

**GROWTH PERFORMANCE OF RICE UNDER
DIFFERENT WATER AND NITROGEN
MANAGEMENT**

SARIAM HJ OTHMAN

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**GROWTH PERFORMANCE OF RICE UNDER DIFFERENT
WATER AND NITROGEN MANAGEMENT**

By

SARIAM HJ OTHMAN

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Anis Syahirah, Aimi Najwa and Hani Nadirah*

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**GROWTH PERFORMANCE OF RICE UNDER DIFFERENT WATER
AND NITROGEN MANAGEMENT**

By

SARIAM HJ OTHMAN

September 2004

Chairman : Professor Mohd Khanif Yusop, Ph.D.

Faculty : Agriculture

The present global water crisis threatens the sustainability of irrigated rice production as the demand for available water from urban and industrial sectors is likely to receive priority over irrigation for agriculture. It may necessitate the adoption of rice production practice that reduces water input without impairing yield. Besides water, nitrogen (N) is also an important factor, which often interacts with water and influence rice growth. The study was undertaken in a series of five greenhouse experiments, to determine the effects of water management on rice growth and N uptake efficiency and to evaluate N fertilizer management on growth, yield and N use efficiency of rice grown under different water management. The three water management treatments studied were flooded, non flooded (NF)-saturated and NF-field capacity, whereas the N management practices evaluated were N rate, source, split and placement.

Experimental results showed that rice growth, grain yield, dry root biomass, total root length, root length density, plant N uptake and N fertilizer recovery were not significantly different between flooded and NF-saturated conditions, but were significantly lower under NF-field capacity condition. Grain yield was 57.6 and 54.4% lower under NF-field capacity than flooded and NF-saturated conditions, respectively. A higher grain yield and plant N uptake response to N application rate was observed under flooded and NF-saturated than NF-field capacity condition. The estimated N rate for maximum grain yield was 99, 105 and 126 kg ha⁻¹ for flooded, NF-saturated and NF-field capacity conditions, respectively. Nitrogen use efficiency decreased with the increasing N rate, and was significantly lower under NF-field capacity.

Results also indicated that urea alone was the most suitable N source for flooded rice. However, for NF-saturated condition, the use of polymer coated urea (PCU) or combined application of urea and compound fertilizer was more superior for grain yield and plant N uptake than urea alone. The 40/30/30 split applied during early tillering, active tillering and panicle initiation stages ensured adequate tillers and panicles which led to increased grain yield, plant N uptake and N use efficiency of flooded rice. All the three splits N treatments performed equally good and significantly better than the two splits, under NF-saturated condition. Grain yield and plant N uptake was low and not significantly affected by N split under NF-field capacity condition. The different methods of N placement

tested did not significantly affect grain yield, plant N uptake and N use efficiency under all water management treatments . These findings suggest that rice can be grown under continuous NF-saturated condition without significantly affecting yield. However, adjustment in the N management practices especially the rate, source and split is necessary to improve N use efficiency and yield of rice grown under NF-saturated condition.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**PERTUMBUHAN PADI DENGAN PENGURUSAN AIR DAN
NITROGEN YANG BERBEZA**

Oleh

SARIAM HJ. OTHMAN

September 2004

Pengerusi : Profesor Mohd Khanif Yusop, Ph.D.

Fakulti : Pertanian

Krisis air yang meluas pada masa kini mengancam pengeluaran padi yang mampan kerana permintaan air dari sektor bandar dan perindustrian dijangka diberi keutamaan berbanding pengairan untuk pertanian. Selain air, nitrogen (N) juga adalah faktor penting yang saling bertindak dengan air dan mempengaruhi pertumbuhan padi. Kajian telah dijalankan dalam lima siri percubaan dirumah tanaman, bertujuan untuk menentukan kesan pengurusan air terhadap pertumbuhan padi dan kecekapan pengambilan N dan untuk menilai pengurusan pembajaan N terhadap pertumbuhan, hasil dan kecekapan penggunaan N oleh tanaman padi dengan pengurusan air yang berbeza. Tiga perlakuan pengurusan air yang dikaji adalah pемbanjiran, tanpa pемbanjiran (TB)-tepu dan TB-keupayaan ladang, sementara amalan N yang dinilai pula ialah kadar, sumber, pembahagian dan kaedah penempatan N.

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Hasil kajian mendapati tiada perbezaan ketara pada pertumbuhan, hasil, biojisim kering akar, jumlah panjang akar, ketumpatan panjang akar,

pengambilan N, dan perolehan baja N oleh pokok padi diantara pembanjiran dan TB-tepu, tetapi pengurangan ketara pada TB-keupayaan ladang. Hasil padi berkurangan sebanyak 57.6 dan 54.4% pada TB-keupayaan ladang, masing-masing, berbanding pembanjiran dan TB-tepu. Gerak balas hasil dan pengambilan N terhadap kadar N adalah lebih tinggi pada pembanjiran dan TB-tepu berbanding TB-keupayaan ladang. Anggaran kadar N untuk hasil maksima adalah 99, 105 dan 126 kg ha⁻¹, masing-masing untuk keadaan pembanjiran, TB-tepu dan TB-keupayaan ladang. Kecekapan penggunaan N pula berkurangan dengan peningkatan kadar N, dan ketara lebih rendah pada keadaan TB-keupayaan ladang.

Hasil kajian juga mendapati, urea adalah sumber N paling sesuai untuk tanaman padi dengan pembanjiran. Walau bagaimana pun, untuk tanaman padi dalam keadaan TB-tepu, penggunaan baja urea bersalut polimer (PCU) atau gabungan urea dan baja sebatian, adalah lebih baik untuk hasil dan pengambilan N berbanding penggunaan hanya urea sahaja. Pembahagian N dengan nisbah 40/30/30 pada peringkat pembiakan awal, pembiakan aktif dan peringkat awal pembentukan tangkai memastikan jumlah anak dan tangkai yang mencukupi, yang akan meningkatkan hasil, pengambilan N dan kecekapan penggunaan N tanaman padi dalam keadaan pembajiran. Kesemua perlakuan dengan tiga pembahagian N menunjukkan prestasi yang setara dan ketara lebih baik dari

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dua pembahagian N dalam keadaan TB-tepu. Hasil dan pengambilan N rendah dan tidak dipengaruhi oleh pembahagian N dalam keadaan TB-

keupayaan ladang. Perbezaan kaedah penempatan N yang diuji didapati tidak memberi kesan ketara pada hasil, pengambilan N dan kecekapan penggunaan N dalam semua keadaan pengurusan air . Kajian ini mendapati kesesuaian tanaman padi dalam keadaan TB-tepu yang berterusan tanpa menjejaskan hasil. Walau bagaimana pun, pengubahsuaian dalam amalan pengurusan baja N khususnya kadar, sumber dan pembahagian adalah perlu untuk meningkatkan kecekapan penggunaan N dan seterusnya hasil tanaman padi dalam keadaan TB-tepu .

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I certify that an Examination Committee met on 23rd September 2004 to conduct the final examination of Sariam Hj Othman on her Doctor of Philosophy thesis entitled “ Growth Performance of Rice under Different Water and Nitrogen Management” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Shamshuddin Jusop, Ph.D.

Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Aminuddin Hussin, Ph.D

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Syed Omar Syed Rastan, Ph.D.

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Wan Sulaiman Wan Harun, Ph.D.

Professor
Faculty of Resource Science and Technology
Universiti Malaysia Sarawak
(Independent Examiner)

GHULAM RUSUL RAHMAT ALI, Ph.D.

Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date : 20 Dec 2004

This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy.

The members of the Supervisory Committee are as follows:

Mohd Khanif Yusop, Ph.D.

Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Jamal Talib , Ph.D.

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Mohd Razi Ismail, Ph.D.

Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Mohd Aris Junus, Ph.D.

Research Officer/State Director
Malaysian Agricultural Research and
Development Institute (MARDI)
(Member)

AINI IDERIS, Ph.D.

Professor/ Dean
School of Graduate Studies
Universiti Putra Malaysia

Date :

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

SARIAM HJ OTHMAN

Date :

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