EFFECTS OF NITROGEN SOURCES ON SELECTED BIOCHEMICAL PROPERTIES OF *ORYZA SATIVA* L. CULTIVARS

By

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DEDICATED TO:

Souls that entrapped in the mastermind of the body,
May you find happiness...

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science
Fifteen recommended rice cultivars were used in this experiment. They were Setanjung, Muda, MR 84, RU 2242-1-1, IR 64, MR 185, MR 151, MR 159, MR 167, MRQ 34, MR 207, MR 209, MR 211, MR 219 and MR 220. Leaves of three-week old seedlings were analyzed for nitrogen assimilating enzymes, namely nitrate reductase (NR), nitrite reductase (NiR), glutamine synthetase (GS), glutamate synthase (GOGAT) and glutamate dehydrogenase (GDH) activities to evaluate the assimilation of N supply whereas ribulose 1,5-bisphosphate carboxylase/oxygenase (Rubisco) activity was use as an indicator for photosynthesis. The end products of N and C metabolism such as chlorophyll, soluble protein, fresh weight, soluble carbohydrates and starch contents were also analyzed. These biochemical evaluation were carried out in three different growth medium known as ‘control ~ without nitrogen sources’, ‘NO₃⁻ containing medium’ and ‘NH₄⁺ containing medium’ to determine the effect of different N sources. Treatments were laid out in split-plots in a randomized complete block design with N treatment as the main plot and cultivars as the subplot. In the study obtained, the addition of external
N sources did not help in accelerating the activities of N assimilating enzymes (NR, NiR, GS, GOGAT and GDH) as well as Rubisco when compared to control medium. In the leaves of three-week old seedlings, NR, NiR, GS and Rubisco activities were negatively related with the availability of N sources (-88%, -28%, -22% and -13%, respectively). GOGAT activity was demonstrated not to be influenced by the addition of N sources (no significant different) whereas GDH activity was higher in control (+51%) and NH$_4^+$ (+20%) containing medium as compared to NO$_3^-$.

In investigation of the effects of different nitrogen sources on selected N and C metabolites, positive correlation was observed. The increment of nearly 40% under nitrate supply and 62% in ammonium of the soluble protein content was seen with the external addition of N. Similarly, there was also an increased in the fresh weight (FW) content of nearly 0.8-fold in NO$_3^-$ grown plants to 0.2-fold in NH$_4^+$ fed plants when different N sources were applied (the increased in ammonium supply was not statistically significant in comparison with control). This lower FW content under ammonium supply could be the consequences of the slight chlorosis observed in the leaves tissue. In contrast, chlorophyll content happened to be lower in both NO$_3^-$ and NH$_4^+$ containing medium, with a reduction of 30% and 14%, respectively. Soluble carbohydrates content was slightly higher under nitrate supply than in ammonium whereas the control medium was found to possess higher starch content. Lower starch content in both medium (NO$_3^-$ and NH$_4^+$) could possibly relate to higher nitrogen use efficiency which resulted in an increase of soluble protein and FW contents. Apparently, the antioxidative property of ascorbic acid content was significantly higher in both control and NH$_4^+$ containing
medium, whereas glutathione reductase (GR) activity was highest under ammonium supply.

Cultivars as the subplot were found to demonstrate high significant evidence ($P < 0.001$) and were in consistency among the entire biochemical analyses, indicating genetic materials (15 rice cultivars) being one of the influential factor in regulating the outcome of the biochemical results obtained.
songsang dengan kehadiran sumber N (-88%, -28%, -22% dan -13%, masing-masing). Aktiviti GOGAT pula tidak dipengaruhi dengan penambahan sumber N (tiada perbezaan yang signifikan) manakala aktiviti GDH adalah lebih tinggi pada kawalan (+51%) dan pada media NH$_4^+$ (+20%) apabila dibandingkan dengan NO$_3^-$.

Berdasarkan kajian ke atas kesan sumber N yang berbeza terhadap metabolit N dan C yang terpilih, perkadaran yang positif dapat dilihat. Peningkatan protein larut sebanyak 40% di bawah sumber nitrat dan 62% di bawah sumber ammonium dapat dikesan dengan penambahan N. Begitu juga dengan kandungan berat basah, di mana penambahan sebanyak 0.8-kali dalam NO$_3^-$ dan 0.2-kali dalam NH$_4^+$ dapat dihampirkan apabila sumber N yang berbeza digunakan (peningkatan pada sumber ammonium tidak menunjukkan perbezaan yang signifikan jika dibandingkan dengan kawalan). Kandungan berat basah yang berkurangan ini mungkin disebabkan oleh klorosis yang dapat diperhatikan pada tisu daun anak pokok padi yang dibekalkan dengan sumber ammonia. Sebaliknya, kandungan klorofil yang diperolehi adalah lebih rendah pada kedua-dua kandungan media NO$_3^-$ dan NH$_4^+$, dengan penurunan masing-masing sebanyak 30% dan 14%. Kandungan karbohidrat larut pula menunjukkan sedikit peningkatan apabila dibekalkan dengan nitrat barbanding dengan ammonium manakala media kawalan mempunyai kandungan kanji yang lebih tinggi. Kandungan kanji yang lebih rendah di kedua-dua NO$_3^-$ dan NH$_4^+$ mungkin disebabkan oleh keberkesanan penggunaan nitrogen yang lebih tinggi dengan menyebabkan peningkatan dalam kandungan protein larut dan berat basah. Sebaliknya, kandungan antioksidan asid askorbik pula menunjukkan secara signifikan
lebih tinggi di media kawalan dan \( \text{NH}_4^+ \), manakala glutathion reductase (GR) menunjukkan aktiviti yang tertinggi pada media ammonium.

Kultivar sebagai subplot pula menunjukkan bukti signifikasi yang tinggi dengan \( P < 0.001 \) dan keadaan ini adalah konsisten pada semua analisis biokimia yang dikaji. Ini menunjukkan bahawa bahan genetik merupakan satu faktor penting yang mengawalatur keputusan yang bakal diperolehi.

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“IN REACHING FOR GOLDS,

MOST PEOPLE FORGOT ABOUT THE SILVER LINING”

I certify that an Examination Committee has met on 5th April 2006 to conduct the final examination of Yap Wai Sum on his Master of Science thesis entitled “Effects of Nitrogen Sources on Selected Biochemical Properties of Oryza sativa L. Cultivars” 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:

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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.

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