International Journal of Advanced Research in Engineering and Applied Sciences

ISSN: 2278-6252
Impact Factor: 5.795

EFFECT OF FLOODING ON NITRATE REDUCTASE ACTIVITIES OF SEEDLING OF SOME INDONESIAN LOCAL RICE VARIETIES

Muliaty Galib*

Abstract: *The aim of this study was to investigate the correlation between nitrate reductase activities (NRA) of some Indonesian local rice varieties. A completely randomized design with two water conditions (control and flooding) was used. Nitrate reductase activities (NRA) samples are collected of the age of two, three, four and five weeks. Nitrate reductase activities (NRA) measured using by spectophotometer. Data were analyzed using Duncan's Multiple Range Test. The data showed that nitrate reductase activity in Indonesian local varieties higher in conditions of unflooding (control). Nitrate reductase activity is different in each of the varieties and age of seedlings. The highest value obtained on the variety Membramo at the age 3 weeks.*

Keywords: *Nitrate Reductase Activities (NRA), Flooding, Indonesian local rice varieties*

*Department/Program study of Agrotechnology, Faculty of Agriculture, Indonesian Moeslim University, South Sulawesi, INDONESIA

INTRODUCTION

Rice was the staple food in the Indonesian diet, accounting for more than half of the calories in the average diet, and the source of livelihood for about 20 million households, or about 100 million people, in the late 1980s. Rice cultivation covered a total of around 10 million hectares throughout the archipelago, primarily on sawah.

Nitrogen on rice plants can be absorbed in the form of ammonia, urea, nitrates and amino acids. For formation of nitrite (NO-2) and ammonia ($NH4^+$) needed enzyme call as Nitrate Reductase (NR) and Nitrite Reductase (NiR). The role of these enzymes is directly related to the formation of amino acids. The first step in nitrate assimilatory pathway is the reduction of NO-3 to NO-2 catalyzed by the enzyme of nitrate reductase, which is a rate-limiting step that regulates the inflow of inorganic nitrogen (NO-3) to organic form in plants (Beevers and Hageman, 1969).

Nitrate reductase is one of the most important enzymes in the assimilation of exogenous nitrate, the predominant form of nitrogen available to green plants growing in soil. Activity of this enzyme in plants gives a good estimate of the nitrogen status of the plant and is very often correlated with growth and yield. Although it is difficult to explain the physiological significance and the mechanism of effects of several factors on the enzyme activity. In some cases suitable postulates have been advanced. In general, the enzyme activity in a plant tissue is a balance between its relative rates of synthesis/degradation and activation/inactivation. Factors may affect the overall activity by interfering with either of these processes. Several studies about of nitrate reductase activity (NRA) in different plant have been published by several authors such as on maize (Morilla *et al*, 1973); aquatic macrophytes (Cedergreen and Madsen, 2003), bean (*Phaseolus vulgaris* L.) (Hoff *et al*, 1991) and rice (Hemalatha and Francis, 1997).

MATERIAL AND METHODS

The paddy seeds (*Oryza sativa* L.) used in the current investigation were the Indonesian Local Varieties namely IR 66, IR 64, Cisadane, Celebes and Membramo. Prior to the nursery, germinated rice seeds of each variety testing for seed germination. This testing is done by 100 seeds from each varieties with 3 repetitions. Germination of seeds that reach 90 - 100% were continued until the stage that will test them for the measurement of NRA. Fertilizer used for rice crops, namely urea, TSP and KCL as basal fertilizer. The dose for each

fertilizer as 40gr / m2 (Kasryno, 1989). Maintenance of seed rice plants include watering, fertilizing, and pest and disease control. Watering is done every day, and pest and disease control carried out at the time of the seeds attacked by pests.

Flooding was done at the age of one week after sowing of the seed which is as high as 5 cm. Seedlings planted in a plastic container with a diameter of 0.5 cm. Environmental conditions such as temperature, humidity and light intensity inside and outside of the plastic house is not much different. So practical to cope with the rain only just overcome. A total of 30 containers prepared according to completely randomized design. Furthermore seedlings at the age of 2, 3, 4 and 5 weeks were measurement of nitrate reductase activity (NRA) in vivo (Hartiko, 1990).

RESULT AND DISCUSSION

Nitrate reductase activity (NRA) in the treatment of flooding and control (unflooding) on all week of observations suggested that variety of Membaramo higher than other varieties, and significantly different in the second and third weeks of observation (Table 1). This is suggested that a different response between varieties against flooding treatment in line with the age of the plant for nitrate reductase activity (NRA). According to Beeveer and Hageman (1969) that some of the factors responsible for the regulation of NRA in plants in addition to environmental factors, namely light, nutrients and plant growth regulators. Plant factors also play an important role such as age, species and varieties. Inhibiting metabolic and energy sources that NRA in photosynthetic tissue generally varies according to the day in relation to the age of the plant with the highest rates during periods of light and the lowest average at the end of a dark period of each day.

Value of nitrate reductase activity (NRA) on the Indonesian local varieties of membaramo always higher than the other varieties in the treatment of flooding and control. On the other hand the variety of IR 64 has not significantly different of a value of NRA on the treatment of flooding and control on all ages of seedlings (Figure 1 and 2). This provided that the varieties of rice plants can basically be grown in a state of stagnant or on dry land.

ISSN: 2278-6252
Impact Factor: 5.795

Tabel 1. Nitrate Reduktase Activity (µ mol/g/jam) on Flooding and Control (unflooding) on Weeks of Seedling 2, 3,4 and 5

Treatment	Indonesian Local Rice Varieties	Nitrat Reduktase (µ mol/g/jam)/ Weeks of Seedlings			
		2	3	4	5
Control (Unflooding)	IR 66	6,277 d	15,867 b	10,310 b	3,943 a
	IR 64	5,323 e	13,780 b	8,973 cd	2,487 b
	Cisadane	6,537 c	16,187 b	10,777 b	4,183 a
	Celebes	4,317 f	8,567 c	4,077 f	2,350 b
	Membramo	7,810 b	19,340 a	12,583 a	4,207 a
Flooding	IR 66	6,257 d	8,607 b	7,280 e	2,157 b
	IR 64	5,343 e	12,047 b	6,197 cd	2,510 b
	Cisadane	6,720 c	8,963 b	7,823 de	2,680 b
	Celebes	4,147 f	8,803 c	5,870 f	1,993 b
	Membramo	8,027 a	13,603 a	9,923 bc	3,997 a

Mean followed by the same letter in the some column showed no significant difference in Duncan test of the level of α 0.05.

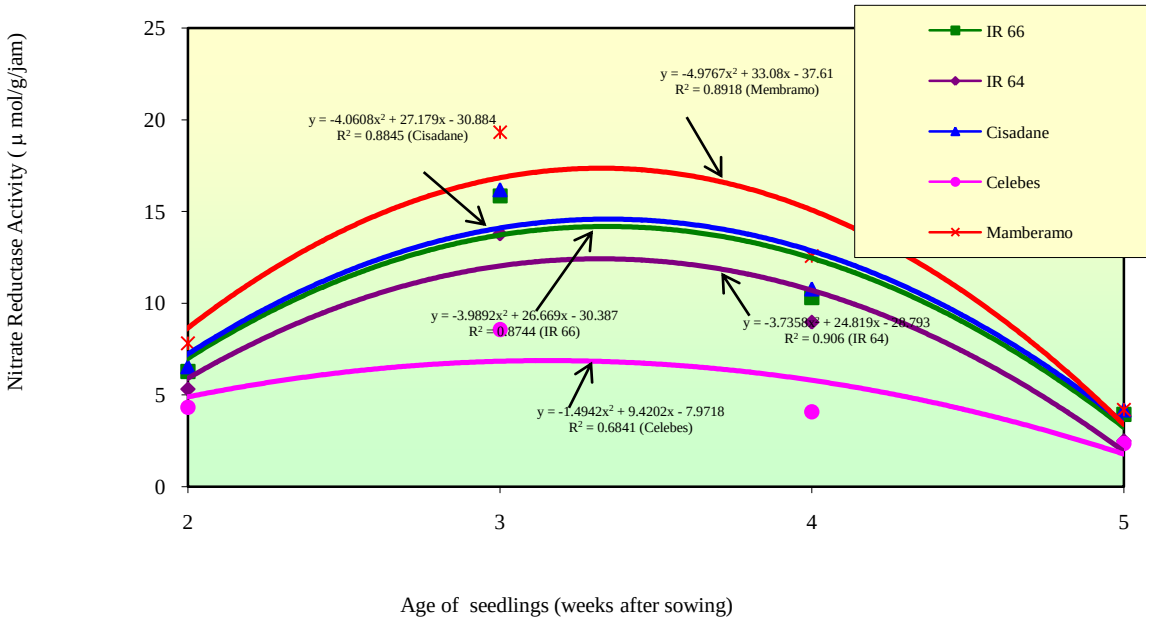

Figure 1. Correlation between Nitrate Reductase Activity (NRA) and Age of Seedlings of Indonesian Local Varieties on the Treatment of Control (Unflooding)

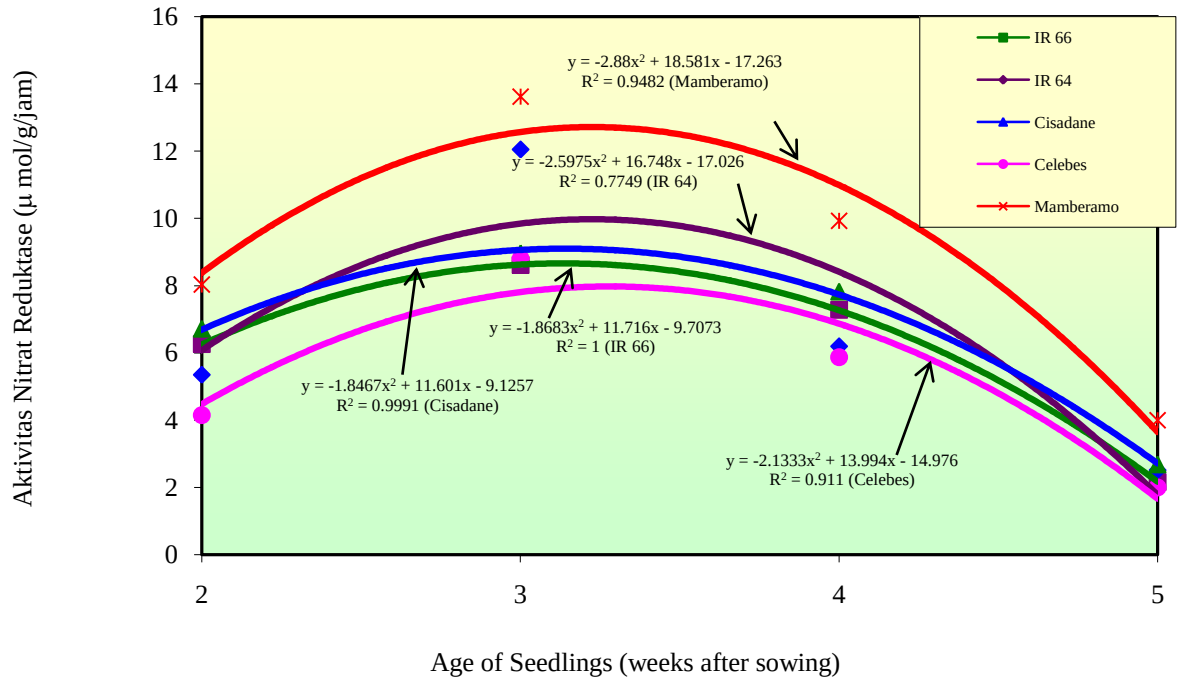

Figure 2. Correlation between Nitrate Reductase Activity (NRA) and Age of Seedlings of Indonesian Local Varieties on the Treatment of Flooding

According to Siregar (1981), the rice crops can be grown well under the conditions of stagnant water or muddy soil . Paddy rice growth is best in a puddle with a height of 5-25 cm. the availability of sufficient water is an advantage in rice paddy fields. Causing inundation of land in a state of O2 is reduced and the reduction of gas exchange between the air in the soil is disturbed. According to Kaiser and Huber (1994) that the flow setting of nitrate reductase activity in vivo is influenced by the availability of oxygen, which in flooding soils will be caused of rapid root in poor condition by oxygen. In this condition nitrate reductase activity increased rapidly and decreased again after oxygen is added. Meanwhile, to overcome the shortage of oxygen, rice plants having specialized tissues in the form of air cavities, where the air can be transported from the shoot to the roots of plants, so the root damage caused by anaerobic conditions can be overcome.

CONCLUSION

Based on the results from this study, it can be concluded that nitrate reductase activity in Indonesian local varieties higher in conditions of unflooding (control). Nitrate reductase

activity is different in each of the varieties and age of seedlings. The highest value obtained on the variety Membramo at the age 3 weeks.

REFERENCES

1. BEEVERS L. and HAGEMAN R.H. (1969). Nitrate reduction in higher plants. Ann. Rev. Plant Physiol., 20 : 495-522
2. CEDERGREEN, N and MADSEN, T.V. 2003. Nitrate reductase activity in roots and shoots of aquatic macrophytes. Aquatic Botany 76 : 203–212
3. HARTIKO, H. 1990. Petunjuk Laboratorium Analisis Enzim Tumbuhan. pp 42.
4. HEMALATHA, S and FRANCIS, K. 1997. Influence of nitrate on induction and turnover of nitrate reductase activity in etiolated and illuminated seedlings of *Oryza sativa.* Act. Bot. Ind., 25: 95-108
5. HOFF, T., STUMMANN, B.M. and HENNINGS, K.W. 1991. Cloning and expression of a gene encoding a root specific nitrate reductase in bean (*Phaseolus vulgaris* L.). Physiol. Plant, 82: 197-204
6. KASRYNO, F. 1998. Panduan Inovasi Teknologi IP Padi 300. BPPP. Departemen Pertanian.
7. Kaiser.W.M and Huber, S.C. 1994. Posttranslational Regulation of Nitrat Reductase in Higher Plants. Plant Physiol. 106 : 817-821.
8. MORILLA. C. A., J. S. BOYER, and R. H. HAGEMAN. 1973. Nitrate reductase activity and polyribosomal content of corn (Zea mays L.) having low leaf water potentials. Plant Physiol. 51: 817-824. 15.
9. SIREGAR, H. 1981. Budidaya Tanaman Padi di Indonesia. Sastra Hudaya Bogor.