

Progress in Breeding of Super Hybrid Rice

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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



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



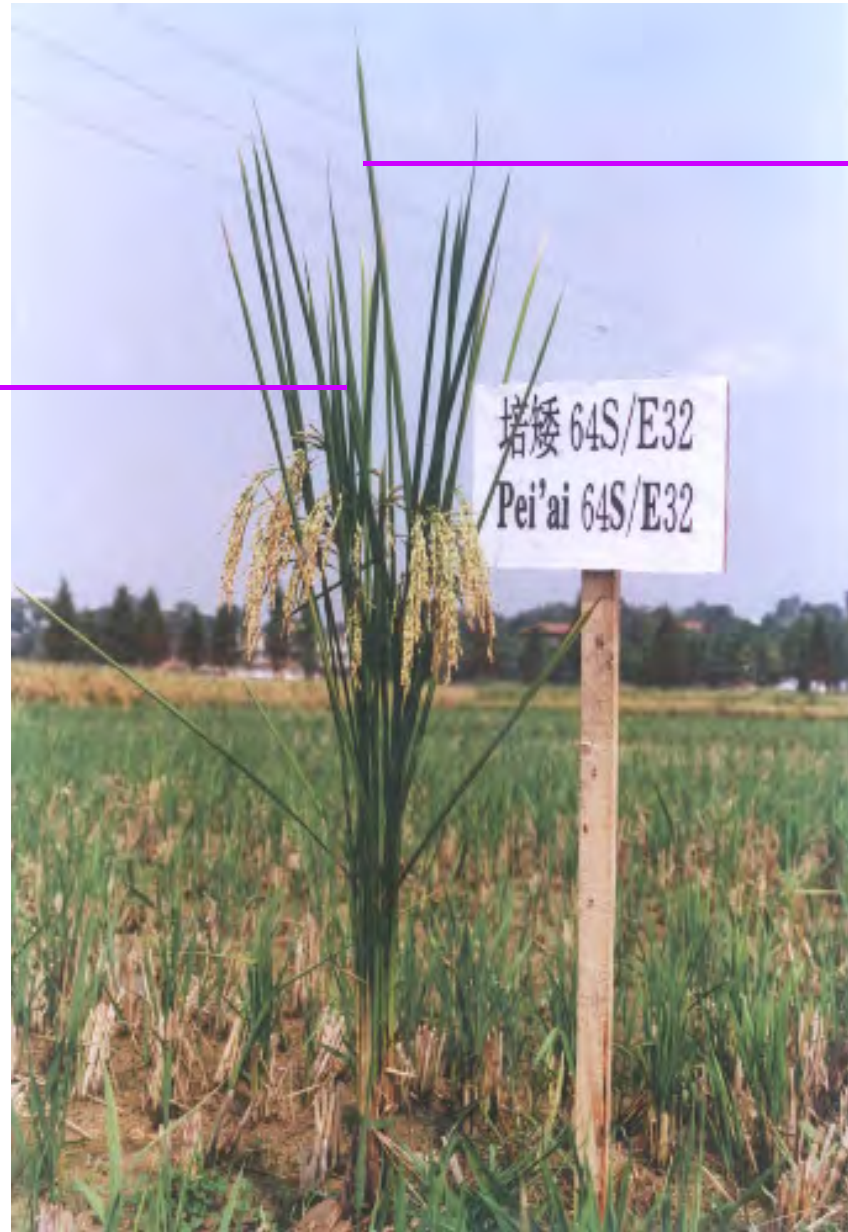
A. Morphological Improvement

Plant type of Super Hybrid Rice

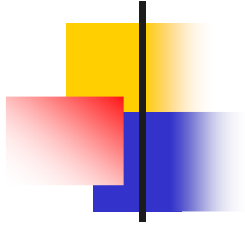
- **Tall erect-leaf canopy**
- **Lower panicle position**
- **Bigger panicle size**



**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

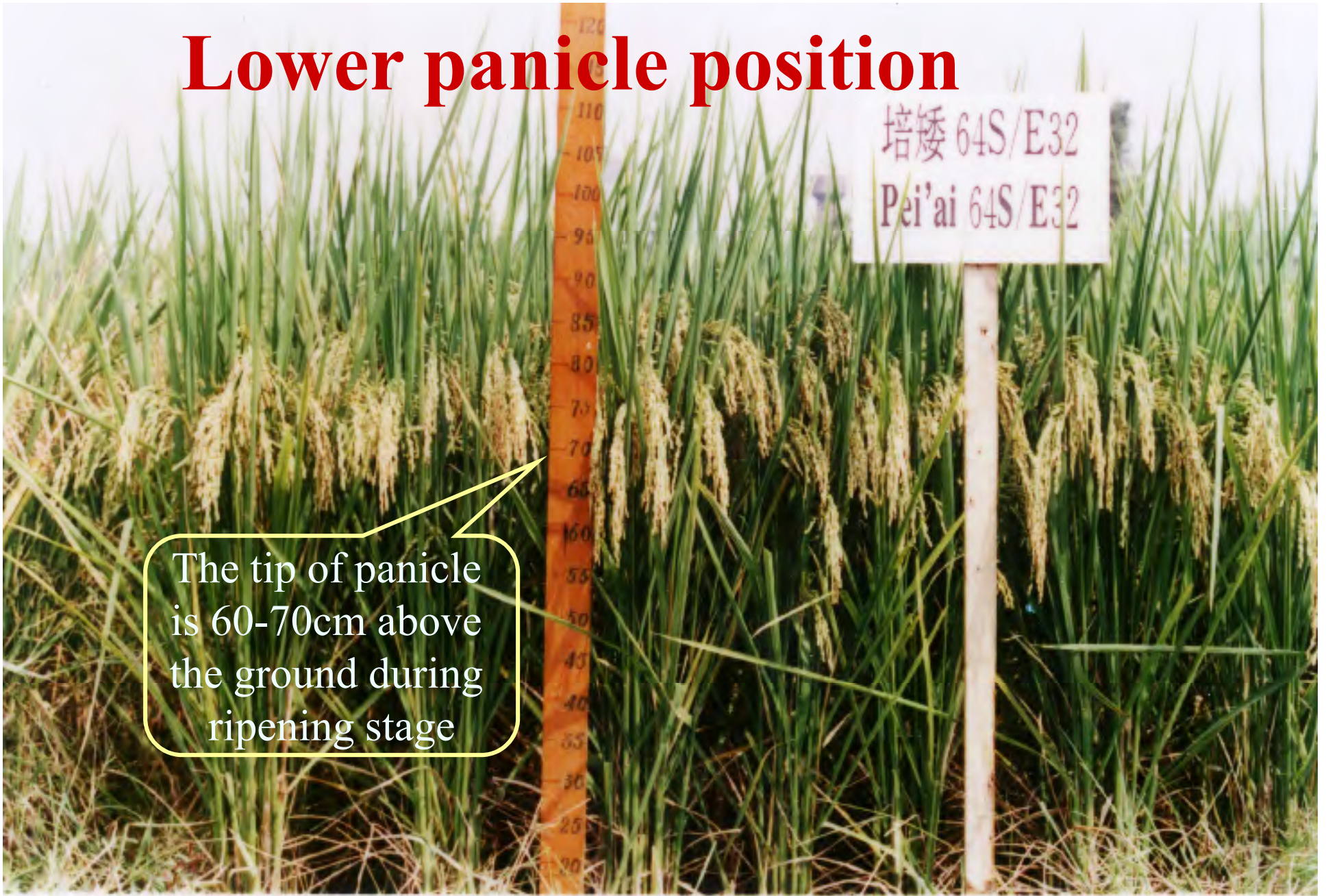


Lower panicle position

培矮 64S/E32

Pei'ai 64S/E32

The tip of panicle
is 60-70cm above
the ground during
ripening stage





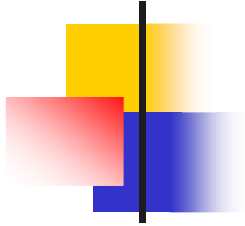
Highly resistant to lodging

Bigger Panicle Size



Grain weight/panicle: around 6 g

Number of panicles: around 250/m²

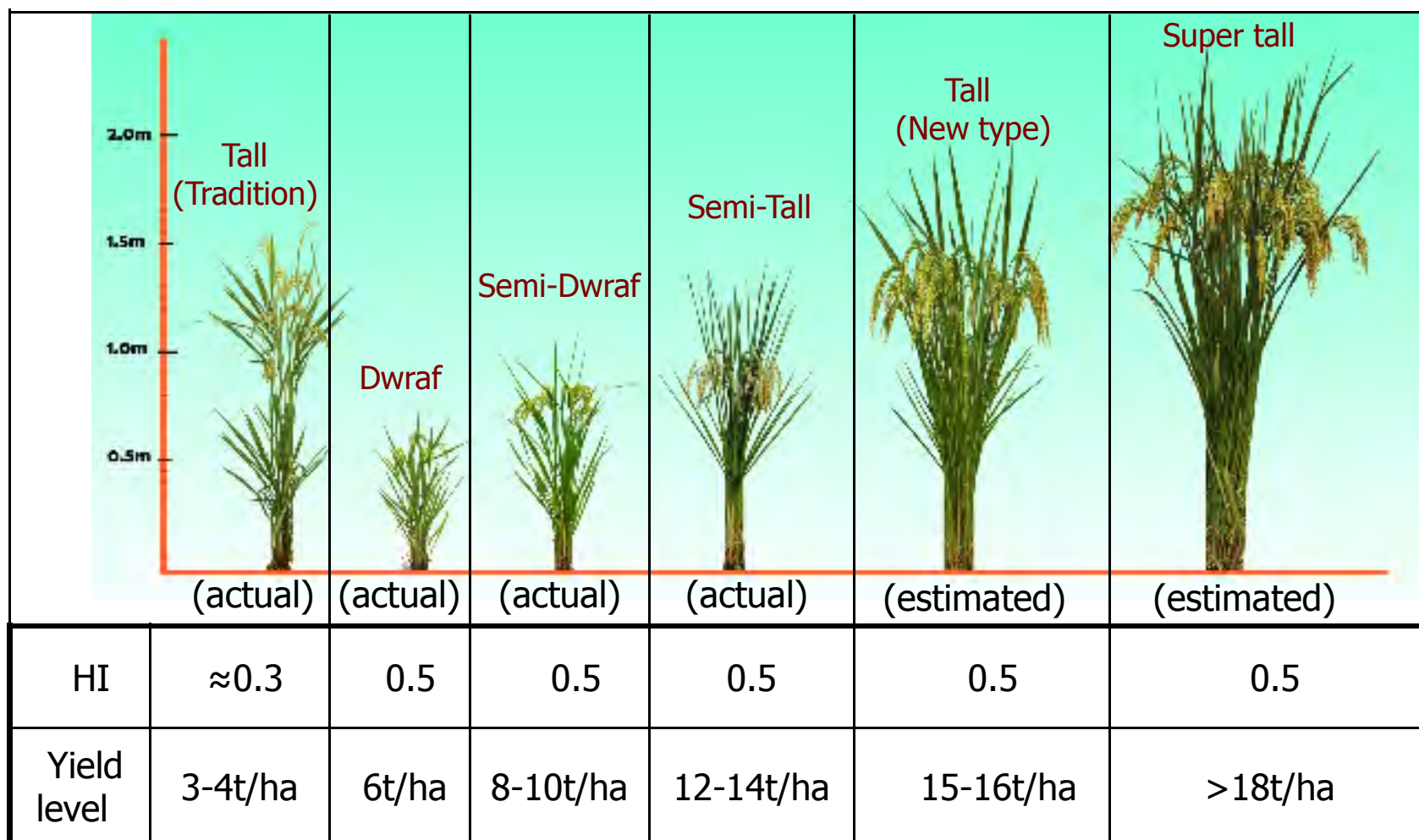


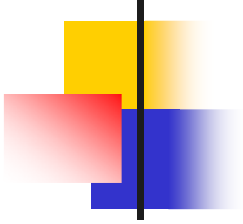
Grain yield = Harvest Index X Biomass

- 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





B. Raising Heterosis Level



Heterosis Level

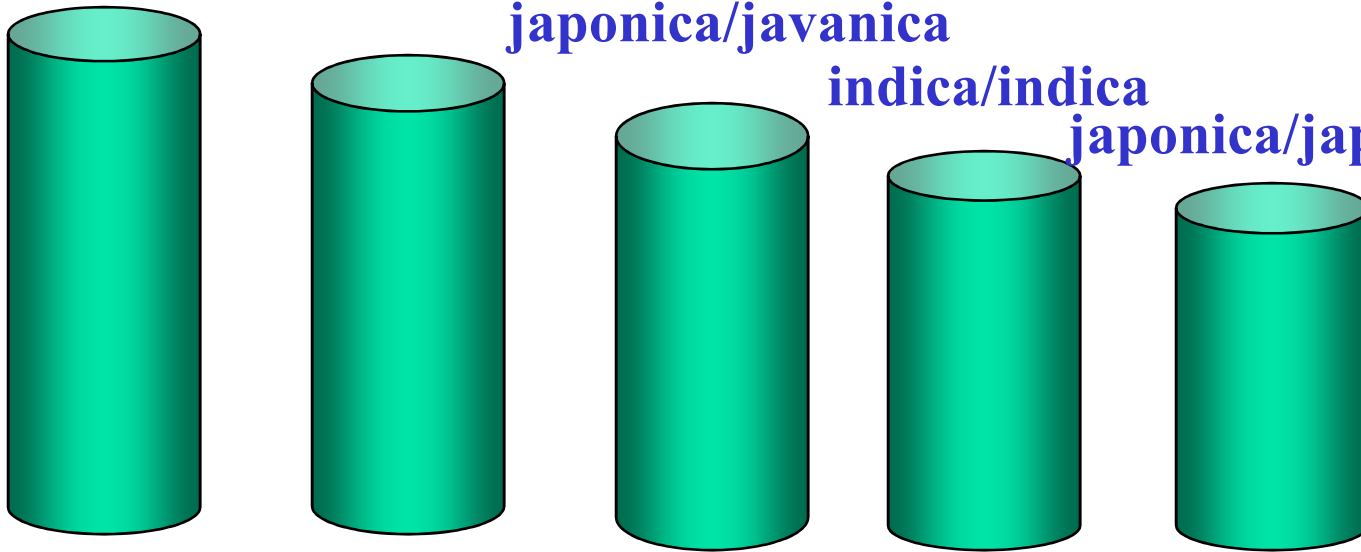
indica/japonica

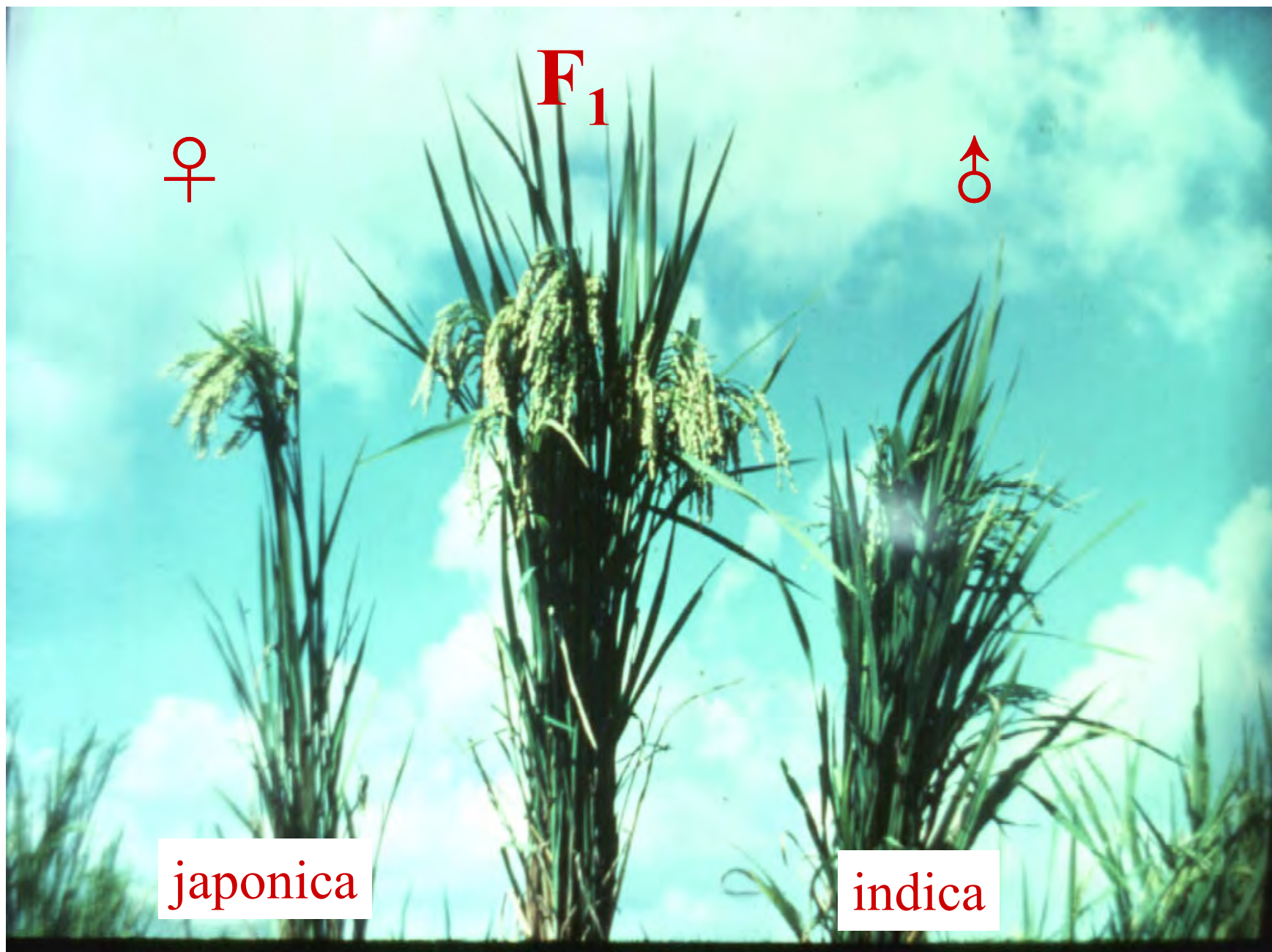
indica/javanica

japonica/javanica

indica/indica

japonica/japonica

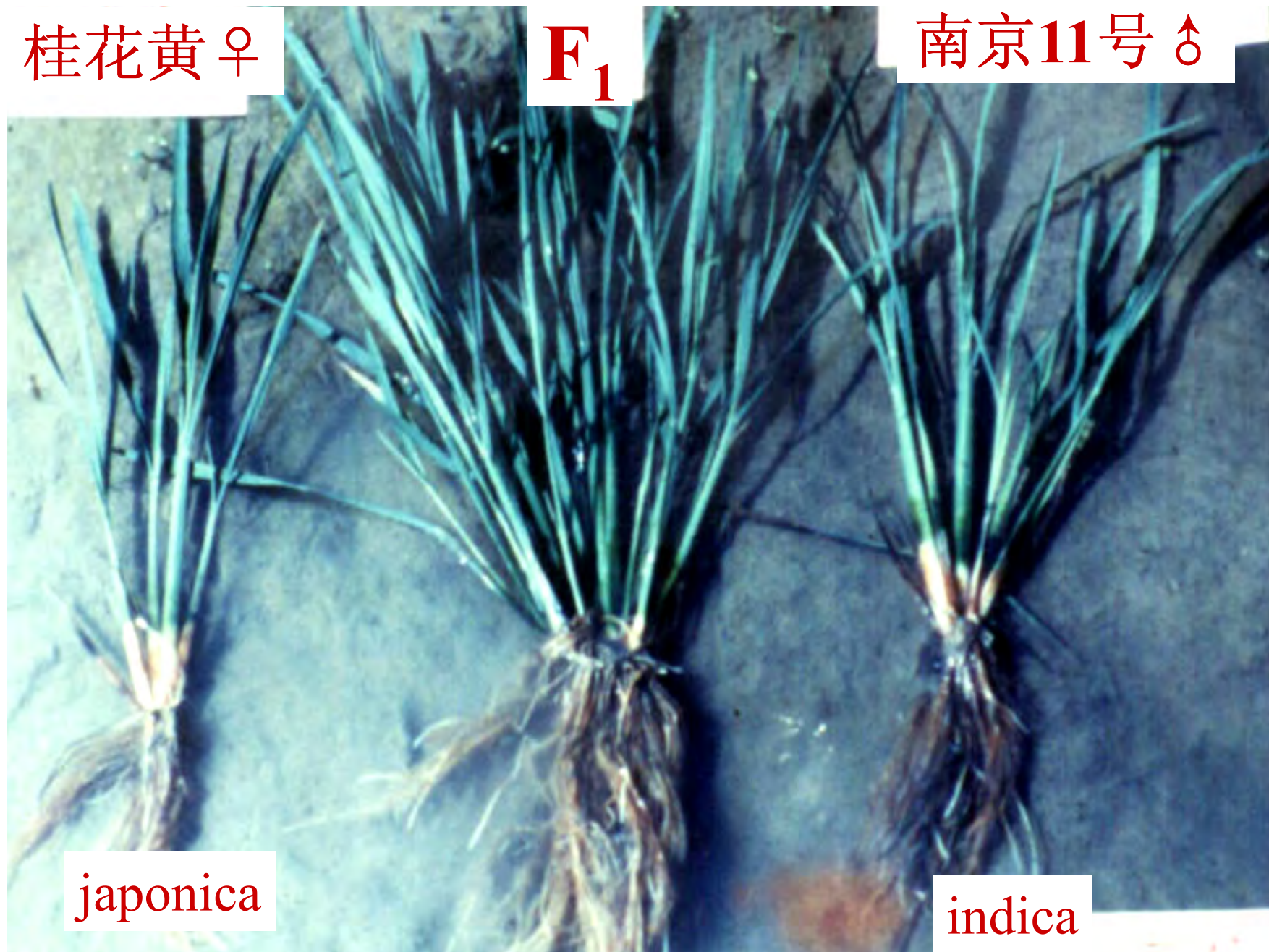




桂花黄 ♀


F₁

南京11号 ♂

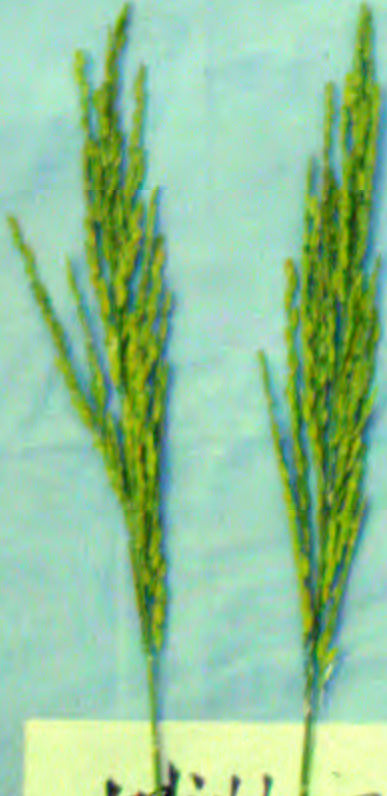


japonica


indica



城特232
(P₁)



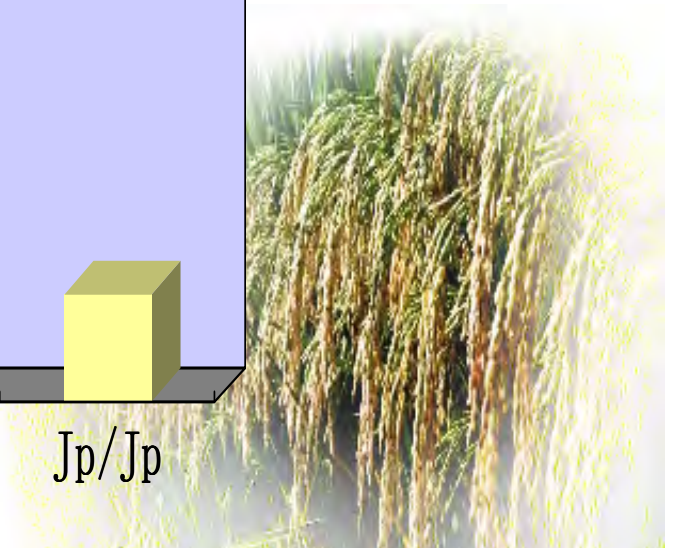
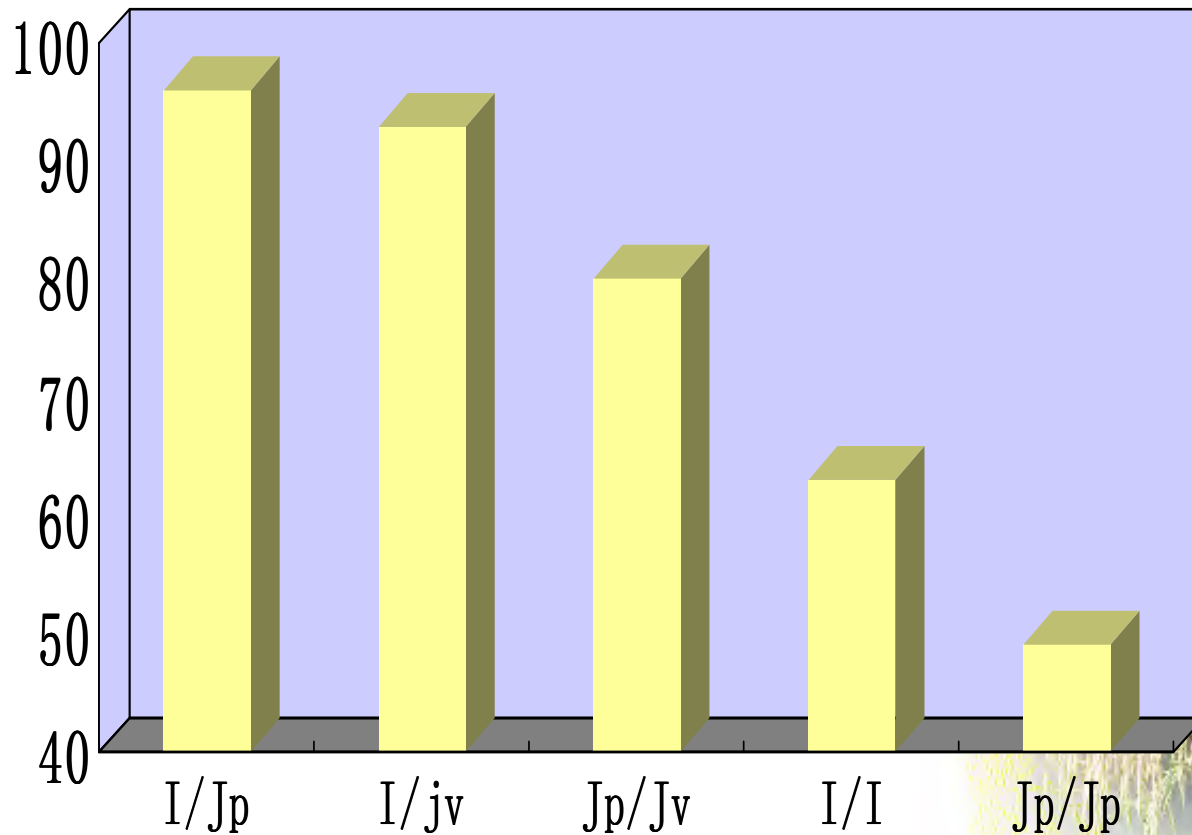
城特232
x
26早
(P₂)



26早
(P₂)

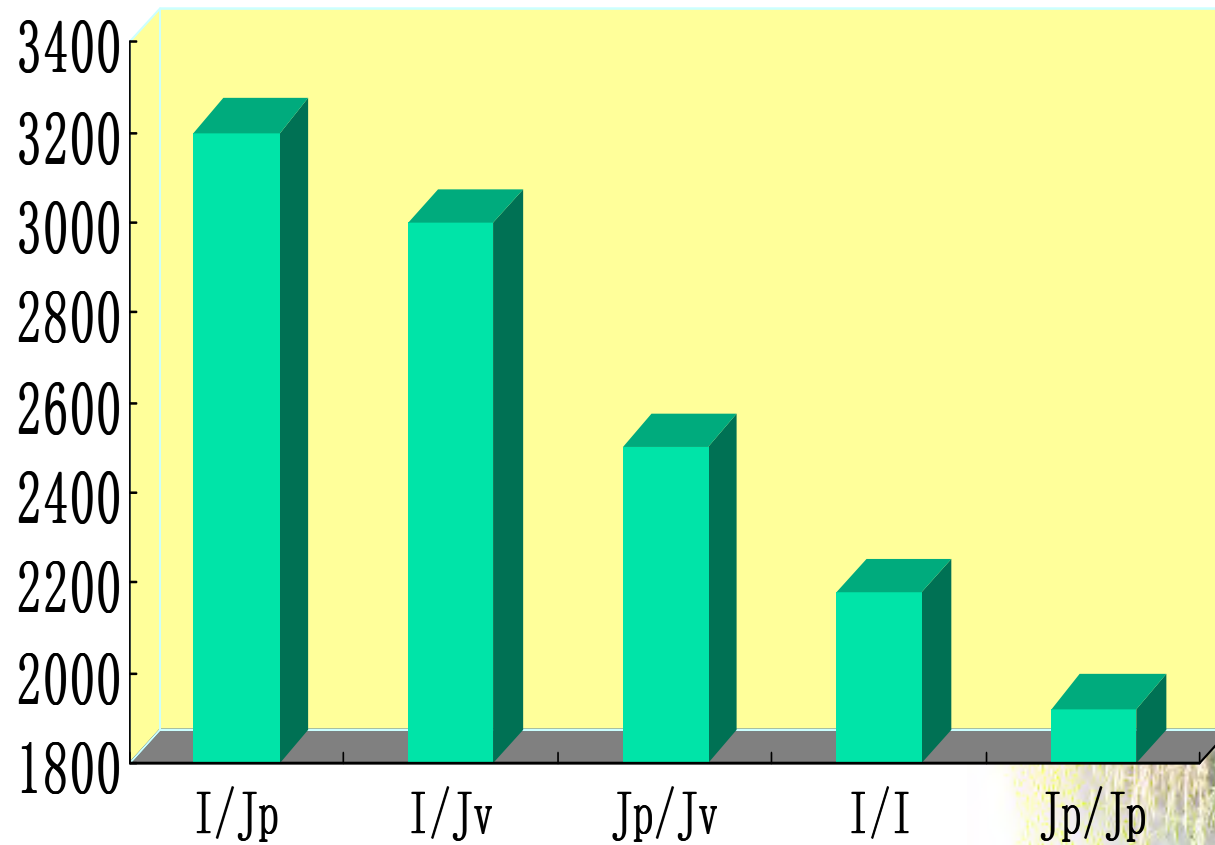
Heterosis in Different Rice Hybrids

Dry matter weight per plant (g)

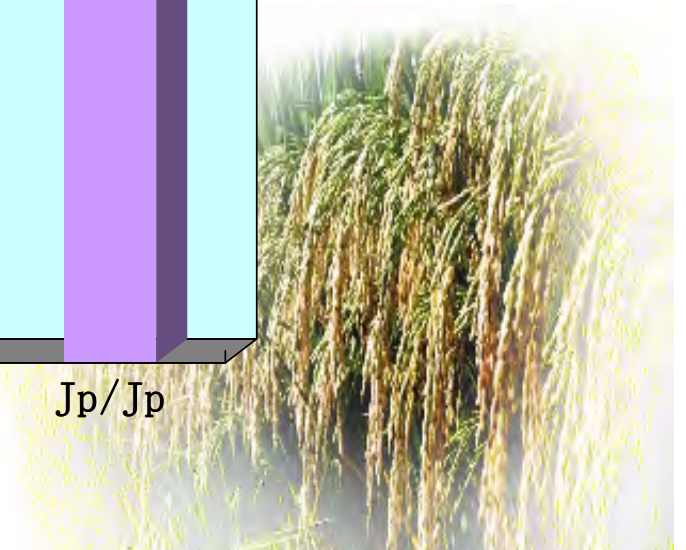
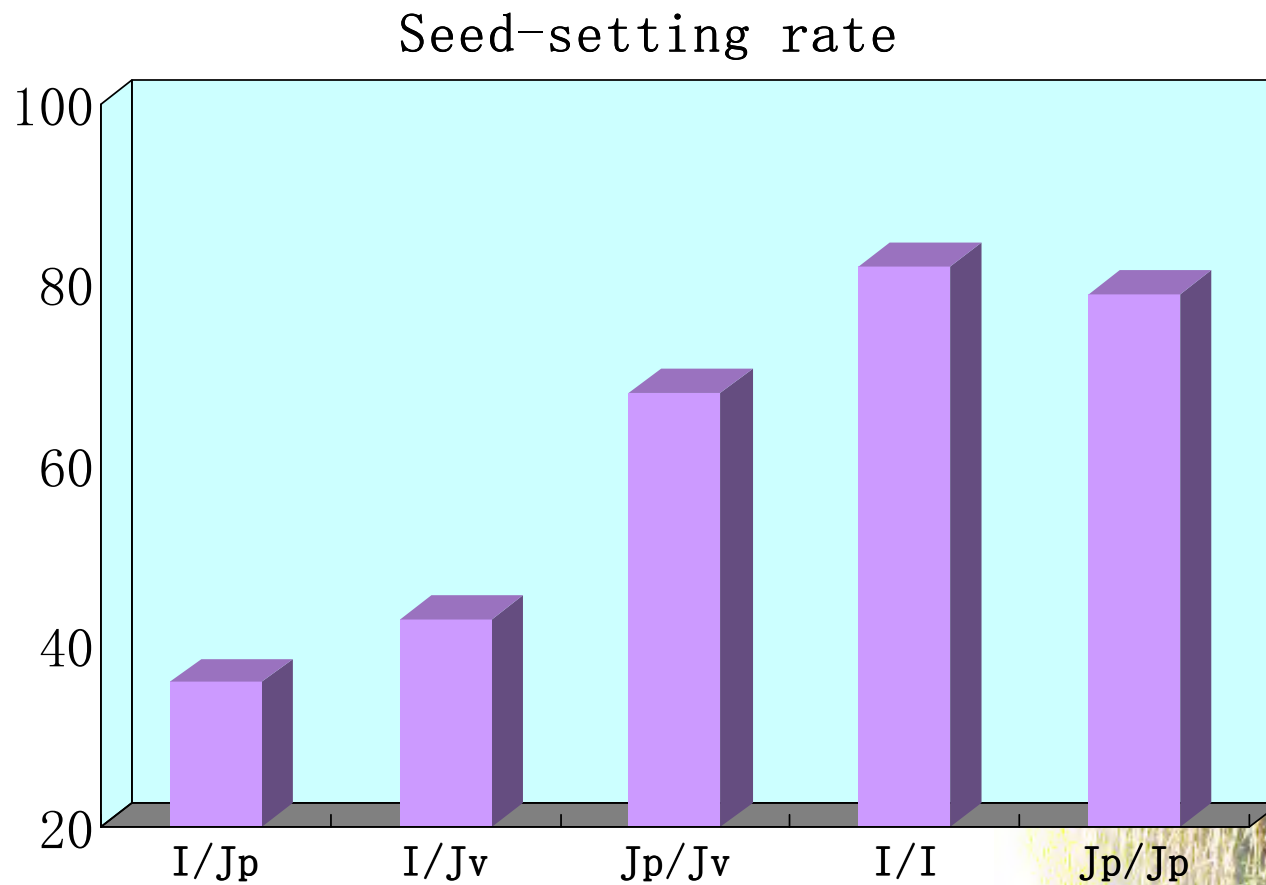


Heterosis in Different Rice Hybrids

Spikelets / plant



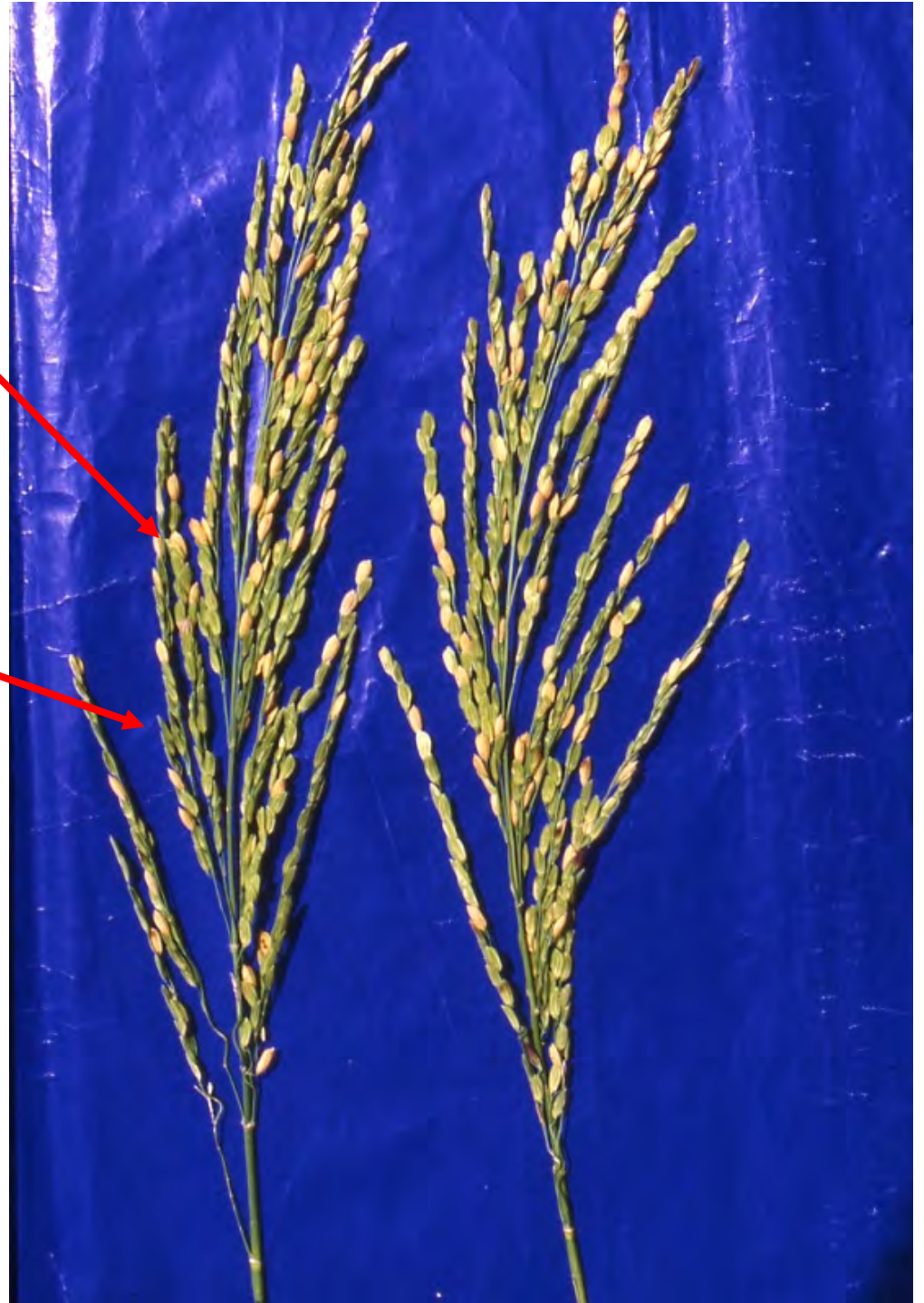
Heterosis in Different Rice Hybrids



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
Weiyu35 (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



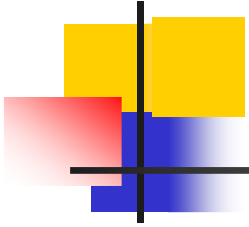


■ $S_{-5}^I / S_{-5}^J \longrightarrow$ sterile F_1

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

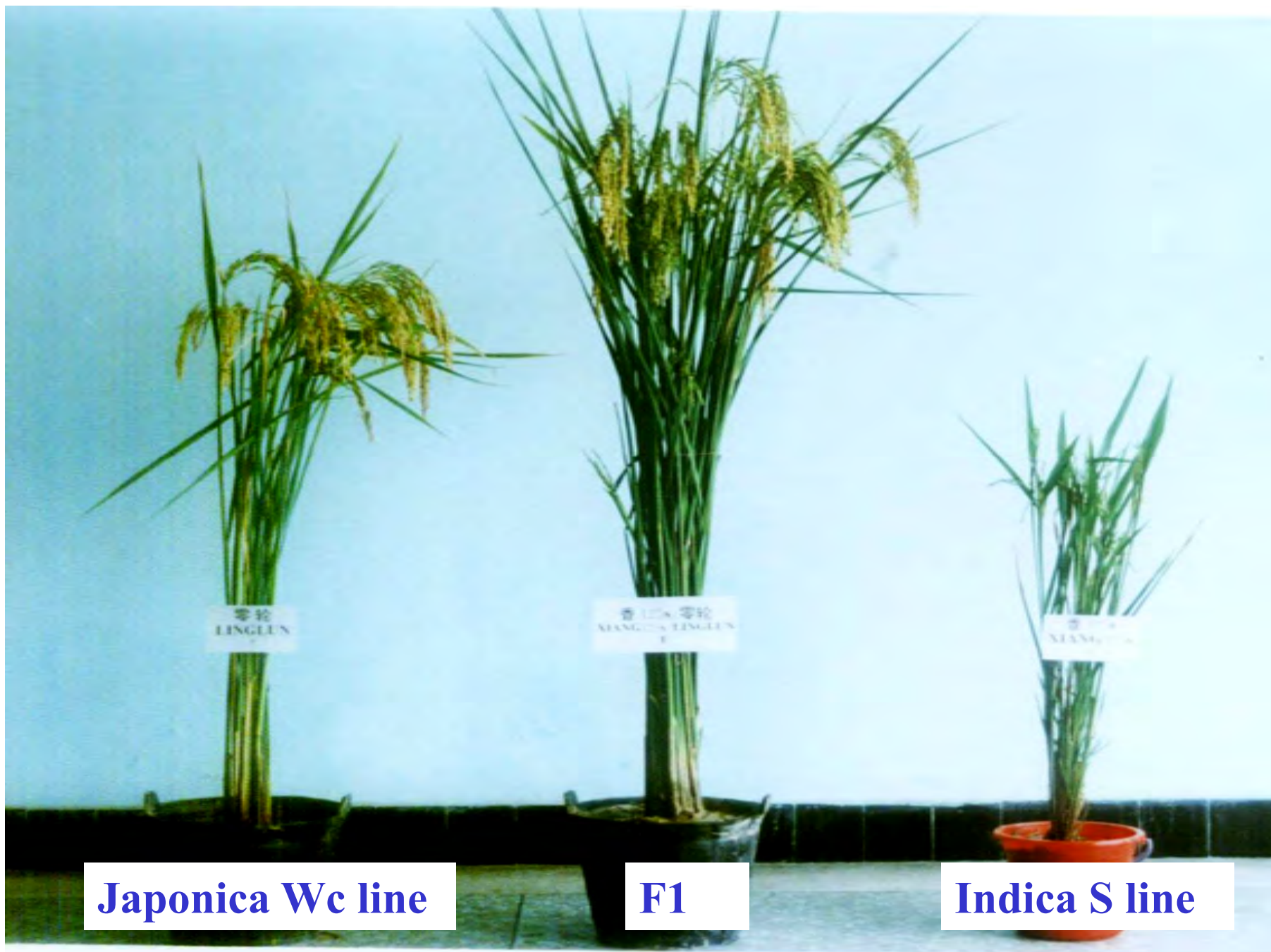
\longrightarrow fertile F_1





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