Supplemental Information

Unravelling miRNA regulation in yield of rice (*Oryza sativa*)
based on differential network model

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Supplemental Materials and Methods

Plant materials, high-throughput sequencing and bioinformatics analysis

Small RNA and transcriptome sequencing were performed for the variety IR64 in Taoyuan (ultra-high yield) and Jinghong (natural yield) at three different stages (tiller, young panicle and flag leaf) for the yield of rice. Total RNA was extracted from three tissues (tillers, young panicles and flag leaves) of rice IR64 using the Trizol (Invitrogen). For each sample, 5 μg of total RNA was used as the input material for constructing the small RNA library. Sequencing libraries were generated using NEBNext Multiplex Small RNA Library Prep Set for Illumina (NEB, USA) according to the manufacturer’s recommendations. Briefly, the small RNAs were ligated with 3’ and 5’ adapters using T4 RNA ligase. The RNAs were subsequently transcribed to single-stranded cDNA using Super-Script II Reverse Transcriptase (RNase H-) (Invitrogen). Then, PCR amplification was performed using LongAmp Taq2X Master Mix and primers that anneal to adapters. PCR products were purified on an 8 % polyacrylamide gel (100V, 80 min). After quality assessment using DNA High Sensitivity Chips with the Agilent 2100 Bioanalyzer, DNA fragments 140–160 bps in length were recovered and dissolved in 8 μl of elution buffer for sequencing. Then, the libraries were sequenced using the Illumina HiSeq2500 platform with single-end (SE) 50 nt.

After Illumina sequencing, any low quality reads, adaptors, contaminating sequences and sequences shorter than 18 nt were discarded. Only the remaining high-quality sequences between 18 and 30 nt were further analyzed. All unique sequences were aligned to the rice genome (Nipponbare-Reference-IRGSP-1.0) and annotated based on MSU-v7.0 (http://rice.plantbiology.msu.edu/) using SOAP for mapping (Li et al., 2008). Reads that mapped to rice rRNA, tRNA, scRNA, snRNA, or snoRNA were removed based on the National Center for Biotechnology Information (NCBI) (http://www.ncbi.nlm.nih.gov/) and Rfam RNA family databases (Gardner et al., 2009). Known miRNAs were identified using a BLAST search against the miRNA database miRBase release 21 (http://miRNA.org/)
(Kozomara and Griffiths-Jones, 2014). Reads that did not annotate to any category were used to predict novel miRNAs using the miRNA prediction program MIREAP (http://sourceforge.net/projects/mireap/) as described (Yan et al., 2015). Secondary structures of potential miRNA precursors were constructed using the MFOLD3.2 web server (http://mfold.rna.albany.edu/) (Zuker, 2003). To identify miRNAs with differential expression between Taoyuan and Jinghong in the three tissues, miRNA read counts were normalized to transcripts per million (TPM) using the following formula: normalized expression = (miRNA count / total count of clean reads) ×10^6 (Hu et al., 2016).

For RNA sequencing (RNA-seq) library construction, 3 μg of total RNA of each sample was used for library preparation using TruSeq Stranded Total RNA Sample Preparation kit (Illumina, San Diego, USA). RNA was fragmented into small pieces and then first-strand cDNA was synthesized with Super Script II reverse transcription (Invitrogen). After purifying, the second strand cDNA library was synthesized, following several rounds of PCR amplification. The clean reads of RNA-seq were mapped to the rice reference genome (Nipponbare-Reference-IRGSP-1.0) using Tophat 2 (version 2.0.13) (Trapnell et al., 2010). Transcript reconstruction was conducted by Cufflinks software (version 2.2.1) (Trapnell et al., 2012). And DESeq2 was used to make read counts and to identify differentially expressed genes (DEGs). A False Discovery Rate (FDR) was determined with threshold of 0.05 and |log2(fold change)| ≥1) to recognize the significance of the gene expression difference. All the small and RNA sequencing data were deposited in the NCBI Short Read Archive (SRA) (http://www.ncbi.nlm.nih.gov/sra) under the accession number: SRP134071 and SRP144409.

**Differential edge-like transformation (DET)**

The differential co-expression analysis is to see if or not the expression correlation of a gene-pair (e.g. two genes or molecules) changes between control and case samples (Zeng et al., 2014; Yu et al., 2015). Thus, the Pearson correlation coefficient (PCC) between genes $i$ and $j$ in control or case samples can be calculated.

On one hand, to evaluate the correlation in one sample, the pseudo-correlation or correlation-like expression of such a gene-pair in a sample $k$ can be defined as:
Pseudo-correlation in control condition: \[
\frac{x_{ik} - \mu_{xi}}{\sigma_{xi}} \cdot \frac{x_{jk} - \mu_{xj}}{\sigma_{xj}} = C(x_{ik})C(x_{jk}) \quad (1)
\]

Pseudo-correlation in case condition: \[
\frac{y_{ik} - \mu_{yi}}{\sigma_{yi}} \cdot \frac{y_{jk} - \mu_{yj}}{\sigma_{yj}} = C(y_{ik})C(y_{jk}) \quad (2)
\]

Where, \( C(\cdot) \) represents the Z-transform of one sample, i.e., sample k, by the mean and variance in such sample's group (e.g. a control sample and control group). Comparing (1) and (2), clearly for one gene-pair, the mean of its pseudo-correlation in all control (or case) samples just equals to the Pearson correlation coefficient on control (or case) group (Zeng et al., 2014; Zhang et al., 2015).

On the other hand, to evaluate the correlation change of one sample compared to multiple controls, the delta expression of a gene-pair can be computed as:

Pseudo-correlation in control condition: \[
\frac{y_{i} - \mu_{yi}}{\sigma_{yi}} \cdot \frac{y_{j} - \mu_{yj}}{\sigma_{yj}} = C'(y_{i})C'(y_{j}) \quad (3)
\]

Where, \( C(\cdot) \) represents the Z-transform of one sample by the mean and variance in such sample's group (e.g. a control sample against the control group); and \( C'(\cdot) \) represents the Z-transform of one sample by the mean and variance in another group (e.g. a case sample against the control group, or vice versa). According to the SSN theory (Liu et al., 2016), such delta-correlation would reflect the significance of correlation (network) change when one case sample mixed in a group of control samples (called reference samples in Liu et al., 2016).

Obviously, the first method (eqn. (2)) solves the weight representation of a gene-pair (e.g. an edge in network) in one sample but does not consider the unbalance of sample numbers between control and case samples. Meanwhile, the second method (eqn. (3)) gives a direct alteration representation for a case sample, however, such measurement for control and case samples would have different correlation meaning, i.e. the mean of delta correlation of a gene-pair in control samples would be the Pearson correlation coefficient on all control samples, but it is not on all case samples.

Thus, to provide a more comprehensive approach to evaluate the network, i.e. the edges / gene-pairs, in one sample, we here introduce a new differential edge-like transformation (DET) such as:

Edge-like correlation in control condition:
\[
\frac{x_{ik} - \mu_{xyi}}{\sigma_{xyi}}, \frac{x_{jk} - \mu_{xyj}}{\sigma_{xyj}}
\]
\[= \lambda_1 \cdot C(x_{ik})C(x_{jk}) + \lambda_2 \cdot C(x_{ik})C'(x_{jk}) + \lambda_3 \cdot C'(x_{ik})C(x_{jk}) + \lambda_4 \cdot C'(x_{ik})C'(x_{jk})
\]

Edge-like correlation in case condition:
\[
\frac{y_{ik} - \mu_{xyi}}{\sigma_{xyi}}, \frac{y_{jk} - \mu_{xyj}}{\sigma_{xyj}}
\]
\[= \lambda_1 \cdot C'(y_{ik})C'(y_{jk}) + \lambda_2 \cdot C'(y_{ik})C(y_{jk}) + \lambda_3 \cdot C(y_{ik})C'(y_{jk}) + \lambda_4 \cdot C(y_{ik})C(y_{jk})
\]

Where, \( \lambda_1 = \frac{\sigma_{xixi}}{4\sigma_{xyi}\sigma_{xyi}}, \lambda_2 = \frac{\sigma_{xixj}}{4\sigma_{xyi}\sigma_{xyj}}, \lambda_3 = \frac{\sigma_{yiyi}}{4\sigma_{xyj}\sigma_{xyj}}, \lambda_4 = \frac{\sigma_{yiyj}}{4\sigma_{xyj}\sigma_{xyj}} \), and there are similar numbers of control and case samples.

DET transforms the expression of genes to the edge-like correlation of gene-pairs in one sample, and the mean of edge-like correlation of a gene-pair in all control and case samples is just the Pearson correlation coefficient on all samples, so that this measurement has equivalent numerical meaning for any control or case sample. In addition, according to the following theory 1, such a transformation also has other two compatible features with previous methods (e.g. above pseudo-correlation and delta-correlation):

(i) When the sample numbers are extremely unbalance between control and case, the edge-like correlation will approach to delta correlation;

(ii) When the genes have the equivalent expression variances between control and case groups, the edge-like correlation will be a linear combination among pseudo-correlation and delta-correlation; otherwise, the edge-like correlation will have weighted variants for control and case samples, respectively.

Totally, DET can provide a more general approach to evaluate the network, i.e. the edges / gene-pairs, in one sample, under more complex practical conditions, such as: the sample numbers are extremely unbalance, or the genes have differential variances / co-variances.

**Theoretical Result:** Assume that gene \( i \) and \( j \) have one-sample’s representative expressions \( x_i \) and \( x_j \) in control with \( m_x \) samples, and \( y_i \) and \( y_j \) in case with \( m_y \) samples, the edge-like correlation of a gene-pair between \( i \) and \( j \) in one sample can be obtained as a transformation:
\[ \begin{align*}
&\frac{x_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{x_j - \mu_{xyj}}{\sigma_{xyj}} \\
&\frac{y_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{y_j - \mu_{xyj}}{\sigma_{xyj}}
\end{align*} \]

Then,

(i) when \( \frac{m_x}{m_y} \to \infty, \)

\[ \begin{align*}
&\frac{x_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{x_j - \mu_{xyj}}{\sigma_{xyj}} \to \frac{\sigma_{xi}\sigma_{sj}}{\sigma_{xyi}\sigma_{xyj}} \left( \frac{x_i - \mu_{xi}}{\sigma_{xi}} , \frac{x_j - \mu_{xj}}{\sigma_{xj}} \right)
\end{align*} \]

\[ \begin{align*}
&\frac{y_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{y_j - \mu_{xyj}}{\sigma_{xyj}} \to \frac{\sigma_{xi}\sigma_{sj}}{\sigma_{xyi}\sigma_{xyj}} \left( \frac{x_i - \mu_{xi}}{\sigma_{xi}} , \frac{x_j - \mu_{xj}}{\sigma_{xj}} \right)
\end{align*} \]

(ii) When \( \frac{m_x}{m_y} \to 1 \) and \( \sigma_{xi} \to \sigma_{yi} \) and \( \sigma_{xj} \to \sigma_{yj}, \)

\[ \begin{align*}
&\frac{x_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{x_j - \mu_{xyj}}{\sigma_{xyj}} \to \lambda \cdot [C(x_i)C(x_j) + C(x_i)C'(x_j) + C'(x_i)C(x_j) + C'(x_i)C'(x_j)]
\end{align*} \]

\[ \begin{align*}
&\frac{y_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{y_j - \mu_{xyj}}{\sigma_{xyj}} \to \lambda \cdot [C(y_i)C(y_j) + C(y_i)C'(y_j) + C'(y_i)C(y_j) + C'(y_i)C'(y_j)]
\end{align*} \]

Where, \( \lambda = \frac{\sigma_{xi}\sigma_{sj}}{4\sigma_{xyi}\sigma_{xyj}}; \) the expression average and variance for gene \( i \) (or gene \( j \)) on control samples are \( \mu_{xi} \) and \( \sigma_{xi} \) (or \( \mu_{xj} \) and \( \sigma_{xj} \)); and conveniently, the sample in case has these similar variables and annotations; and \( \mu_{xyi} \) and \( \sigma_{xyi} \)(or \( \mu_{xyj} \) and \( \sigma_{xyj} \)) are the mean and variance of gene \( i \) (or gene \( j \)) in all control and case samples.

**Proof:**

According to the relation between sample means in control, case and all, there are:

\[ \mu_{xyi} = \frac{m_x}{m} \mu_{xi} + \frac{m_y}{m} \mu_{yi} \]
\[ \mu_{xyj} = \frac{m_x}{m} \mu_{xj} + \frac{m_y}{m} \mu_{yj} \]

where \( m = m_x + m_y \), so,

\[ \frac{x_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{x_j - \mu_{xyj}}{\sigma_{xyj}} = \frac{\sigma_{xi}\sigma_{sj}}{\sigma_{xyi}\sigma_{xyj}} \left( \frac{x_i - \mu_{xi}}{\sigma_{xi}} , \frac{x_j - \mu_{xj}}{\sigma_{xj}} \right) \]

\[ \frac{y_i - \mu_{xyi}}{\sigma_{xyi}} , \frac{y_j - \mu_{xyj}}{\sigma_{xyj}} = \frac{\sigma_{xi}\sigma_{sj}}{\sigma_{xyi}\sigma_{xyj}} \left( \frac{y_i - \mu_{yi}}{\sigma_{yi}} , \frac{y_j - \mu_{yj}}{\sigma_{yj}} \right) \]

Then following results hold,
(i) When \( \frac{m_x}{m_y} \to \infty \),

there will be \( \frac{m_x}{m} \to 1 \) and \( \frac{m_y}{m} \to 0 \), and

\[
\frac{x_i - \mu_{xyi}}{\sigma_{xyi}} \cdot \frac{x_j - \mu_{xyj}}{\sigma_{xyj}} \to \frac{\sigma_{xi} \sigma_{xi}}{\sigma_{xyi} \sigma_{xyj}} \cdot \left( \frac{x_i - \mu_{xi}}{\sigma_{xi}} \cdot \frac{x_j - \mu_{xj}}{\sigma_{xj}} \right)
\]

\[
\frac{y_i - \mu_{xyi}}{\sigma_{xyi}} \cdot \frac{y_j - \mu_{xyj}}{\sigma_{xyj}} \to \frac{\sigma_{yi} \sigma_{yi}}{\sigma_{xyi} \sigma_{xyj}} \cdot \left( \frac{y_i - \mu_{yi}}{\sigma_{yi}} \cdot \frac{y_j - \mu_{yj}}{\sigma_{yj}} \right)
\]

Under this condition, the edge-like correlation will approach to delta-correlation (with a scale).

Similarly, when \( \frac{m_x}{m_y} \to 0 \), it can be dealt as \( \frac{m_y}{m_x} \to \infty \).

(ii) When \( \frac{m_x}{m_y} \to 1 \),

there will be \( \frac{m_x}{m} \to \frac{1}{2} \) and \( \frac{m_y}{m} \to \frac{1}{2} \), and

\[
\frac{x_i - \mu_{xyi}}{\sigma_{xyi}} \cdot \frac{x_j - \mu_{xyj}}{\sigma_{xyj}} = \frac{\sigma_{xi} \sigma_{xi}}{\sigma_{xyi} \sigma_{xyj}} \cdot \frac{2x_i - \mu_{xi} - \mu_{yi}}{2\sigma_{xi}} \cdot \frac{2x_j - \mu_{xj} - \mu_{yj}}{2\sigma_{xj}}
\]

\[
= \frac{\sigma_{xi} \sigma_{xi}}{4\sigma_{xyi} \sigma_{xyj}} \cdot \left( \frac{x_i - \mu_{xi}}{\sigma_{xi}} + \frac{x_i - \mu_{yi}}{\sigma_{xi}} \right) \cdot \left( \frac{x_j - \mu_{xj}}{\sigma_{xj}} + \frac{x_j - \mu_{yj}}{\sigma_{xj}} \right)
\]

\[
= \frac{\sigma_{xi} \sigma_{xi}}{4\sigma_{xyi} \sigma_{xyj}} \cdot \left( \frac{x_i - \mu_{xi}}{\sigma_{xi}} \cdot \frac{x_j - \mu_{xj}}{\sigma_{xj}} \right) + \frac{\sigma_{yi} \sigma_{yi}}{\sigma_{xyi} \sigma_{xyj}} \cdot \left( \frac{x_i - \mu_{yi}}{\sigma_{yi}} \cdot \frac{x_j - \mu_{yj}}{\sigma_{yj}} \right)
\]

\[
= \lambda_1 \cdot C(x_i)C(x_j) + \lambda_2 \cdot C(x_i)C'(x_j) + \lambda_3 \cdot C'(x_i)C(x_j) + \lambda_4 \cdot C'(x_i)C'(x_j)
\]

Where, \( \lambda_1 = \frac{\sigma_{xi} \sigma_{xi}}{4\sigma_{xyi} \sigma_{xyj}} \), \( \lambda_2 = \frac{\sigma_{yi} \sigma_{yi}}{4\sigma_{xyi} \sigma_{xyj}} \), \( \lambda_3 = \frac{\sigma_{yi} \sigma_{yi}}{4\sigma_{xyi} \sigma_{xyj}} \), \( \lambda_4 = \frac{\sigma_{yi} \sigma_{yi}}{4\sigma_{xyi} \sigma_{xyj}} \)

Similarly, there is,

\[
\frac{y_i - \mu_{xyi}}{\sigma_{xyi}} \cdot \frac{y_j - \mu_{xyj}}{\sigma_{xyj}} = \frac{\sigma_{yi} \sigma_{yi}}{\sigma_{xyi} \sigma_{xyj}} \cdot \frac{2y_i - \mu_{xi} - \mu_{yi}}{2\sigma_{yi}} \cdot \frac{2y_j - \mu_{xj} - \mu_{yj}}{2\sigma_{yj}}
\]
correlations is proposed in this study (Fig. 1).

In addition, if 

\[ \frac{x_i - \mu_{xyi}}{\sigma_{xyi}}, \frac{x_j - \mu_{xyj}}{\sigma_{xyj}} \to \lambda \cdot \left[ C(x_i)C(x_j) + C(x_i)C'(x_j) + C'(x_i)C(x_j) + C'(x_i)C'(x_j) \right] \]

\[ \frac{y_i - \mu_{xyi}}{\sigma_{xyi}}, \frac{y_j - \mu_{xyj}}{\sigma_{xyj}} \to \lambda \cdot \left[ C(y_i)C(y_j) + C(y_i)C'(y_j) + C'(y_i)C(y_j) + C'(y_i)C'(y_j) \right]. \]

Where, \( \lambda = \frac{\sigma_{xyi}\sigma_{xyj}}{4\sigma_{xyi}\sigma_{xyj}}. \)

Thus, under this condition, the edge-like correlation will be a linear combination among pseudo-correlation and delta-correlation and their combinations, similarly for control or case samples.

**Gene regulatory networks with DET**

Based on the theory of differential edge-like transformation (DET), a new differential network model by combining the miRNA-mRNA regulatory network and its edge-like correlationis proposed in this study (Fig. 1).

In one condition or in one tissue, there is usually only one sample, the conventional correlation-based approaches (e.g. WGCNA) will not be applicable. By contrast, we applied DET to capture the significant gene expression and correlation changes simultaneously in a dynamical and network manner. Assume that the (miRNA & mRNA) expression data

\[ X = [x_1, x_2, \ldots, x_N] \]

with \( x_i = [x_{i1}, x_{i2}, \ldots, x_{iM}] \) are an expression profile of a miRNA or a mRNA across a group of tissues,

(i) the tissue-specific expression of molecule \( i \) on one tissue \( k \) can be obtained by:

\[ \bar{x}_{i,k} = \frac{x_{ik} - \text{mean}(x_i)}{\text{std}(x_i)} \]

(ii) the tissue-specific edge-like correlation of molecules \( i \) and \( j \) on one tissue \( k \) can be obtained by (given molecule \( i \) is a miRNA and molecule \( j \) is a target mRNA):

\[ \tilde{p}_{ij,k} = \frac{x_{ik} - \text{mean}(x_i)}{\text{std}(x_i)} \cdot \frac{x_{jk} - \text{mean}(x_j)}{\text{std}(x_j)} \]

Simply, the differential molecule or tissue-specific molecule on one tissue \( k \) can be selected by Mann–Whitney U test between \( \{\bar{x}_{i,k}\} \) and \( \{\bar{x}_{i,1}, \ldots, \bar{x}_{i,k-1}, \bar{x}_{i,k+1}, \ldots\} \). And the differential molecule-pairs or sample-specific molecule association on one sample \( k \) can be selected by
Mann–Whitney U test between $[\bar{p}_{ij,k}]$ and $[\bar{p}_{ij,1}, \ldots, \bar{p}_{ij,k-1}, \bar{p}_{ij,k+1}, \ldots]$. For any miRNA, its average PCC (i.e. the edge-like correlation) with other relevant miRNAs or mRNAs in control or case is defined as $\text{AP}_{\text{control}}$ and $\text{AP}_{\text{case}}$, then a factor as PCC-induced key-associated score for this miRNA is computed as $|\text{AP}_{\text{case}} - \text{AP}_{\text{control}}|$.

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Supplementary Fig. S1 Subnetwork of differentially expressed miRNAs in DAF10, DAF15, DAF21, DAF27 of 'xingfeng 2' rice. The thickness of lines represents the correlation extent of miRNAs and their targets and the thicker, the more negative correlation between them. Rectangles: miRNAs, circles: genes, triangles: TF. The color of them indicates differential expression (red, up-regulation; green, down-regulation).
Supplementary Fig. S2  Weighted gene co-expression network analysis (WGCNA) of differentially expressed miRNAs (DEmiRNAs) in superior and inferior spikelets of Xinfeng2 rice. (A) Hierarchical cluster tree showing nine modules of co-expressed miRNAs. (B) Module-grain filling correlations and corresponding $P$-values (left). Heatmaps of the miRNAs expression in “grey” and “yellow” with expression patterns of selected candidate miRNAs (right). (C) Networks of “grey” and “yellow” module. The miRNAs co-expression relationships are colored in “grey” and “yellow”, respectively.
Supplementary Fig. S3 Subnetwork of three miRNAs in tillers, young panicles and flag leaves of Taoyuan (L) and Jinghong (R) IR64 rice. (A) osa-miR396b-5p, (B) osa-miR171a, (C) osa-miR812m. The thickness of lines represents the correlation extent of miRNAs and their targets and the thicker, the more negative correlation between them. Rectangles: miRNAs, circles: genes, triangles: TF. red color, up-regulation and green, down-regulation.
ultra-high yield rice (C, tiller, D, panicle and E, flag leaf). Rectangles: miRNAs, circles: genes, triangles: TF.
**Supplementary Fig. S4** Co-expression networks of candidate yield miRNAs identified by DET with reported yield miRNAs in Taoyuan ultra-high yield rice (A, tiller, B, panicle and C, flag leaf). Rectangles: miRNAs, circles: genes, triangles: TF.
Supplementary Fig. S5 GO enrichment of genes co-regulated with sample specific miRNAs (SmiRNAs) which are identified by differential edge-like transformation (DET) between Taoyuan and Jinghong samples.
## Supplementary Table S1
Details of sample-specific miRNAs (SmiRNAs) in different tissues at the key yield stage analyzed using differential edge-like transformation (DET) analysis with their expression levels in each sample.

| Rank | miRNA     | DAF10 FC (S/I) | DAF15 FC (S/I) | DAF21 FC (S/I) | DAF27 FC (S/I) | △PCC (S-I) |
|------|-----------|----------------|----------------|----------------|----------------|-------------|
| 1    | osa-miR2105 | 0.000          | 0.000          | 0.000          | 0.090          | 0.8933      |
| 2    | osa-miR395n | 0.000          | 0.000          | 0.000          | 0.090          | 0.8933      |
| 3    | osa-miR2096-5p | 0.000     | 0.000          | 0.090          | 0.090          | 0.7594      |
| 4    | osa-miR1861c | 0.140          | 0.080          | 0.000          | 0.000          | 0.7448      |
| 5    | osa-miR1862g | 0.070          | 0.080          | 0.000          | 0.000          | 0.7448      |
| 6    | osa-miR444b  | 0.647          | 2.666          | 1.305          | 3.061          | 0.7290      |
| 7    | osa-miR444c  | 0.647          | 2.666          | 1.305          | 3.061          | 0.7290      |
| 8    | osa-miR812l  | 1.577          | 2.319          | 2.612          | 1.054          | 0.7247      |
| 9    | osa-miR164b  | 0.607          | 0.743          | 0.287          | 0.337          | 0.7205      |
| 10   | osa-miR164a  | 0.607          | 0.743          | 0.289          | 0.337          | 0.7200      |
| 11   | osa-miR164f  | 0.608          | 0.743          | 0.2870         | 0.337          | 0.7205      |
| 12   | osa-miR812a  | 2.712          | 3.160          | 5.092          | 1.047          | 0.7205      |
| 13   | osa-miR812c  | 2.419          | 3.390          | 3.461          | 1.233          | 0.7110      |
| 14   | osa-miR1432  | 0.385          | 0.643          | 0.231          | 0.171          | 0.6716      |
| 15   | osa-miR812e  | 2.451          | 3.270          | 3.544          | 1.182          | 0.6605      |
| 16   | osa-miR2102-5p | 0.560        | 0.080          | 0.090          | 0.000          | 0.6459      |
| 17   | osa-miR166l  | 0.700          | 0.685          | 0.265          | 0.355          | 0.5894      |
| 18   | osa-miR166k  | 0.709          | 0.696          | 0.268          | 0.361          | 0.5741      |
| 19   | osa-miR1846a-3p | 0.539       | 0.150          | 0.948          | 2.000          | 0.5553      |
| 20   | osa-miR169a  | 0.898          | 0.353          | 0.278          | 0.065          | 0.5124      |

| Rank | miRNA     | Taoyuan PCC (Taoyuan) | Jinghong PCC (Jinghong) | △PCC (Taoyuan-Jinghong) |
|------|-----------|-----------------------|-------------------------|-------------------------|
| 1    | osa-miR1428c-3p | 1.474                 | 1.477                   | 2.132                   |
| 2    | osa-miR1861i  | 4.069                 | 3.545                   | 2.144                   |
| 3    | osa-miR1861f  | 4.069                 | 3.545                   | 2.144                   |
| 4    | osa-miR1861l  | 4.069                 | 3.545                   | 2.144                   |
| 5    | osa-miR1861b  | 4.069                 | 3.545                   | 2.144                   |
| 6    | osa-miR1676-3p | 12.913                | 13.293                  | 2.143                   |
| 7    | osa-miR1671-3p | 12.913                | 13.293                  | 2.143                   |
| 8    | osa-miR396b-5p | 77.481                | 83.895                  | 2.132                   |
| 9    | osa-miR396a-5p | 77.539                | 83.895                  | 2.132                   |
| 10   | osa-miR169m   | 7.194                 | 6.499                   | 2.145                   |
| 11   | osa-miR169l   | 7.194                 | 6.499                   | 2.145                   |
| 12   | osa-miR169k   | 7.194                 | 6.499                   | 2.145                   |
|   | Gene Symbol  | Gene   | Genes   | Genes   | Genes   |
|---|--------------|--------|---------|---------|---------|
|   |             | Mean   | Min     | Max     | Mean   |
|13 | osa-miR169j | 7.194  | 6.499   | 2.145   | 0.056  | 2.091  |
|14 | osa-miR169i-5p | 7.194 | 6.499   | 2.145   | 0.056  | 2.091  |
|15 | osa-miR396f-3p | 24.641 | 25.240  | 2.156   | 0.075  | 2.081  |
|16 | osa-miR3979-3p | 14.608 | 3.770   | 2.158   | 0.082  | 2.077  |
|17 | osa-miR1870-5p | 92.864 | 151.110 | 2.140   | 0.066  | 2.074  |
|18 | osa-miR167d-3p | 2.649  | 0.410   | 2.159   | 0.088  | 2.071  |
|19 | osa-miR396e-5p | 10.514 | 4.015   | 2.117   | 0.047  | 2.070  |
|20 | osa-miR396f-5p | 5813.221 | 1200.491 | 2.117   | 0.047  | 2.070  |
|21 | osa-miR5825  | 2.536  | 1.477   | 2.162   | 0.101  | 2.062  |
|22 | osa-miR169g  | 2.2407 | 3.2495  | 2.070   | 0.020  | 2.050  |
|23 | osa-miR169f.1 | 2.2407 | 3.2495  | 2.070   | 0.020  | 2.050  |
|24 | osa-miR396d  | 37.325 | 33.381  | 2.141   | 0.093  | 2.048  |
|25 | osa-miR396g  | 37.325 | 33.381  | 2.141   | 0.093  | 2.048  |
|26 | osa-miR396h  | 37.325 | 33.381  | 2.141   | 0.093  | 2.048  |
|27 | osa-miR818d  | 1.179  | 0.591   | 2.166   | 0.120  | 2.046  |
|28 | osa-miR3979-5p | 182.557 | 231.598 | 2.107   | 0.063  | 2.043  |
|29 | osa-miR1871  | 14.152 | 20.678  | 2.108   | 0.075  | 2.033  |
|30 | osa-miR810b.1 | 6.84   | 3.5449  | 2.166   | 0.134  | 2.032  |
|31 | osa-miR529b  | 13.444 | 5.613   | 2.169   | 0.140  | 2.030  |
|32 | osa-miR390-3p | 24.765 | 15.361  | 2.160   | 0.133  | 2.027  |
|33 | osa-miR169b  | 1.533  | 0.591   | 2.171   | 0.147  | 2.023  |
|34 | osa-miR171h  | 24.589 | 9.158   | 2.171   | 0.150  | 2.021  |
|35 | osa-miR167e-5p | 220.589 | 176.062 | 2.150   | 0.131  | 2.018  |
|36 | osa-miR167i-5p | 219.882 | 175.176 | 2.150   | 0.132  | 2.017  |
|37 | osa-miR1861m | 13.562 | 4.727   | 2.172   | 0.156  | 2.016  |
|38 | osa-miR1861k | 13.562 | 4.727   | 2.172   | 0.156  | 2.016  |
|39 | osa-miR1861e | 13.562 | 4.727   | 2.172   | 0.156  | 2.016  |
|40 | osa-miR5145  | 3.007  | 2.068   | 2.144   | 0.132  | 2.012  |

**Young panicles**

|   | Gene Symbol  | Gene   | Genes   | Genes   | Genes   |
|---|--------------|--------|---------|---------|---------|
|   |             | Mean   | Min     | Max     | Mean   |
|   |             |        |         |         |        |
|1  | osa-miR5834 | 2.105  | 0.483   | 1.529   | 0.034  | 1.495  |
|2  | osa-miR2863c | 2.679 | 0.483   | 1.539   | 0.107  | 1.432  |
|3  | osa-miR160f-3p | 1.340 | 0.241   | 1.539   | 0.107  | 1.432  |
|4  | osa-miR2879 | 1.531  | 0.483   | 1.506   | 0.094  | 1.412  |
|5  | osa-miR5528 | 1.531  | 0.241   | 1.543   | 0.140  | 1.403  |
|6  | osa-miR5488 | 1.723  | 0.241   | 1.546   | 0.166  | 1.380  |
|7  | osa-miR5499 | 1.914  | 0.242   | 1.547   | 0.186  | 1.361  |
|8  | osa-miR5143b | 3.445 | 1.448   | 1.468   | 0.248  | 1.220  |
|9  | osa-miR5802 | 1.722  | 0.724   | 1.468   | 0.248  | 1.220  |
|10 | osa-miR172b | 1.722  | 0.724   | 1.468   | 0.248  | 1.220  |
|11 | osa-miR2876-3p | 2.295 | 0.01    | 1.555   | 0.367  | 1.188  |
|12 | osa-miR5518 | 1.340  | 0.01    | 1.555   | 0.367  | 1.188  |
|13 | osa-miR5514 | 3.253  | 1.448   | 1.458   | 0.283  | 1.174  |
|14 | osa-miR160f-5p | 9.377 | 2.413   | 1.418   | 0.265  | 1.153  |
|15 | osa-miR171i-5p | 3.827 | 3.137   | 1.446   | 0.298  | 1.148  |
|   | OSA-miR5836 |       |       |       |       |
|---|-------------|-------|-------|-------|-------|
| 16| 8.803       | 4.102 | 1.448 | 0.313 | 1.135 |
| 17| 13.970      | 7.722 | 1.407 | 0.434 | 0.973 |
| 18| 3.445       | 1.448 | 1.079 | 0.137 | 0.941 |
| 19| 6.124       | 4.344 | 1.230 | 0.322 | 0.907 |
| 20| 43.631      | 30.888| 1.343 | 0.488 | 0.855 |
| 21| 0.766       | 1.207 | 0.852 | 0.000 | 0.852 |
| 22| 44.014      | 31.370| 1.338 | 0.502 | 0.830 |
| 23| 43.823      | 31.370| 1.336 | 0.506 | 0.830 |
| 24| 2.296       | 1.448 | 1.366 | 0.537 | 0.829 |
| 25| 1.531       | 0.965 | 1.366 | 0.537 | 0.829 |
| 26| 55.496      | 40.057| 1.349 | 0.526 | 0.823 |
| 27| 8.420       | 8.204 | 1.349 | 0.526 | 0.823 |
| 28| 2.488       | 1.690 | 1.339 | 0.599 | 0.739 |
| 29| 1.722       | 1.207 | 1.326 | 0.626 | 0.700 |
| 30| 14.544      | 11.100| 0.915 | 0.315 | 0.600 |
| 31| 16.266      | 12.307| 1.293 | 0.694 | 0.599 |
| 32| 3.827       | 2.896 | 0.838 | 0.259 | 0.548 |
| 33| 2036.889    | 1719.811| 1.250 | 0.702 | 0.548 |
| 34| 2215.432    | 1904.654| 1.244 | 0.727 | 0.517 |
| 35| 18.180      | 14.720| 1.261 | 0.755 | 0.506 |

Flag leaves

|   | OSA-miR1425-3p |       |       |       |       |
|---|----------------|-------|-------|-------|-------|
| 1 | 1.911          | 0.970 | 1.195 | 0.495 | 0.699 |
| 2 | 1.528          | 0.776 | 1.195 | 0.495 | 0.699 |
| 3 | 14.138         | 3.734 | 1.187 | 0.516 | 0.671 |
| 4 | 18.150         | 11.450| 1.061 | 0.451 | 0.611 |
| 5 | 98.774         | 282.166| 0.706 | 0.103 | 0.604 |
| 6 | 18.150         | 11.450| 1.033 | 0.466 | 0.567 |
| 7 | 1.146          | 0.194 | 0.853 | 0.323 | 0.530 |
| 8 | 12.418         | 23.676| 0.531 | 0.004 | 0.527 |
| 9 | 341.028        | 891.325| 0.603 | 0.078 | 0.525 |
|10 | 13818.22       | 32552.27| 0.516 | 0.014 | 0.502 |
|11 | 13818.22       | 32595.74| 0.516 | 0.014 | 0.502 |
|12 | 2.866          | 1.941 | 1.021 | 0.578 | 0.444 |
|13 | 3.248          | 2.135 | 1.100 | 0.702 | 0.397 |
|14 | 7541.59        | 25320.18| 0.574 | 0.188 | 0.285 |
|15 | 7548.08        | 25333.96| 0.574 | 0.188 | 0.385 |
|16 | 7549.99        | 25341.53| 0.574 | 0.188 | 0.385 |
|17 | 7549.80        | 25341.14| 0.574 | 0.188 | 0.385 |
|18 | 1.720          | 1.164 | 1.086 | 0.728 | 0.359 |
|19 | 3.63           | 0.970 | 0.730 | 0.385 | 0.345 |
|20 | 20.824         | 15.525| 0.853 | 0.534 | 0.320 |
|21 | 2.484          | 1.747 | 1.069 | 0.760 | 0.309 |
|22 | 2.866          | 4.075 | 0.338 | 0.032 | 0.305 |
|23 | 13.374         | 13.373| 1.000 | 0.713 | 0.287 |
|   | miRNA          | FC   | Expression   | p-value | q-value |
|---|----------------|------|--------------|---------|---------|
|24 | osa-miR1425-5p | 1425.057 | 623.326 | 0.775 | 0.516   | 0.259 |
|25 | osa-miR395i    | 1.528  | 0.388       | 0.675   | 0.420   | 0.255 |
|26 | osa-miR395j    | 1.528  | 0.388       | 0.675   | 0.420   | 0.255 |
|27 | osa-miR395k    | 1.528  | 0.388       | 0.675   | 0.420   | 0.255 |
|28 | osa-miR1860-3p | 2.866  | 1.358       | 0.575   | 0.325   | 0.250 |
|29 | osa-miR156c-3p | 0.573  | 1.552       | 0.328   | 0.086   | 0.242 |
|30 | osa-miR156g-3p | 0.573  | 1.552       | 0.328   | 0.086   | 0.242 |
|31 | osa-miR395h    | 1.528  | 0.388       | 0.634   | 0.394   | 0.240 |
|32 | osa-miR395m    | 1.528  | 0.388       | 0.634   | 0.394   | 0.240 |
|33 | osa-miR535-5p  | 15.475 | 33.573      | 0.668   | 0.437   | 0.230 |
|34 | osa-miR166j-5p | 97.054 | 77.042      | 0.767   | 0.561   | 0.206 |

Note: FC, fold change.
Supplementary Table S2  The differentially expressed miRNAs (DEmiRNAs) in tillers, young panicles and flag leaves of IR64 rice planted at Taoyuan and Jinghong.

| miRNA          | Taoyuan | Jinghong | Fold-change | P-value |
|----------------|---------|----------|-------------|---------|
| **Tillers**    |         |          |             |         |
| osa-miR159a.1  | 69.9919 | 184.3334 | 1.397058    | 0.0000  |
| osa-miR159b    | 70.0508 | 184.3334 | 1.395844    | 0.0000  |
| osa-miR160a-3p | 2.0048  | 0.2954   | -2.76272    | 0.0234  |
| osa-miR160b-3p | 2.0048  | 0.2954   | -2.76272    | 0.0234  |
| osa-miR164c    | 0.059   | 1.477    | 4.645811    | 0.0003  |
| osa-miR166e-3p | 5.6017  | 2.3632   | -1.24512    | 0.0127  |
| osa-miR169c    | 7.5476  | 1.477    | -2.35335    | 0.0000  |
| osa-miR169e    | 1.651   | 0.01     | -7.3672     | 0.0102  |
| osa-miR169i-5p.2 | 0.5897 | 6.4989   | 3.462142    | 0.0000  |
| osa-miR169n    | 1.8279  | 0.2954   | -2.62945    | 0.0374  |
| osa-miR169o    | 1.8279  | 0.2954   | -2.62945    | 0.0374  |
| osa-miR169r-3p | 1.0614  | 5.6127   | 2.402727    | 0.0000  |
| osa-miR169r-5p | 0.7665  | 5.6127   | 2.872337    | 0.0000  |
| osa-miR171h    | 24.5885 | 9.1576   | -1.42494    | 0.0000  |
| osa-miR171i-3p | 2.0638  | 4.1357   | 1.002828    | 0.0273  |
| osa-miR172d-3p | 0.3538  | 1.1816   | 1.739736    | 0.0487  |
| osa-miR172d-5p | 0.2948  | 1.477    | 2.324861    | 0.0091  |
| osa-miR1846e   | 0.2948  | 1.1816   | 2.002933    | 0.0307  |
| osa-miR1861e   | 13.562  | 4.7265   | -1.52073    | 0.0000  |
| osa-miR1861h   | 22.4068 | 3.2495   | -2.78565    | 0.0000  |
| osa-miR1861j   | 22.4068 | 3.2495   | -2.78565    | 0.0000  |
| osa-miR1861k   | 13.562  | 4.7265   | -1.52073    | 0.0000  |
| osa-miR1861m   | 13.562  | 4.7265   | -1.52073    | 0.0000  |
| osa-miR1868    | 13.4441 | 48.1512  | 1.840599    | 0.0000  |
| osa-miR1883a   | 18.1024 | 7.976    | -1.18244    | 0.0000  |
| osa-miR2880    | 14.4465 | 2.3632   | -2.61191    | 0.0000  |
| osa-miR319a-3p | 6.722   | 20.6784  | 1.621162    | 0.0000  |
| osa-miR393a    | 4.8352  | 0.5908   | -3.03283    | 0.0001  |
| osa-miR393b-5p | 3.8917  | 1.1816   | -1.71966    | 0.0103  |
| osa-miR395b    | 0.4717  | 2.6587   | 2.494779    | 0.0004  |
| osa-miR395d    | 0.3538  | 2.9541   | 3.061713    | 0.0000  |
| osa-miR395e    | 0.4128  | 2.6587   | 2.687206    | 0.0002  |
| osa-miR395g    | 0.3538  | 2.6587   | 2.909715    | 0.0001  |
| osa-miR395h    | 0.2948  | 2.3632   | 3.002933    | 0.0002  |
| osa-miR395i    | 0.2948  | 2.6587   | 3.172913    | 0.0000  |
| osa-miR395j    | 0.2948  | 2.6587   | 3.172913    | 0.0000  |
| miRNA       | Fold Change | p-value  | q-value | Log2 Fold Change |
|------------|-------------|----------|---------|-----------------|
| osa-miR395k| 0.2948      | 3.172913 | 0.0000  |
| osa-miR395l| 0.2948      | 3.172913 | 0.0000  |
| osa-miR395m| 0.2948      | 3.172913 | 0.0000  |
| osa-miR395n| 0.2948      | 3.172913 | 0.0000  |
| osa-miR395p| 0.2948      | 3.172913 | 0.0000  |
| osa-miR395q| 0.2948      | 3.172913 | 0.0000  |
| osa-miR395r| 0.2948      | 3.172913 | 0.0000  |
| osa-miR395s| 0.3538      | 2.90715  | 0.0001  |
| osa-miR395t| 0.3538      | 2.90715  | 0.0001  |
| osa-miR395u| 0.3538      | 2.90715  | 0.0001  |
| osa-miR395v| 0.3538      | 2.90715  | 0.0001  |
| osa-miR397a| 34.5537     | 904.829  | 0.0000  |
| osa-miR397b| 361.5755    | 904.829  | 0.0000  |
| osa-miR397c| 1.8279      | -7.51404 | 0.0059  |
| osa-miR397d| 2.8893      | 10.6346  | 0.0000  |
| osa-miR397e| 7.4296      | -1.33057 | 0.0022  |
| osa-miR397f| 0.5897      | 2.324666 | 0.0004  |
| osa-miR397g| 0.4717      | 4.369224 | 0.0000  |
| osa-miR397h| 0.4128      | 3.604718 | 0.0000  |
| osa-miR397i| 13.4441     | -1.26021 | 0.0001  |
| osa-miR397j| 5.8965      | -1.51176 | 0.0030  |
| osa-miR397k| 5.8965      | -1.51176 | 0.0030  |
| osa-miR397l| 5.8965      | -1.51176 | 0.0030  |
| osa-miR397m| 0.3538      | 2.547091 | 0.0014  |
| osa-miR397n| 0.3538      | 2.547091 | 0.0014  |
| osa-miR397o| 5.7786      | -1.96805 | 0.0005  |
| osa-miR397p| 2.9483      | -1.73418 | 0.0287  |
| osa-miR397q| 7.5476      | -1.86792 | 0.0001  |
| osa-miR397r| 3.3021      | -1.48264 | 0.0362  |

**Young panicles**

| miRNA       | Fold Change | p-value  | q-value | Log2 Fold Change |
|------------|-------------|----------|---------|-----------------|
| osa-miR160f-5p| 9.3769      | -1.95822 | 0.0000  |
| osa-miR167a-3p| 2.105      | 1.197067 | 0.0241  |
| osa-miR171c-5p| 4.4014     | 1.020439 | 0.0068  |
| osa-miR171d-5p| 5.9323     | 1.080805 | 0.0008  |
| osa-miR1850.1| 3.2532      | 1.334556 | 0.0013  |
| osa-miR1880  | 1.3396      | 1.775088 | 0.0033  |
| osa-miR2106  | 1.7223      | 1.971982 | 0.0001  |
| osa-miR2863c| 2.6791      | -2.47285 | 0.0098  |
| osa-miR2871a-3p| 7.6546     | -1.28694 | 0.0035  |
| osa-miR2871a-5p| 24.4947  | -1.53616 | 0.0000  |
| osa-miR2871b| 7.6546      | -1.28694 | 0.0035  |
| osa-miR2876-3p| 2.2964     | -7.84323 | 0.0010  |
| osa-miR2878-5p| 4.21       | -1.80299 | 0.0065  |
| osa-miR396c-3p| 2.4877     | 1.093573 | 0.0277  |
| osa-miR408-5p| 0.01        | 6.914684 | 0.0150  |
| osa-miR444d.3| 1.7223      | -2.83544 | 0.0316  |
| miRNA     | Log2 Fold Change | p-value  | LogFC    | p-value  |
|----------|-----------------|----------|----------|----------|
| osa-miR528-5p | 5.3582         | 13.5133  | 1.33456  | 0.0000   |
| osa-miR529a   | 20.4761         | 81.3212  | 1.989691 | 0.0000   |
| osa-miR531a   | 1.1482          | 4.1023   | 1.837059 | 0.0044   |
| osa-miR531b   | 1.1482          | 4.1023   | 1.837059 | 0.0044   |
| osa-miR531c   | 1.1482          | 4.1023   | 1.837059 | 0.0044   |
| osa-miR5486   | 0.3827          | 2.1718   | 2.504605 | 0.0136   |
| osa-miR5488   | 1.7223          | 0.2413   | -2.83544 | 0.0316   |
| osa-miR5499   | 1.9136          | 0.2413   | -2.98739 | 0.0190   |
| osa-miR5505   | 1.1482          | 4.1023   | 1.837059 | 0.0044   |
| osa-miR5513   | 1.1482          | 0.01     | -6.84323 | 0.0336   |
| osa-miR5518   | 1.3396          | 0.01     | -7.06566 | 0.0187   |
| osa-miR5519   | 0.7655          | 3.8609   | 2.334463 | 0.0013   |
| osa-miR5834   | 2.105           | 0.4826   | -2.12492 | 0.0391   |
| osa-miR5836   | 8.8028          | 4.1023   | -1.10153 | 0.0055   |
| osa-miR815b   | 0.01            | 1.2065   | 6.914684 | 0.0150   |

**Flag leaves**

| miRNA     | Log2 Fold Change | p-value  | LogFC    | p-value  |
|----------|-----------------|----------|----------|----------|
| osa-miR1425-5p | 1425.057      | 623.3257 | -1.19296 | 0.0000   |
| osa-miR1432-5p | 83.4897       | 195.42   | 1.226908 | 3.85E-54 |
| osa-miR159c   | 2.1016         | 4.6575   | 1.148068 | 0.0256   |
| osa-miR159d   | 2.1016         | 4.6575   | 1.148068 | 0.0256   |
| osa-miR159e   | 2.1016         | 4.6575   | 1.148068 | 0.0256   |
| osa-miR160e-5p| 2.2926         | 4.6575   | 1.022571 | 0.0420   |
| osa-miR164d   | 0.5732         | 2.9109   | 2.344355 | 0.0040   |
| osa-miR166a-3p| 7549.801       | 25341.14 | 1.746971 | 0.0000   |
| osa-miR166b-3p| 7541.585       | 25320.18 | 1.747348 | 0.0000   |
| osa-miR166c-3p| 13836.37       | 32595.74 | 1.236219 | 0.0000   |
| osa-miR166d-3p| 7549.992       | 25341.53 | 1.746957 | 0.0000   |
| osa-miR166e-3p| 1.1463         | 3.105    | 1.437609 | 0.0316   |
| osa-miR166f   | 7548.081       | 25333.96 | 1.746891 | 0.0000   |
| osa-miR166g-3p| 1694.249       | 6291.864 | 1.892842 | 0.0000   |
| osa-miR166h-3p| 341.0278       | 891.3247 | 1.386062 | 0.0000   |
| osa-miR166i-3p| 36.682         | 84.4168  | 1.202458 | 0.0000   |
| osa-miR166j-3p| 13818.22       | 32552.27 | 1.236187 | 0.0000   |
| osa-miR166k-3p| 118.0701       | 245.6819 | 1.057148 | 0.0000   |
| osa-miR166l-3p| 132.208        | 298.6607 | 1.175698 | 0.0000   |
| osa-miR166m   | 98.7739        | 282.1655 | 1.51434  | 0.0000   |
| osa-miR167a-3p| 3.63           | 0.9703   | -1.90347 | 0.0046   |
| osa-miR168a-3p| 2994.931       | 6580.822 | 1.135745 | 0.0000   |
| osa-miR1846d-3p| 1.7195         | 4.4634   | 1.376154 | 0.0119   |
| osa-miR1846d-5p| 0.5732         | 2.1347   | 1.896923 | 0.0326   |
| osa-miR1865-3p| 2.8658         | 0.5822   | -2.29935 | 0.0049   |
| osa-miR2871a-5p| 58.653         | 29.3033  | -1.00114 | 0.0000   |
| osa-miR2878-5p| 3.2479         | 0.5822   | -2.47992 | 0.0017   |
| osa-miR2880   | 1.1463         | 3.8812   | 1.759518 | 0.0052   |
| Gene       | Value1 | Value2   | Value3 | Value4 |
|------------|--------|----------|--------|--------|
| osa-miR397a | 148.4474 | 782.2622 | 2.3977 | 0.0000 |
| osa-miR397b | 1499.185 | 8553.069 | 2.512264 | 0.0000 |
| osa-miR398a | 3.63 | 0.3881 | -3.22547 | 0.0001 |
| osa-miR398b | 134.8827 | 1467.3 | 3.443386 | 0.0000 |
| osa-miR408-3p | 265.1801 | 2552.298 | 3.266752 | 0.0000 |
| osa-miR408-5p | 4.2031 | 26.7805 | 2.671657 | 0.0000 |
| osa-miR5083 | 0.1911 | 1.3584 | 2.829509 | 0.00369 |
| osa-miR528-3p | 61.7098 | 291.0923 | 2.237905 | 0.0000 |
| osa-miR528-5p | 52.1572 | 218.5133 | 2.066783 | 0.0000 |
| osa-miR535-5p | 15.4752 | 33.5727 | 1.117331 | 0.0000 |
| osa-miR7694-5p | 1.3374 | 0.1941 | -2.78456 | 0.0413 |
### Supplementary Table S3

A set of 150 sequencing screened yield related miRNAs from literatures.

| ID | miRNA    | Target                                                                 |
|----|----------|------------------------------------------------------------------------|
| 1  | osa-miR1320-3p | LOC_Os03g13800; LOC_Os05g38590; LOC_Os08g19610; LOC_Os05g31230;       |
|    |          | LOC_Os11g02464; LOC_Os12g02390; LOC_Os06g16919; LOC_Os06g03600;       |
|    |          | LOC_Os01g48250; LOC_Os06g09170; LOC_Os03g37920                      |
| 2  | osa-miR1432-3p | LOC_Os10g30540; LOC_Os04g08350; LOC_Os06g40940                     |
| 3  | osa-miR1435   | LOC_Os03g42280; LOC_Os04g44354; LOC_Os04g42444; LOC_Os08g29260;      |
|    |          | LOC_Os07g13020; LOC_Os04g41238; LOC_Os05g22910; LOC_Os04g50204;      |
|    |          | LOC_Os09g07200; LOC_Os06g43910; LOC_Os12g16060; LOC_Os03g48320;      |
|    |          | LOC_Os07g36080                                                        |
| 4  | osa-miR156a  | LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310;      |
|    |          | LOC_Os02g07780; LOC_Os08g41940; LOC_Os07g32170; LOC_Os02g04680;      |
|    |          | LOC_Os09g03670; LOC_Os09g33820                                        |
| 5  | osa-miR156b-3p | LOC_Os03g26650                                                   |
| 6  | osa-miR156b-5p | LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310;      |
|    |          | LOC_Os02g07780; LOC_Os08g41940; LOC_Os08g39890; LOC_Os01g69830;      |
|    |          | LOC_Os07g32170; LOC_Os02g04680; LOC_Os09g03670; LOC_Os09g33820       |
| 7  | osa-miR156c-3p | LOC_Os07g04390; LOC_Os07g15370                                    |
|    |          | LOC_Os08g04180; LOC_Os02g04490; LOC_Os04g37670                      |
| 8  | osa-miR156c-5p | LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310;      |
|    |          | LOC_Os02g07780; LOC_Os08g41940; LOC_Os08g39890; LOC_Os01g69830;      |
|    |          | LOC_Os07g32170; LOC_Os02g04680; LOC_Os02g04680; LOC_Os09g03670       |
| 9  | osa-miR156d  | LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310;      |
|    |          | LOC_Os02g07780; LOC_Os08g41940; LOC_Os08g39890; LOC_Os01g69830;      |
|    |          | LOC_Os07g32170; LOC_Os02g04680; LOC_Os09g03670; LOC_Os09g33820       |
| 10 | osa-miR156f-3p | LOC_Os07g37580; LOC_Os07g13140; LOC_Os01g03170; LOC_Os09g36670       |
|    |          | LOC_Os07g04390; LOC_Os05g25210; LOC_Os07g49270                      |
| 11 | osa-miR156f-5p | LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310;      |
|    |          | LOC_Os02g07780; LOC_Os08g41940; LOC_Os08g39890; LOC_Os01g69830;      |
|    |          | LOC_Os07g32170; LOC_Os02g04680; LOC_Os09g03670; LOC_Os09g33820       |
| 12 | osa-miR156g-3p | LOC_Os07g04390; LOC_Os07g15370                                    |
|    |          | LOC_Os08g04180; LOC_Os02g04490; LOC_Os04g37670                      |
| 13 | osa-miR156g-5p | LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310;      |
|    |          | LOC_Os02g07780; LOC_Os08g41940; LOC_Os08g39890; LOC_Os01g69830;      |
|    |          | LOC_Os07g32170; LOC_Os02g04680; LOC_Os09g03670; LOC_Os09g33820       |
| 14 | osa-miR156h-3p | LOC_Os07g04390; LOC_Os07g15370                                    |
|    |          | LOC_Os07g37580; LOC_Os05g25210; LOC_Os07g49270                      |
| 15 | osa-miR156h-5p | LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310;      |
|    |          | LOC_Os02g07780; LOC_Os08g41940; LOC_Os08g39890; LOC_Os01g69830;      |
|    |          | LOC_Os02g07780; LOC_Os07g32170; LOC_Os02g04680; LOC_Os09g03670       |
16 osa-miR156i LOC_Os09g33820; LOC_Os11g30370; LOC_Os02g07780; LOC_Os02g07780; LOC_Os09g33820
LOC_Os10g30940; LOC_Os04g34890; LOC_Os09g31438; LOC_Os06g45310; LOC_Os08g43980; LOC_Os01g69830; LOC_Os08g41940; LOC_Os07g32170; LOC_Os02g04680; LOC_Os09g03670;
17 osa-miR156j-3p LOC_Os05g13940; LOC_Os04g34890
18 osa-miR156j-5p LOC_Os11g30370; LOC_Os09g32944; LOC_Os09g31438; LOC_Os06g45310; LOC_Os02g07780; LOC_Os08g41940; LOC_Os08g39890; LOC_Os01g69830; LOC_Os08g41940; LOC_Os07g32170; LOC_Os02g04680; LOC_Os09g03670; LOC_Os09g33820
19 osa-miR159a.1 LOC_Os01g12700; LOC_Os05g41166; LOC_Os09g36650; LOC_Os06g40330; LOC_Os03g47949; LOC_Os05g42240; LOC_Os01g11430; LOC_Os03g21380; LOC_Os05g04630; LOC_Os01g59660; LOC_Os01g11430; LOC_Os03g47949;
20 osa-miR159a.2 LOC_Os03g02240; LOC_Os10g40920; LOC_Os03g28310; LOC_Os08g10800; LOC_Os02g05720; LOC_Os12g24550
21 osa-miR160a-3p LOC_Os02g56000; LOC_Os02g49240; LOC_Os08g43570; LOC_Os11g38140; LOC_Os07g37130
22 osa-miR160a-5p LOC_Os10g33940; LOC_Os04g43910; LOC_Os09g29160; LOC_Os04g59430; LOC_Os02g44760
23 osa-miR160b-3p LOC_Os02g56000; LOC_Os02g49240; LOC_Os08g43570; LOC_Os11g38140; LOC_Os07g37130
24 osa-miR160b-5p LOC_Os10g33940; LOC_Os04g43910; LOC_Os09g29160; LOC_Os04g59430; LOC_Os02g44760
25 osa-miR160c-5p LOC_Os10g33940; LOC_Os04g43910; LOC_Os09g29160; LOC_Os04g59430; LOC_Os02g44760
26 osa-miR160d-3p LOC_Os05g18840; LOC_Os10g29020
27 osa-miR160d-5p LOC_Os10g33940; LOC_Os04g43910; LOC_Os09g29160; LOC_Os04g59430; LOC_Os02g44760
28 osa-miR160e-3p LOC_Os06g37480; LOC_Os09g39430
29 osa-miR160e-5p LOC_Os10g33940; LOC_Os04g43910; LOC_Os09g29160; LOC_Os04g59430; LOC_Os02g44760
30 osa-miR160f-3p LOC_Os03g01890; LOC_Os10g33960; LOC_Os12g41860; LOC_Os03g35380; LOC_Os03g01890; LOC_Os10g29020; LOC_Os03g44835; LOC_Os01g33740; LOC_Os03g01890; LOC_Os10g33960; LOC_Os03g35380; LOC_Os07g08900; LOC_Os08g34740
31 osa-miR160f-5p LOC_Os04g59430; LOC_Os10g33940; LOC_Os04g43910; LOC_Os09g29160; LOC_Os09g29160; LOC_Os09g29160; LOC_Os02g49930; LOC_Os09g29160; LOC_Os02g49930; LOC_Os09g29160; LOC_Os02g49930; LOC_Os02g49930
32 osa-miR164e LOC_Os03g47310; LOC_Os06g23650; LOC_Os06g46270; LOC_Os12g41680; LOC_Os07g12620; LOC_Os06g05760; LOC_Os09g32960; LOC_Os10g24200; LOC_Os03g01890; LOC_Os03g44835; LOC_Os04g23200; LOC_Os01g33740; LOC_Os03g01890; LOC_Os03g44835; LOC_Os04g23200; LOC_Os01g33740; LOC_Os03g35380; LOC_Os07g08900; LOC_Os08g34740
33 osa-miR166a-3p LOC_Os10g33960; LOC_Os12g41860; LOC_Os03g43930; LOC_Os03g01890; LOC_Os03g44835; LOC_Os04g23200; LOC_Os01g33740; LOC_Os03g35380; LOC_Os07g08900; LOC_Os08g34740
34 osa-miR166a-5p LOC_Os09g08440; LOC_Os12g24410; LOC_Os09g25520; LOC_Os06g36960; LOC_Os12g24410; LOC_Os09g25520; LOC_Os06g36960; LOC_Os12g24410; LOC_Os09g25520; LOC_Os06g36960;
54 osa-miR169h LOC_Os02g53620; LOC_Os03g48970; LOC_Os12g42400; LOC_Os05g07880; LOC_Os03g07880; LOC_Os07g41720; LOC_Os03g29760; LOC_Os06g13920
55 osa-miR169i-3p LOC_Os07g16360; LOC_Os11g38610; LOC_Os02g51260
56 osa-miR169i-5p.1 LOC_Os02g53620; LOC_Os03g48970; LOC_Os12g42400; LOC_Os05g07880; LOC_Os03g07880; LOC_Os07g41720; LOC_Os03g29760; LOC_Os06g13920
57 osa-miR169i-5p.2 LOC_Os11g34110; LOC_Os02g03220; LOC_Os02g57370; LOC_Os05g40720
58 osa-miR169j LOC_Os02g53620; LOC_Os03g48970; LOC_Os12g42400; LOC_Os05g07880; LOC_Os03g07880; LOC_Os07g41720; LOC_Os03g29760; LOC_Os06g13920
59 osa-miR169k LOC_Os02g53620; LOC_Os03g48970; LOC_Os12g42400; LOC_Os05g07880; LOC_Os03g07880; LOC_Os07g41720; LOC_Os03g29760; LOC_Os06g13920
60 osa-miR169l LOC_Os02g53620; LOC_Os03g48970; LOC_Os12g42400; LOC_Os05g07880; LOC_Os03g07880; LOC_Os07g41720; LOC_Os03g29760; LOC_Os06g13920
61 osa-miR169m LOC_Os02g53620; LOC_Os03g48970; LOC_Os12g42400; LOC_Os05g07880; LOC_Os03g07880; LOC_Os07g41720; LOC_Os03g29760; LOC_Os06g13920
62 osa-miR171a LOC_Os02g44360; LOC_Os06g01620; LOC_Os02g19990
63 osa-miR171b LOC_Os06g01620; LOC_Os02g44360; LOC_Os09g38330; LOC_Os05g34460; LOC_Os06g02304
64 osa-miR171i-3p LOC_Os02g44360; LOC_Os06g01620; LOC_Os12g18080; LOC_Os01g60000; LOC_Os11g27440; LOC_Os02g19990
65 osa-miR171i-5p LOC_Os10g27480; LOC_Os03g06890; LOC_Os07g06770
66 osa-miR172a LOC_Os05g03040; LOC_Os07g13170; LOC_Os05g03040; LOC_Os04g55560; LOC_Os02g56320; LOC_Os03g57070; LOC_Os12g37780; LOC_Os04g58720; LOC_Os01g52120; LOC_Os02g55290; LOC_Os03g47650; LOC_Os12g09570; LOC_Os10g36250; LOC_Os10g41030
67 osa-miR172b LOC_Os05g03040; LOC_Os07g13170; LOC_Os05g03040; LOC_Os04g55560; LOC_Os01g39810; LOC_Os05g45980; LOC_Os04g36054; LOC_Os05g07070; LOC_Os05g07070; LOC_Os05g26926; LOC_Os05g26902; LOC_Os03g44420; LOC_Os02g56320; LOC_Os12g07800; LOC_Os11g40120; LOC_Os04g54190; LOC_Os10g31240
68 osa-miR172c LOC_Os05g03040; LOC_Os07g13170; LOC_Os05g03040; LOC_Os05g03040; LOC_Os05g03040; LOC_Os04g55560; LOC_Os04g39630; LOC_Os08g26870; LOC_Os11g23110; LOC_Os04g02230; LOC_Os04g28750; LOC_Os06g49700; LOC_Os01g67970
69 osa-miR172d-3p LOC_Os05g03040; LOC_Os07g13170; LOC_Os05g03040; LOC_Os04g55560; LOC_Os02g56320; LOC_Os03g57070; LOC_Os03g13370; LOC_Os05g23720; LOC_Os12g37780; LOC_Os04g58720; LOC_Os01g52120; LOC_Os02g55290; LOC_Os03g47650; LOC_Os12g09570; LOC_Os10g36250; LOC_Os10g41030
70 osa-miR172d-5p LOC_Os01g39810; LOC_Os07g04860; LOC_Os06g06050; LOC_Os03g51030; LOC_Os03g19590; LOC_Os05g03174; LOC_Os03g06410; LOC_Os05g32430; LOC_Os01g59180; LOC_Os05g32430
71 osa-miR1850.1 LOC_Os10g36650; LOC_Os03g46440; LOC_Os09g24820; LOC_Os04g33510;
| Gene ID          | LOC_Os04g47410 | LOC_Os03g01216 | LOC_Os03g63260 | LOC_Os08g06478 | LOC_Os02g48140 | LOC_Os08g04650 | LOC_Os04g02070 | LOC_Os02g05244 | LOC_Os06g49250 | LOC_Os10g35810 |
|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| osa-miR1850.2   | LOC_Os07g07530 | LOC_Os04g39160 | LOC_Os07g03100 | LOC_Os03g25110 | LOC_Os01g17470 |
| osa-miR1850.3   | LOC_Os12g06610 | LOC_Os03g39690 | LOC_Os08g43580 |
| osa-miR1861b    | LOC_Os01g63810 | LOC_Os05g51790 |
| osa-miR1861e    | LOC_Os06g44970 | LOC_Os03g18710 |
| osa-miR1861f    | LOC_Os05g51790 |
| osa-miR1861g    | LOC_Os08g32060 |
| osa-miR1861i    | LOC_Os01g63810 | LOC_Os01g63810 | LOC_Os05g51790 |
| osa-miR1861k    | LOC_Os06g44970 | LOC_Os03g18710 |
| osa-miR1861l    | LOC_Os05g51790 |
| osa-miR1861m    | LOC_Os01g63810 | LOC_Os06g44970 | LOC_Os03g18710 |
| osa-miR1862d    | LOC_Os02g30730 | LOC_Os02g39070 | LOC_Os03g22800 |
| osa-miR1862e    | LOC_Os06g41930 | LOC_Os01g09330 |
| osa-miR1874-3p  | LOC_Os02g0950  |
| osa-miR1874-5p  | LOC_Os05g18774 | LOC_Os01g09330 | LOC_Os08g28410 |
| osa-miR1881     | LOC_Os01g63810 | LOC_Os06g10130 | LOC_Os11g47030 |
| osa-miR2055     | LOC_Os01g53900 | LOC_Os01g53900 | LOC_Os07g23340 |
| osa-miR2863b    | LOC_Os09g17560 | LOC_Os04g58580 | LOC_Os01g15000 |
| osa-miR2871b    | LOC_Os04g53830 |
| osa-miR2875b    | LOC_Os03g51040 | LOC_Os04g29990 | LOC_Os11g36140 |
| osa-miR390-5p   | LOC_Os03g36080 | LOC_Os03g01216 | LOC_Os04g16020 |
| osa-miR393a     | LOC_Os03g36080 | LOC_Os03g01216 | LOC_Os04g16020 |
| osa-miR396a-3p  | LOC_Os03g41010 |
| osa-miR396a-5p  | LOC_Os03g41010 |
| osa-miR396b-3p  | LOC_Os08g06478 | LOC_Os02g05244 | LOC_Os04g28060 |
| osa-miR396b-5p  | LOC_Os07g03100 | LOC_Os03g25110 | LOC_Os04g16020 |
| ID   | Name            | LOC_Os02g27674 | LOC_Os02g27674 | LOC_Os11g05394 | LOC_Os11g05394 |
|------|-----------------|----------------|----------------|----------------|----------------|
| 127  | osa-miR2864.1   | LOC_Os09g07154 | LOC_Os03g64290 | LOC_Os11g06540 | LOC_Os04g23760 |
|      |                 | LOC_Os03g11734 | LOC_Os04g23720 | LOC_Os04g06290 | LOC_Os10g33484 |
|      |                 | LOC_Os02g50040 | LOC_Os01g37310 | LOC_Os03g55040 | LOC_Os07g03040 |
|      |                 | LOC_Os07g03040 | LOC_Os05g48790 | LOC_Os05g48790 | LOC_Os05g48790 |
|      |                 | LOC_Os02g05930 | LOC_Os05g48790 | LOC_Os03g55130 | LOC_Os08g06130 |
|      |                 | LOC_Os05g31920 | LOC_Os05g31920 | LOC_Os04g32620 | LOC_Os04g39260 |
|      |                 | LOC_Os12g36440 | LOC_Os04g39260 | LOC_Os04g39260 | LOC_Os07g41600 |
|      |                 | LOC_Os02g47150 | LOC_Os06g51250 | LOC_Os06g10230 | LOC_Os04g47320 |
|      |                 | LOC_Os02g46990 | LOC_Os01g70330 | LOC_Os11g41880 | LOC_Os10g17790 |
| 128  | osa-miR2864.2   | LOC_Os02g16270 | LOC_Os02g16270 | LOC_Os01g55880 | LOC_Os01g15540 |
|      |                 | LOC_Os02g36770 | LOC_Os01g21820 | LOC_Os05g25974 | LOC_Os05g25974 |
|      |                 | LOC_Os01g56900 | LOC_Os06g10290 | LOC_Os09g34847 | LOC_Os04g34360 |
|      |                 | LOC_Os09g34847 | LOC_Os04g34410 | LOC_Os02g54720 | LOC_Os04g36830 |
|      |                 | LOC_Os03g64030 | LOC_Os12g10340 | LOC_Os06g36090 |                |
| 129  | osa-miR2880     | LOC_Os08g37360 | LOC_Os03g40920 | LOC_Os01g63830 | LOC_Os04g58390 |
| 130  | osa-miR2907a    | LOC_Os05g18660 | LOC_Os03g49990 |                |                |
| 131  | osa-miR2923     | LOC_Os01g72290 | LOC_Os03g57460 | LOC_Os01g13350 | LOC_Os01g13350 |
|      |                 | LOC_Os01g48210 | LOC_Os02g16490 | LOC_Os04g49000 | LOC_Os11g45190 |
|      |                 | LOC_Os01g70790 | LOC_Os11g45130 | LOC_Os01g64780 | LOC_Os04g42480 |
|      |                 | LOC_Os04g54970 | LOC_Os06g46670 | LOC_Os07g48630 | LOC_Os05g35010 |
| 132  | osa-miR2926     | LOC_Os01g13350 | LOC_Os01g13350 | LOC_Os04g52640 | LOC_Os07g01340 |
|      |                 | LOC_Os01g16460 | LOC_Os04g01570 | LOC_Os12g41490 | LOC_Os05g03640 |
|      |                 | LOC_Os04g56580 | LOC_Os08g07740 | LOC_Os10g38170 | LOC_Os04g41560 |
|      |                 | LOC_Os11g18660 | LOC_Os10g42490 | LOC_Os10g42490 | LOC_Os07g41580 |
|      |                 | LOC_Os08g20570 | LOC_Os08g20570 |                |                |
| 133  | osa-miR2930     | LOC_Os06g14780 | LOC_Os07g17070 | LOC_Os02g48150 | LOC_Os03g58700 |
|      |                 | LOC_Os11g35720 | LOC_Os02g21770 | LOC_Os03g54220 | LOC_Os04g30430 |
|      |                 | LOC_Os02g49970 | LOC_Os03g19820 |                |                |
| 134  | osa-miR395m     | LOC_Os03g09940 | LOC_Os03g53230 | LOC_Os03g09930 | LOC_Os06g46480 |
|      |                 | LOC_Os11g44580 | LOC_Os10g42439 | LOC_Os05g29800 |                |
| 135  | osa-miR395n     | LOC_Os03g09940 | LOC_Os03g53230 | LOC_Os03g09930 | LOC_Os06g46480 |
|      |                 | LOC_Os11g44580 | LOC_Os10g42439 | LOC_Os05g29800 |                |
| 136  | osa-miR395o     | LOC_Os03g53230 | LOC_Os03g09940 | LOC_Os03g07200 | LOC_Os06g46480 |
|      |                 | LOC_Os03g09930 | LOC_Os05g49890 | LOC_Os02g01740 | LOC_Os03g21250 |
|      |                 | LOC_Os07g38300 |                |                |                |
| 137  | osa-miR395p     | LOC_Os03g09940 | LOC_Os03g53230 | LOC_Os03g09930 | LOC_Os06g46480 |
|      |                 | LOC_Os11g44580 | LOC_Os10g42439 | LOC_Os05g29800 |                |
| 138  | osa-miR395q     | LOC_Os03g09940 | LOC_Os03g53230 | LOC_Os03g09930 | LOC_Os03g19750 |
|      |                 | LOC_Os06g46480 | LOC_Os11g44580 | LOC_Os10g42439 | LOC_Os05g29800 |
| 139  | osa-miR395r     | LOC_Os03g09940 | LOC_Os03g53230 | LOC_Os03g09930 | LOC_Os06g46480 |
|      |                 | LOC_Os11g44580 | LOC_Os10g42439 | LOC_Os05g29800 |                |
| 140  | osa-miR395s     | LOC_Os03g09940 | LOC_Os03g53230 | LOC_Os03g09930 | LOC_Os06g46480 |
|      |                 | LOC_Os11g44580 | LOC_Os10g42439 | LOC_Os05g29800 |                |
| 141 | osa-miR398a | LOC_Os07g46990; LOC_Os01g68770; LOC_Os11g27220 |
| 142 | osa-miR415 | LOC_Os12g42280; LOC_Os05g02520; LOC_Os02g18320; LOC_Os03g02514; LOC_Os03g61990; LOC_Os02g26810; LOC_Os03g61990; LOC_Os03g10290; LOC_Os04g38630; LOC_Os02g01560; LOC_Os02g56540; LOC_Os01g72490; LOC_Os06g51240; LOC_Os07g12810; LOC_Os10g35690; LOC_Os12g40890; LOC_Os12g40560; LOC_Os05g37330 |
| 143 | osa-miR439a | LOC_Os12g11340 |
| 144 | osa-miR439c | LOC_Os12g11340 |
| 145 | osa-miR439e | LOC_Os12g11340 |
| 146 | osa-miR810b.1 | LOC_Os01g65986; LOC_Os02g03930 |
| 147 | osa-miR818a | LOC_Os07g40450; LOC_Os06g11500; LOC_Os03g63370; LOC_Os11g47160; LOC_Os06g05530; LOC_Os01g12820; LOC_Os03g49126; LOC_Os08g29760; LOC_Os01g18850; LOC_Os06g38210; LOC_Os01g51890; LOC_Os02g43560; LOC_Os09g37020; LOC_Os06g48060; LOC_Os03g47960; LOC_Os06g4690; LOC_Os09g07320; LOC_Os06g17950; LOC_Os01g72370; LOC_Os01g57630; LOC_Os07g48370; LOC_Os03g53600; LOC_Os05g39540; LOC_Os01g01720; LOC_Os11g12060; LOC_Os06g45890; LOC_Os03g25945 |
| 148 | osa-miR820b | LOC_Os03g02010; LOC_Os01g13650; LOC_Os11g03310; LOC_Os05g00996; LOC_Os10g42196 |
| 149 | osa-miR821a | LOC_Os12g16350; LOC_Os02g38340; LOC_Os12g14840; LOC_Os10g27274; LOC_Os02g32110; LOC_Os05g34750; LOC_Os06g48510; LOC_Os04g40860 |
| 150 | osa-miR821b | LOC_Os12g16350; LOC_Os02g38340; LOC_Os12g14840; LOC_Os10g27274; LOC_Os02g32110; LOC_Os05g34750; LOC_Os06g48510; LOC_Os04g40860 |

**Note:** The underline one was confirmed by degradome sequencing (Zhou et al., 2010; Li et al., 2010), while the bold one was validated by both degradome sequencing and experiment.

Zhou, M., Gu, L.F., Li, P.C., Song, X.W., Wei, L.Y., Chen, Z.Y. (2010). Degradome sequencing reveals endogenous small RNA targets in rice (Oryza sativa L. ssp. indica). Front. Biol. 5(1): 67-90.

Li, Y.F., Zheng, Y., Quaye, C.A., Zhang, L., Saini, A., Jagadeeswaran, G., Axtell, M.J., Zhang, W.X., Sunkar, R. (2010). Transcriptome wide identification of microRNA targets in rice. Plant J. 62, 742-759.
### Supplementary Table S4 Details of reported miRNAs and their targets that is crucial for yield in rice.

| miRNA     | targets                  | Annotation | Strategy          | effect                                | Reference                |
|-----------|--------------------------|------------|-------------------|---------------------------------------|--------------------------|
| osa-miR156| LOC_Os08g39890           | OsSPL14    | Point mutation in OsSPL14 | Reduce tiller, increase panicle branches | Jiao et al., 2010         |
| osa-miR393a| LOC_Os05g05800           | OsTIR1     | Overexpression of miR393 | Promote tillering                      | Miura et al., 2010       |
|           | LOC_Os04g32460           | OsAFB2     |                   | Promote tillering                      | Xie et al., 2012         |
| osa-miR397| LOC_Os05g38420           | Laccase    | Overexpression of miR397 | Promote panicle branches, increase grain size | Zhang et al., 2013       |
| osa-miR396b| LOC_Os03g51970          | GRF4/6     | Overexpression and MIM396 | Modulate auxiliary branches, grain size | Gao et al., 2015         |
| osa-miR172| LOC_Os05g03040           | OsTIR1     | Overexpression     | Panicle                               | Wang et al., 2015        |
|           | LOC_Os07g13170           | OsAFB2     | and MIM172         | Panicle                               | Wang et al., 2015        |
| osa-miR444a| LOC_Os02g49840          | OsMADS57   | Overexpression of miR444a | Suppressed tillering                | Guo et al., 2013         |
| osa-miR159a| LOC_Os01g59660          | MYB        |                   | Panicle                               | Peng et al., 2014        |
| osa-miR164e| LOC_Os03g47310          | NAC        |                   | Grain filling                         | Peng et al., 2014        |
| osa-miR186l| LOC_Os01g63810          |            |                   | Grain filling                         | Peng et al., 2014        |
| osa-miR160a| LOC_Os06g47150          |            | Northern blot      | Grain filling                         | Lan et al., 2012         |
| osa-miR167a| LOC_Os04g57610          | ARF        |                   | Flag leaf                             | Xu et al., 2014          |
| osa-miR171a| LOC_Os04g46860          |            | Northern blot      | Grain filling                         | Lan et al., 2012         |

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**Supplementary Table S5**  Primers for qRT-PCR used in this study.

| Gene      | Sequences (5’-3’)                                                                 |
|-----------|-----------------------------------------------------------------------------------|
| miR393a-F | GTCGCTCCAAAGGGATCGC                                                                |
| miR393a-RT| GTCGTATCCAGTGCGGGGTCCAGGTATTCCGACTGGATACGACGATCAA                                 |
| miR171a-F | GCTCTCTGATTGAGCCGCG                                                                |
| miR171a-RT| GTCGTATCCAGTGCGGGGTCCAGGTATTCCGACTGGATACGACGATATT                                 |
| Universal-R| GTGCCAGGGGTCCAGGGT                                                             |
| U6-F      | CAACGGATATCTCGGCTCT                                                              |
| U6-R      | CAACCTTGCGTTCAAAAGACTC                                                           |