Characterizing local upland rice cultivars for on-farm crop diagnosis in northern Thailand

The problem
- In Southeast Asia, swidden cultivation of upland rice (UR) is still an important component of remote montane farming systems. In such still poorly researched systems, UR yields are generally low [1-1.5 t ha\(^{-1}\)] and extremely variable.
- Prior to looking for ways to improve these UR cropping systems, more in-depth knowledge on potentials of UR cultivars and factors/conditions limiting UR yields in actual farming situations is required.

Research objectives
- To assess key characteristics of local UR planting material.
- To construct an empirical model of yield buildup processes of the UR crop to be used for on-farm crop diagnosis of limiting factors.

The on-farm diagnostic survey approach
- A 4-year (1993-96) on-farm survey on the extent and causes of UR yield variability was conducted.
- Data on crop physiological parameters and yield components were obtained through intensive monitoring of 4.32 squares (1 m² each) in 63 farmers’ fields.
- An isozyme analysis assessed the genetic variability of farmers’ UR cultivars.

The study site
Mae Haeng, a highland Lahu village in northwestern Thailand, is characterized by:
- A monsoon climate, a strong relief, deep granitic soils of medium chemical fertility, and heterogeneous (2- to 10-year-old) types of fallow vegetation.
- Farming systems at an early stage of diversification and still mainly based on the subsistence cultivation of upland rice.
- Traditional swidden cultivation practices in UR and no-input cropping systems with gradually diversifying weed control practices (tree-culture and NaCl application).

Key genetic and physiological characteristics of upland rice planting material
- Farmers grow only local cultivars, belonging to two physiologically different groups, for on-farm crop diagnosis of limiting factors.
- Late-maturing non-glutinous cultivars (the farmers' basic staple) amount to 70-80% of the total UR production.

Physiological and genetic characteristics of local UR cultivars in Mae Haeng, 1993-96WS.

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<th>Cultivar</th>
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<td><em>Based on isozyme analysis.</em></td>
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Empirical model of yield buildup processes for the main early and late UR cultivars
- Local UR cultivars displayed yield potentials amounting to 3.1 and 4.4 t ha\(^{-1}\) [at 0% \(H_2O\)] for early and late cultivars, respectively.

Conclusions
- The inherent yield potential of local cultivars is not a major cause of low UR yields at our study site. Improvements in UR crop management practices could lead to very significant progress in closing the current important yield gap. Consequently, crop management research should dominate the research agenda for such montane UR-based cropping systems.
- This empirical model of UR yield buildup can be applied to identify and to rank the periods of yield differentiation. Subsequently, it will be used to identify and to grade limiting factors of the crop to be alleviated, as well as to conceive, to design and to evaluate improved cropping systems.

References

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<tr>
<th>Cultivar</th>
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<tbody>
<tr>
<td>No. of monitoring squares</td>
<td>75</td>
<td>274</td>
</tr>
<tr>
<td>Maximum grain yield (g at 0% H(_2)O)</td>
<td>30</td>
<td>43</td>
</tr>
<tr>
<td>Maximum 1000-grain weight (g at 0% H(_2)O)</td>
<td>25.2</td>
<td>24.3</td>
</tr>
<tr>
<td>Threshold value(^a) for filled spikelets m(^{-2}) (no.)</td>
<td>13,300</td>
<td>16,300</td>
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<td>16,200</td>
<td>20,800</td>
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<td>Maximum grain filling (%)</td>
<td>80</td>
<td>96</td>
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<td>Maximum value for filled spikelets m(^{-2}) (no.)</td>
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<tr>
<td>Threshold value for spikelets per panicle m(^{-2}) (no.)</td>
<td>144</td>
<td>146</td>
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<td>Maximum value for spikelets per panicle m(^{-2}) (no.)</td>
<td>22,300</td>
<td>26,600</td>
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<td>Threshold value for spikelets per panicle m(^{-2}) (no.)</td>
<td>154</td>
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<td>Maximum value for panicles per plant (no.)</td>
<td>228</td>
<td>227</td>
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<tr>
<td>Threshold value for panicles per plant (no.)</td>
<td>23</td>
<td>36</td>
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<tr>
<td>Threshold value for plants m(^{-2}) (no.)</td>
<td>91</td>
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*Threshold value = value required to achieve the maximum for a particular yield component.*

**Data scatters from UR fields support the existence of such yield buildup reference curves, similar to those already established for other cereal crops.**

**Yield differentiation between early and late cultivars started at spikelet formation and continued in a cumulative way during the following development phases.**

**For both early and late cultivars, yield differentiation occurred mainly during panicle and spikelet formation.**

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**Guy Trébuil** 1, **Koen Van Keer** 1, **Chawrap Vejpas** 1, **Brigitte Courtois** 1, **Chazu Rare Nonglutinous 1230**, **Chanoko Common Nonglutinous 1060**, **Chafuma Common Glutinous 1000**, **Chaloioe Rare 670**, **Kochokai Rare 800**, **Chaloina Chaae**, **Thailand, is characterized by:**

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