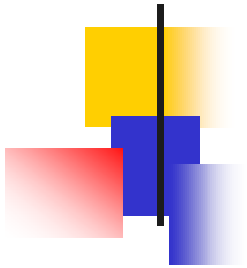


Progress in Breeding of Super Hybrid Rice

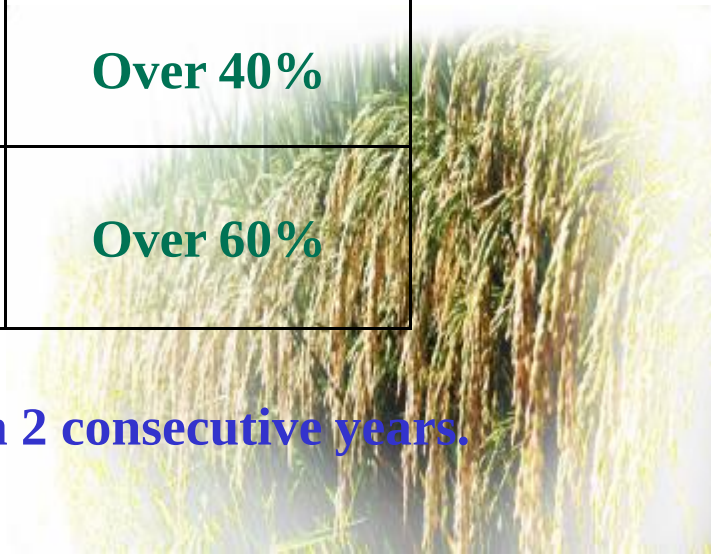
L. P. Yuan

(China National Hybrid Rice R & D Center)

Super Rice Breeding Program

Yield standards of Super Hybrid Rice in China

Phase	Yield of single season rice	Yield increase
1990's level	8.25	0
Phase Ⅰ (1996-2000)	10.50	Over 20%
Phase Ⅱ (2001-2005)	12.00	Over 40%
Phase Ⅲ (2006-2015)	13.50	Over 60%



* Tons/ha at 2 locations with 6.7 ha each in 2 consecutive years.

P64S/9311


P64S/9311
'99 9 11


P64S/E32 created a record yield of
17.1 t/ha in 1999


两优293


Y两优1号

The 7.2 ha-demonstrative location yielding 13.9 t/ha at Longhui, Hunan in 2011

Y Liangyou No. 2, the super hybrid rice variety yielding 13.9 t/ha
at Longhui, Hunan in 2011

Y Liangyou No. 2, the super hybrid rice variety yielding 13.9 t/ha
at Longhui, Hunan in 2011

Super hybrid rice in upland condition
Estimated yield: around 8 t/ha

Technical Approaches

A . Morphological improvement

B . Raising heterosis level

A. Morphological Improvement

Plant type of Super Hybrid Rice

- **Tall erect-leaf canopy**
- **Lower panicle position**
- **Bigger panicle size**

Height of canopy:
1.2 m above

Upper 3 leaves: long, erect, narrow, V-shape and thick

Long------to increase leaf area

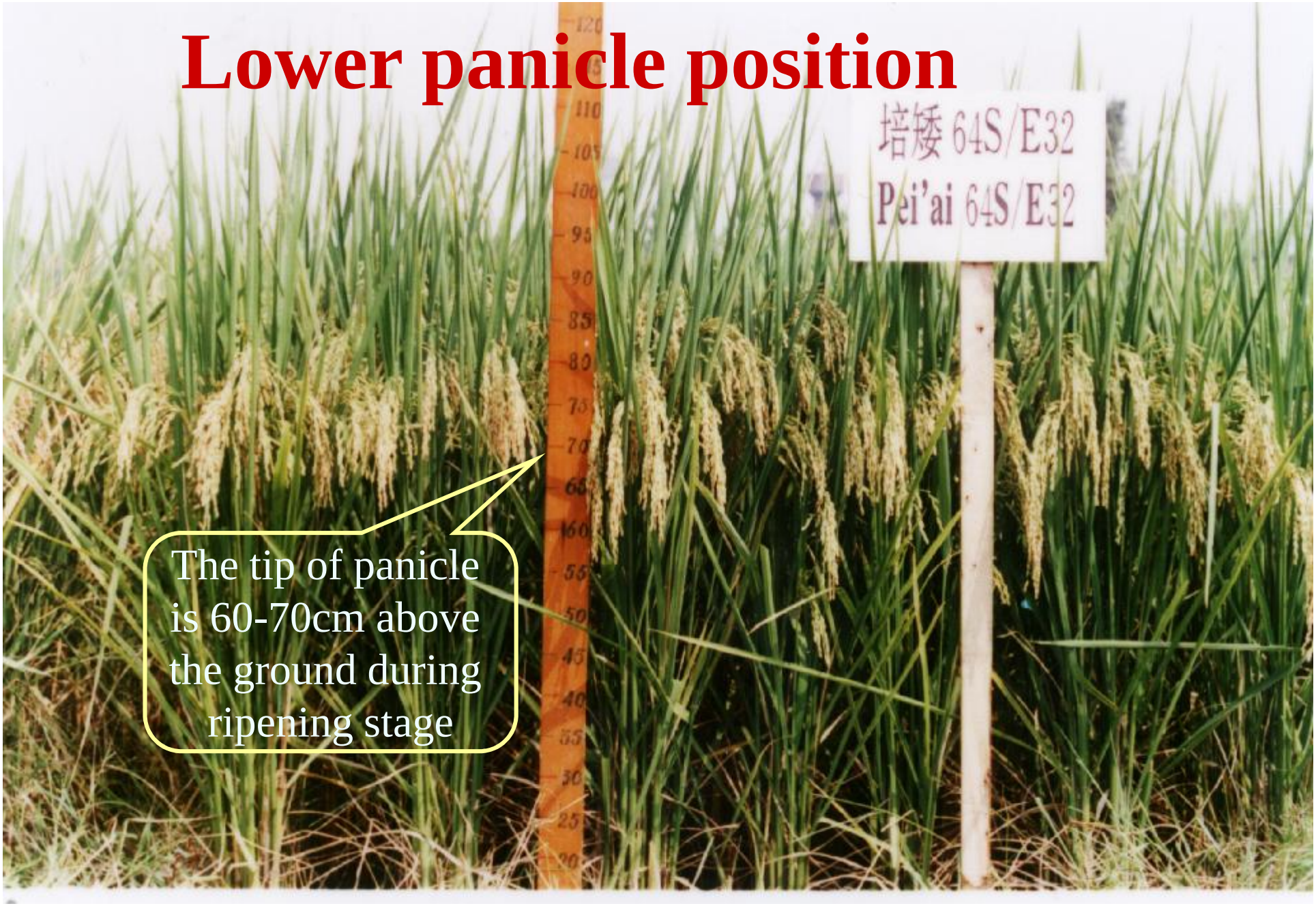
Erect------to intercept solar radiation from both sides

Narrow---to occupy less space, with higher LAI

V-shape--making leaf blade stiffer, so not prone to droopy

Thick-----with higher photosynthetic function and not easy to senescent

Lower panicle position



Highly resistant to lodging

Bigger Panicle Size

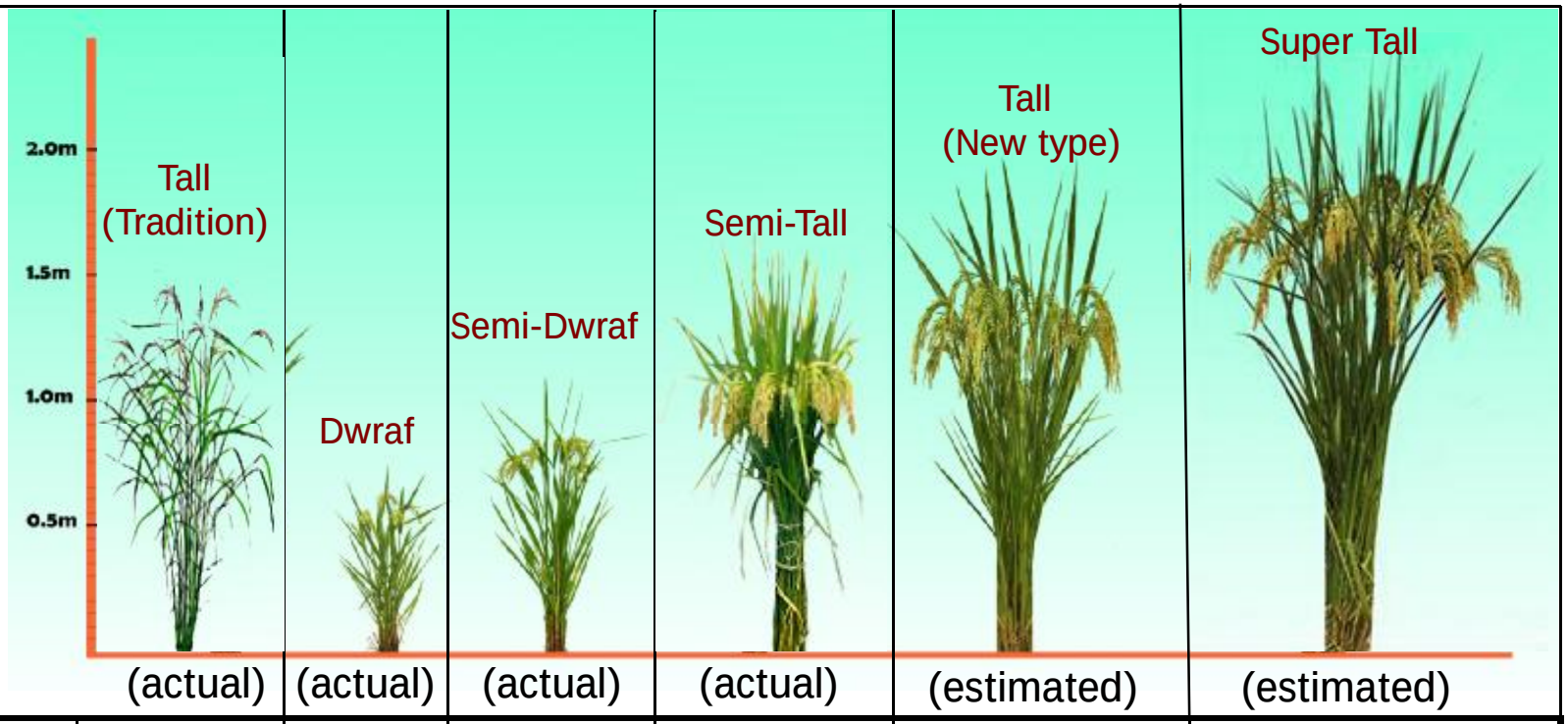
Grain weight/panicle: around 6 g

Number of panicles: around 250/m^2

Grain yield = Biomass X Harvest Index

- Further raising rice yield ceiling should rely on increasing biomass.
- Increasing plant height is an effective and feasible way to increase biomass

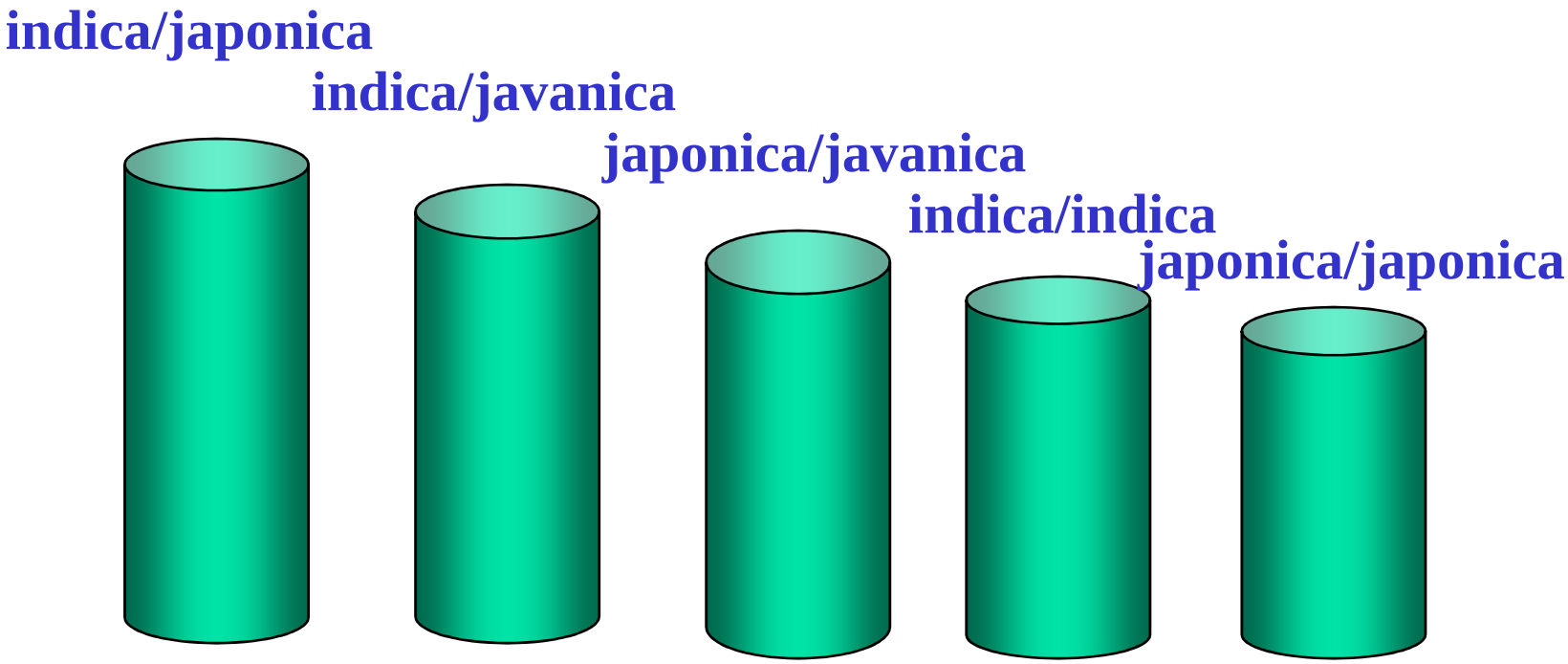
Trend of plant height to develop super high yield hybrid rice

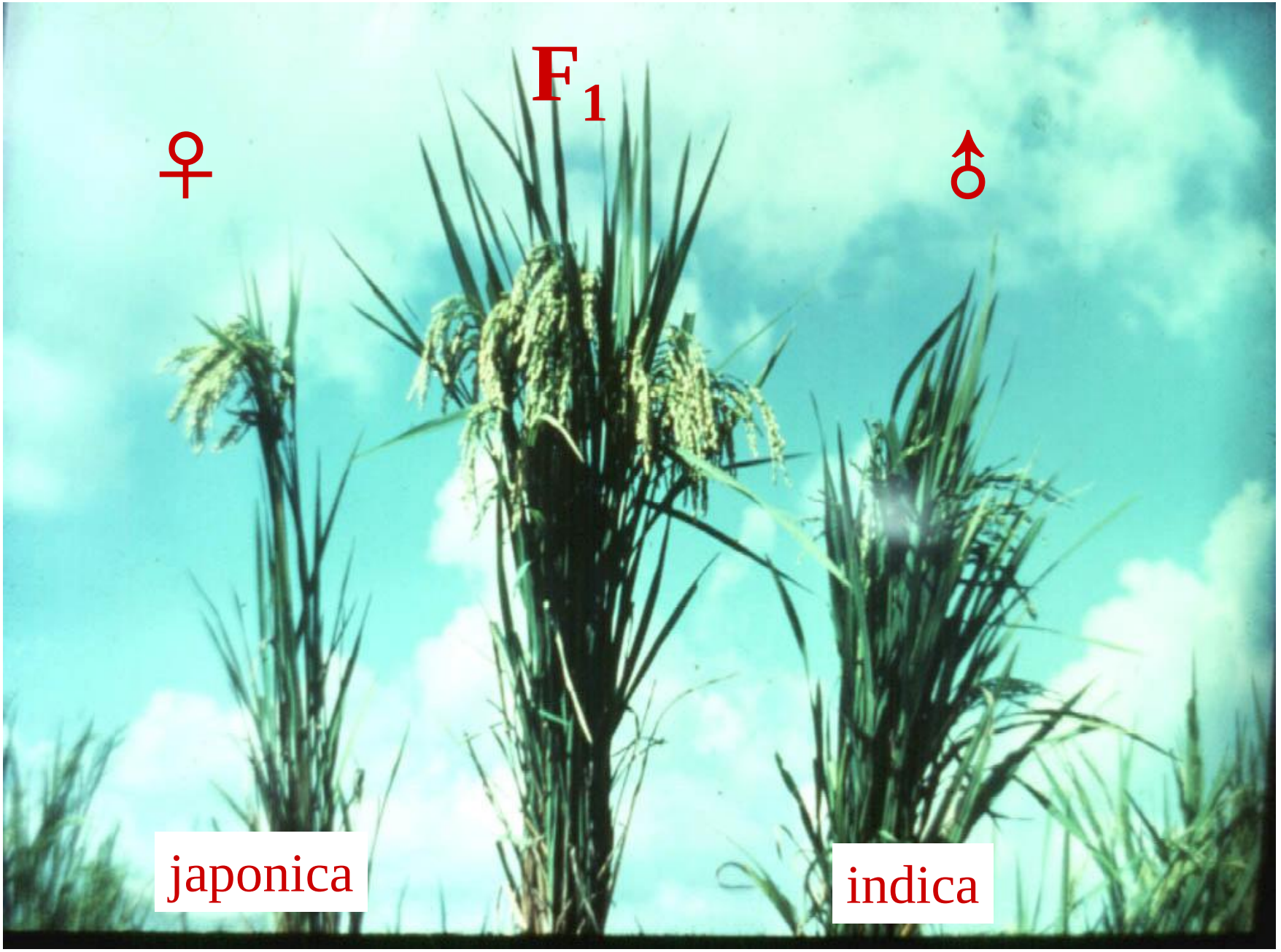


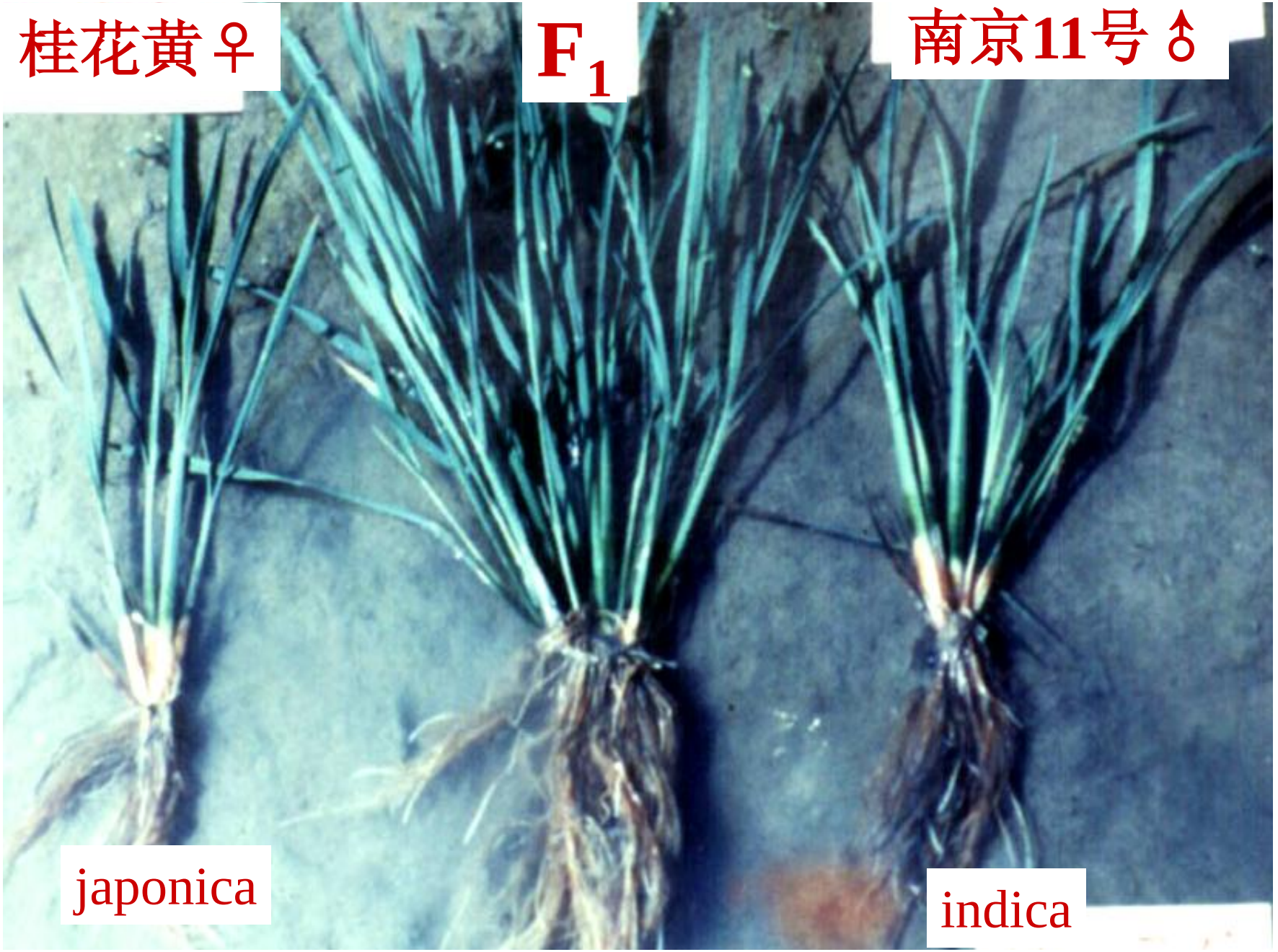
HI	≈0.3	≈0.5	≈ 0.5	≈0.5	≈ 0.5	≈ 0.5
Yield level	3-4t/ha	6t/ha	8-10t/ha	12-14t/ha	15-16t/ha	>18t/ha

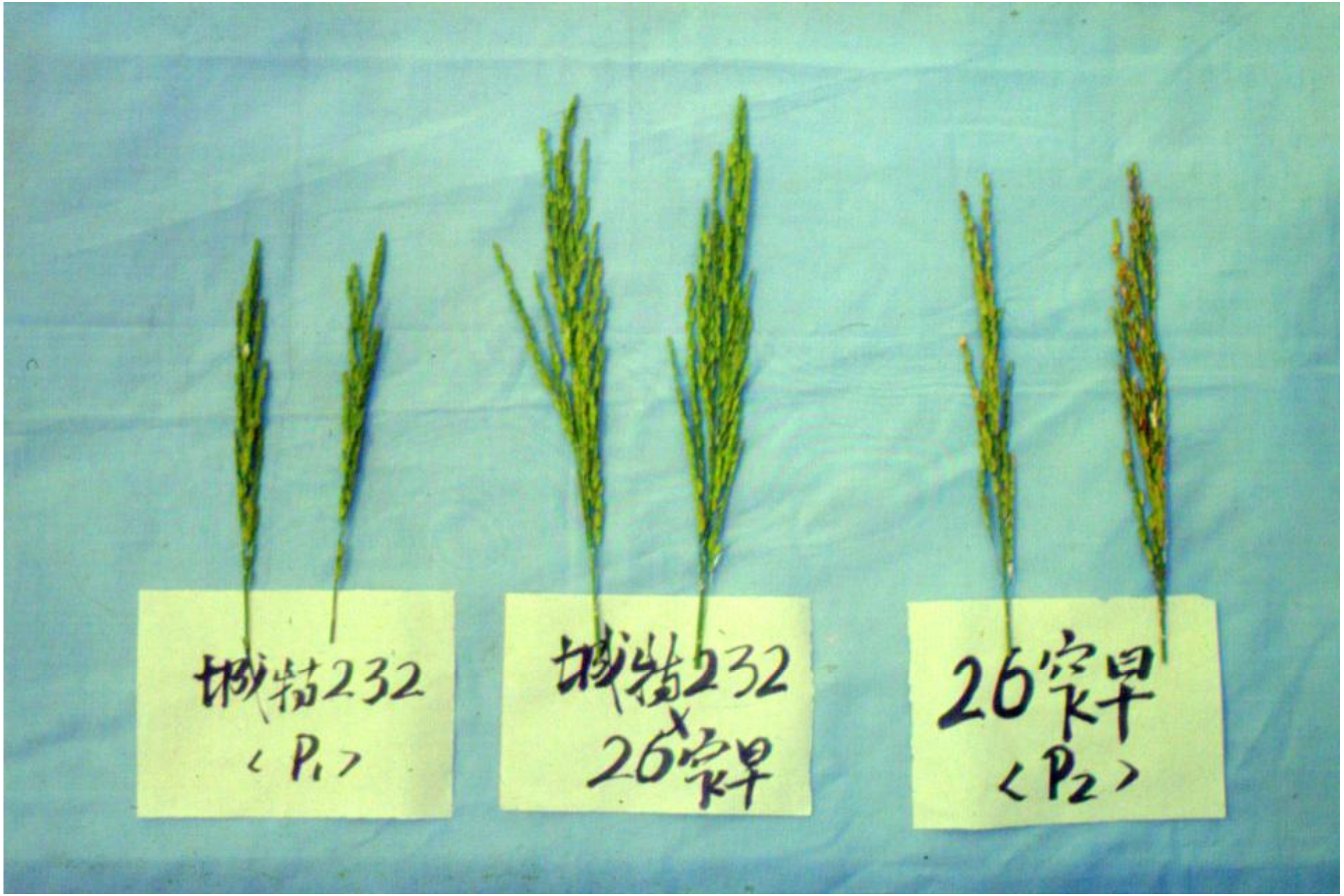
B. Raising Heterosis Level

Heterosis Level

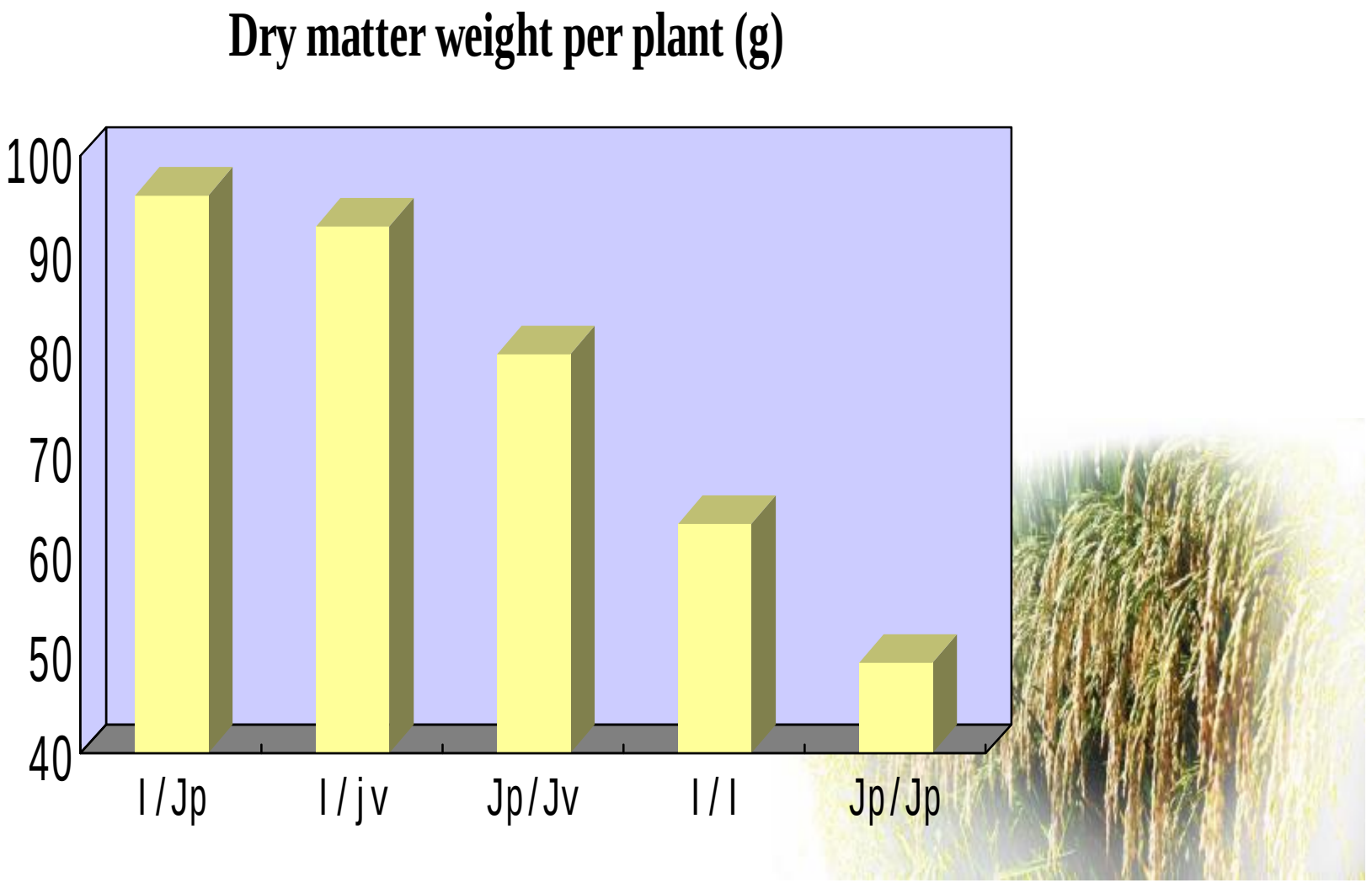



F1
♀
♂
japonica
indica

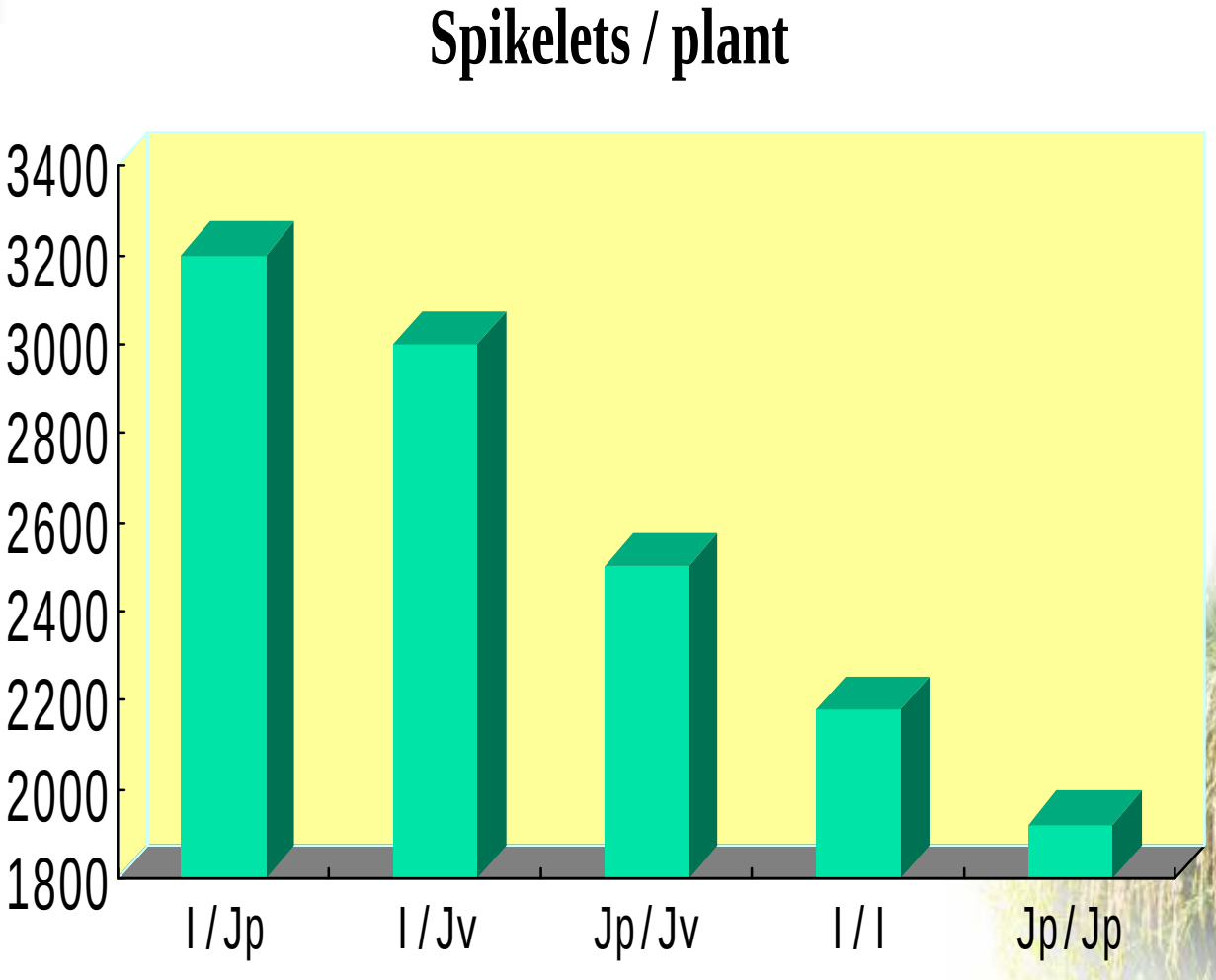

桂花黄♀
F1
南京11号♂
japonica
indica


矮粘232
〈P1〉
矮粘232
×
26窄早
26窄早
〈P2〉

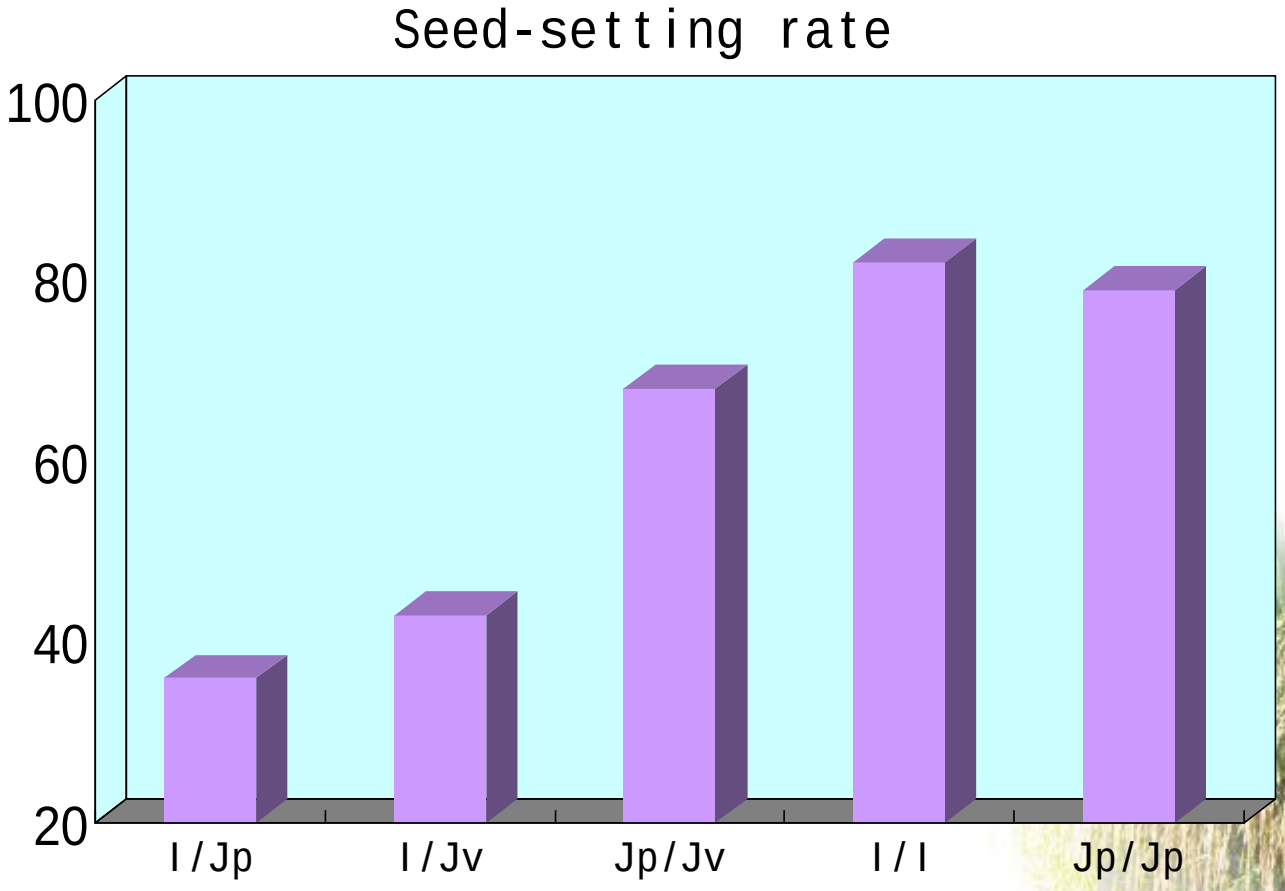
Heterosis in Different Rice Hybrids

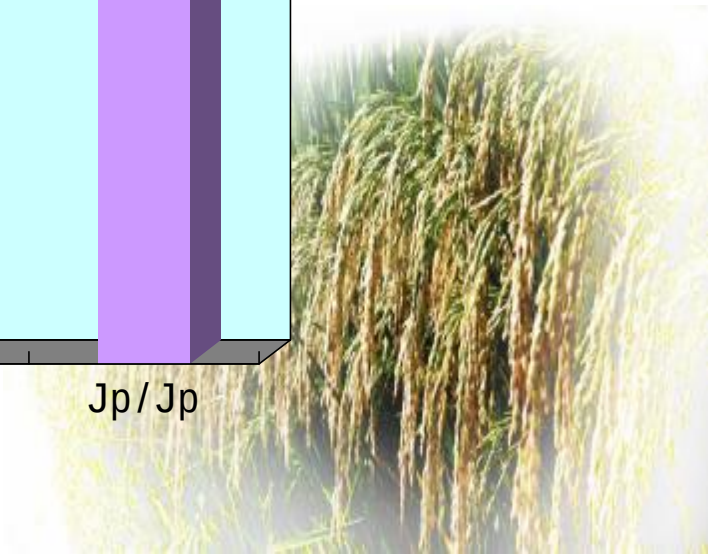


Heterosis in Different Rice Hybrids



Heterosis in Different Rice Hybrids





Filled seed

Empty seed

Indica/Japonica F1

Yield potential of an indica/japonica hybrid

Combination	**Plant height (cm)**	**Number of spikelets /panicle**	**Number of spikelets /plant**	**Seed setting rate %**	**Actual yield (kg/ha)**
Chengte232(japonica) ×26Zhaizao(indica)	**120**	**269.4**	**1779.4**	**54.0**	**8250**
Weiyou35 (indica/indica)	**89**	**102.6**	**800.3**	**92.9**	**8625**
Increase %	**34.8**	**162.8**	**122.4**	**-41.9**	**-4.3**

Strategy of developing indica/japonica hybrids

Ⅰ. Using wide-compatibility (WC) gene to overcome low seed-set problem

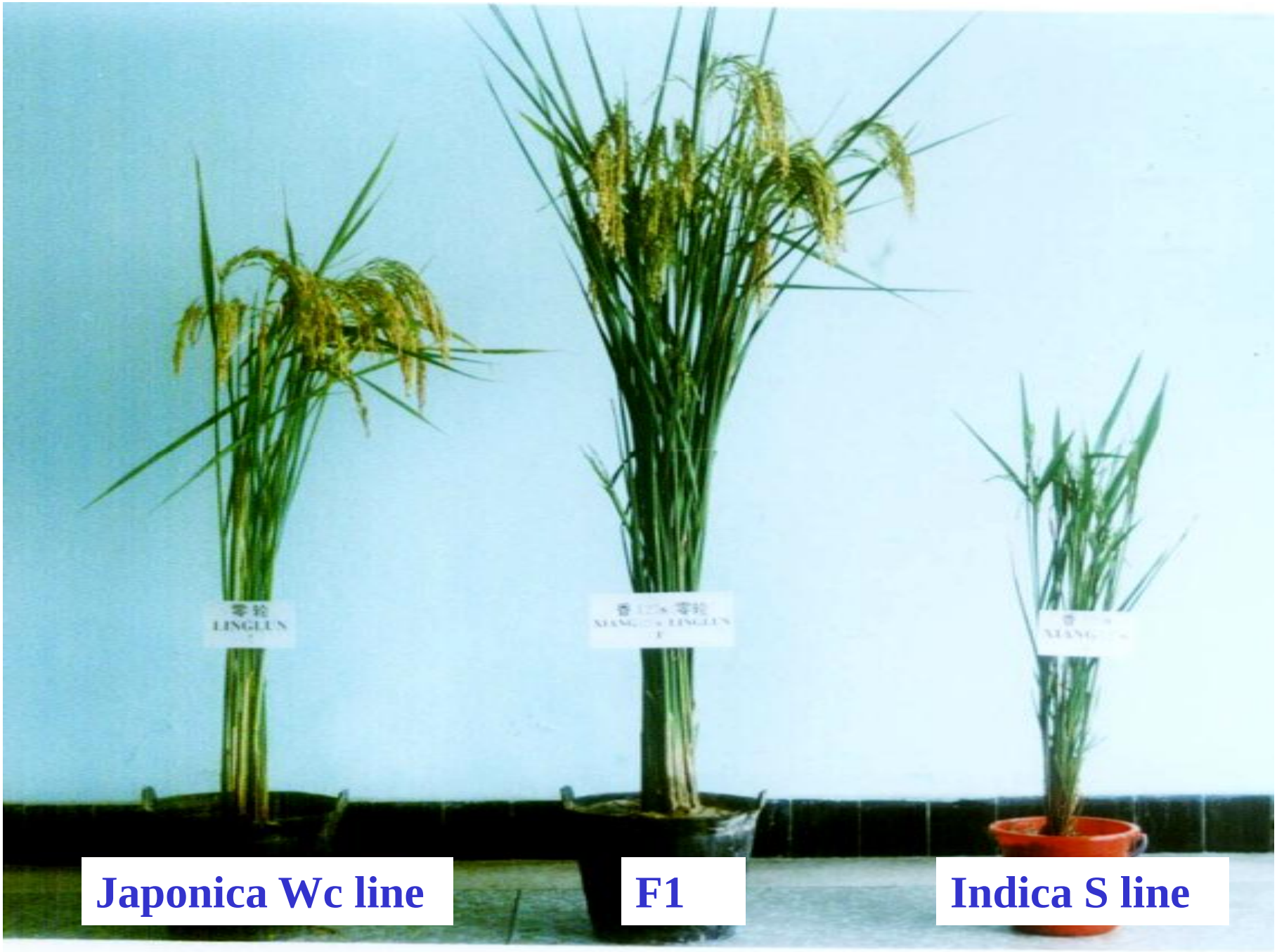
- Indica—S_{-5}^{I}
- Japonica —S_{-5}^{J}
- WC varieties—S_{5}^{n}

n S_{-5}^{I} / S_{-5}^{J} ⟶ sterile F_1

n S_{-5}^{I} / S_{-5}^{n} or S_{-5}^{J} / S_{-5}^{n}

⟶ fertile F_1

Ⅱ. Select intermediate indica or japonica rice cultivars as parental lines instead of typic indica or japonic


Japonica Wc line
F1
Indica S line

Conclusion

To develop phase Ⅳ super hybrid rice is under way, yield target: 15t/ha.

Chinese people not only can meet their food demand by themselves, but also can help other developing countries to solve food shortage problem.

Super hybrid rice can make great contribution to world food security and peace!

Giant panicle rice


Thank you