	Leaf blade length	Leaf blade area§	Shoot biomass	Shoot / root biomass
	cm	no.	mm	cm	cm ²	mg plant ⁻¹	mg/mg
Pavon	49.1 [†] a	3.1 ab	10.1 a	32.7 c	25.8 a	678.6 a	3.12 ab
1RS.1BL	51.0 a	3.3 ab	9.7 a	39.0 a	29.5 a	701.4 a	2.69 b
T-14	49.8 a	3.2 a	9.4 a	37.3 ab	27.4 a	557.1 a	3.16 a
1B+2	49.9 a	3.4 a	10.1 a	36.5 b	28.8 a	711.4 a	3.20 a
1B+38	49.6 a	3.0 b	9.9 a	37.1 b	28.7 a	681.4 a	3.14 a
CV [‡] (%)	5.7	10.0	9.4	6.1	14.2	17.5	12.99

§ Leaf blade area = leaf blade width × leaf blade length × 0.78.

Block 1

Genotype	NR>30	LRL	TRL	SRW	DRW	Rank sum (RAI)
G1	5 (2)	101 (1)	370 (1)	180 (2)	45 (1)	7
G2	6 (3)	103 (2)	470 (4)	195 (4)	70 (4)	17
G3	7 (4)	105 (3)	380 (2)	140 (1)	50 (2)	12
G4	4 (1)	110 (4)	420 (3)	185 (3)	55 (3)	14

Block 2

Block 3

ANOVA used to compare genotypes for each root traits.

To compare mean rank sums of the genotypes, rank sums in blocks were subjected to the statistical nonparametric Quade analysis developed for RCB designs. Quade test W is similar to F test in ANOVA.

Genotype	NR>30	LRL	TRL	SRW	DRW	RB	S_j §	RAI
	no.	-----cm-----		-----mg-----				
Pavon	5.3[†] b	101 a	370 b	180 a	43 b	223 bc	-27.5	14.2 C
1RS.1BL	6.7 a	103 a	472 a	195 a	69 a	264 a	33.5	24.1 A
T-14	5.1 b	102 a	383 b	143 b	50 b	193 c	-26.5	12.8 C
1B+2	6.3 a	102 a	419 ab	185 a	54 ab	239 ab	1.5	18.9 B
1B+38	6.7 a	106 a	432 ab	168 ab	55 ab	223 bc	19.0	19.6 AB
CV[‡] (%)	13.5	8	14	17	26	16		

§The critical value for a difference $|S_i - S_j|$ to be significant = 21.8



Genotype:	T-14	Pavon	1B+2	1B+38	1RS.1BL
Rank sum:	12.8	14.2	18.9	19.6	24.1

Conclusions:

- The distal segment of 1RS (~ 15% genetic map) carries major gene (s) enlarging root system in some 1RS.1BL bread wheat cultivars.
- There may be minor genes on other segments of 1RS affecting root system.
- Distal segments of chromosomes are subjected more to crossovers, therefore distal segments of different 1RSs have different genetic constitutions, and thus have different effects on root system and consequently on agronomic performance as reported in the literature.
- The distal segment of 1RS could be translocated to other wheat cultivars to manipulate their rooting ability, and thus improve their agronomic performance.
- Improved rooting ability should be coordinated with an appropriate preanthesis shoot system in order to accumulate maximum stem reserves as a consequence of greater water and nutrient uptake.

The End



Thank you for your listening.