EFFECT OF PRIMERS ON GROWTH AND BIOCHEMICAL PARAMETERS OF RAINFED RICE

Kumud Upadhyay, *Uma Singh, R.K. Yadav, H.C.Yadav, Mubeen, **Satendra Kumar and Kalpana

Department of Crop Physiology, N.D. U. & T., Kumarganj (Faizabad) -224 229
***Department of Soil Science, S.V.P.U. A. & T., Meerut -250110*

Abstract: An experiment to study the effect of primers on growth and biochemical parameters of rice (Var. NDR-118) was conducted at Department of Crop Physiology, N.D. University of Agriculture & Technology, Kumarganj, Faizabad (U.P.). Seed priming was done by soaking the seeds for 16 hours in distilled water, GA_3 50 ppm, GA_3 100 ppm, GA_3 150 ppm, K_2HPO_4 300 ppm, K_2HPO_4 400 ppm and K_2HPO_4 500 ppm. Application of primers brought a considerable increase in growth parameters like root length, root and shoot dry weight. The biochemical parameters viz., total chlorophyll content, total soluble carbohydrate and nitrate reductase activity showed a significant increase due to seed priming. Among different treatments, GA_3 100 ppm was the best treatment in increasing these parameters being at par with GA_3 50 ppm and significantly higher than rest of the treatments.

Keywords: GA_3, primers, rice, soluble carbohydrate, nitrate reductase

INTRODUCTION

Seed priming is one of the method which results in modifying the physiological and biochemical nature of seeds so as to get the characters that are favourable for drought tolerance. During priming process a number of physico-chemical changes occurs, modifying the protoplasmic characters and increasing physiological activity of the embryo and associated structures. This results in the absorption of more water due to increase in the elasticity of the cell wall and development of a stronger and efficient root system (Krishnasamy & Srimathi, 2001). Priming of rice seeds widely practiced to cope up the adverse effect of drought and high temperature in many parts of the world. Seed soaking of rice seeds have become popular among the farmers because it is simple, cheap and effective to tolerate the drought stress. However the work with efficient primers are very scanty. Therefore, the present investigation was carried out to explore the possibilities of primers on growth and biochemical parameters due to seed priming.

MATERIAL AND METHOD

The present investigation was carried out in pot culture at Department of Crop Physiology, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. The experiment was conducted in earthern pots with one rainfed rice variety i.e. NDR-118. Seed priming was done by soaking the seeds for 16 hrs in distilled water, GA_3 50 ppm, GA_3 100 ppm, GA_3 150 ppm, K_2HPO_4 300 ppm, K_2HPO_4 400 ppm and K_2HPO_4 500 ppm. Each pot was lined with polyethylene bag and filled with 8 kg well pulverized sandy loam texture soil mixed with half of the recommended dose of nitrogen, total phosphorus and potash (120:60:60). Fifteen primed seeds were directly sown in pots. Thinning was done in each pot after seedling emergence and only 3 healthy and uniform plants were maintained in each pot. Sampling was done at 30, 50 and 70 Days after sowing of seeds. Root length was measured with the help of meter scale from the base of the shoot to tip of longest root. Dry weight of root and shoot were oven dried at $80^0C\pm1^0C$ and their constant weight was taken. Chlorophyll content was estimated according to the method of Arnon (1949) and expressed as mg g-1 fresh weight of leaves. Total soluble carbohydrate was measured by the method of Yemm and Willis (1954) and nitrate reductase was assayed by Jaworski (1971). The statistical analysis of experimental data was done by method described by Panse and Shukatme (1978) using complete randomized design.

RESULT AND DISCUSSION

Application of all seed primers showed a significant increase in root length of crop at 30 DAS, however, a non-significant response was found at later stages of observations i.e. 50 and 70 DAS (days after sowing) (Table-1). Highest root length was found with GA_3 100 ppm which was at par with rest of the treatments except water soaking which recorded significantly lower root length than GA_3 100 ppm. Root length of rice increased after seed priming were observed by many workers (Singh *et al.*, 1974 and Gupta, 1984). Krishnasamy *et al.,* (2001) defined that during priming process a number of physiological changes occurs, modify the protoplasmic characters and increasing physiological activity of the embryo and associated structures. Eventually, this results in the absorption of more water due to increase in the elasticity of cell wall and development of a stronger and efficient root system.

Data revealed that application of primers significantly influenced the shoot dry weight of rice crop at 30, 50 and 70 DAS (Table-2). Highest shoot dry weight was recorded with**,** GA_3 100 ppm, followed by GA_3 50 ppm, K_2HPO_4 400 ppm, and GA_3 150 ppm at all the stages of observations. Minimum increase in shoot dry weight was found with water soaking treatment. At 70 DAS all the treatments showed non-significant response except GA_3 50 and 100 ppm. Root dry weight increased with all the primers over control at all the stages except water soaking, effect of which was non-significant at 50 and 70 DAS (Table-3). GA_3 100 ppm resulted in significantly higher root dry weight over rest of the treatments at 30 and 70 DAS. However, at 50 DAS the effect of GA_3 50 ppm and GA_3 150 ppm was at par with GA_3 100 ppm while rest of the treatments showed significantly lower values. Stimulatory effect of primers on root, shoot dry weight was due to fast radical and seedling growth, faster water uptake, higher rate of protein synthesis and higher nutrient uptake by well organized root system. Similar findings were reported by Zhao *et al.*, (1986), Muhammad (2005).

Chlorophyll content increased upto 50 DAS and declined later. Application of primers brought a significant increase in total chlorophyll content at 30 and 50 DAS while the effect was non-significant at 70 DAS (Table-4). At 30 DAS, all the doses of GA_3 resulted in significant increase in total chlorophyll over K_2HPO_4. However at 50 and 70 DAS, GA_3 100ppm being at par with GA_3 50 ppm which showed significantly higher total chlorophyll content than rest of the treatments. Water soaking caused no significant increase at any stage. Increase in chlorophyll content were reported by Singhvi and Chaturvedi (1984).

Nitrate reductase activity increased upto 50 DAS and later on decreased (Table-5). At 30 DAS, GA_3 100 ppm resulted in significantly higher nitrate reductase activity over rest of the treatments. However, at 50 and 70 DAS, GA_3 50 ppm showed at par results with GA_3 100 ppm while other treatments recorded significantly lower values. The response of K_2HPO_4 400 ppm ranked third after GA_3 100 ppm and GA_3 50 ppm in increasing the nitrate reductase activity. It is clear that nitrate reductase activity increased upto 100 ppm GA_3 and 400 ppm K_2HPO_4 while it declined at higher dose of GA_3 (150 ppm) and K_2HPO_4 (500 ppm). Among primers, GA_3 100 ppm showed higher response followed by GA_3 50 ppm and K_2HPO_4 400ppm. Similar findings were also obtained by other workers (Zaidi and Singh, 1993 and Sharma *et al.*, 1995). The effect of GA_3 seed priming on NR enzymes is perhaps due to phospholipids synthesizing enzymes which in turn increases synthesis of ER which become proliferated forming stacks of lamellae (Evins and Varner, 1971). This facilitates the availability of more sites for the attachment of ribosomes which in turn promote protein synthesis on the available mRNA template which is specific for specific enzyme synthesis. A large number of enzyme is either completely dependent or stimulated by K^* (Suelter, 1970). In general, K^* induced conformational changes of enzyme which increase the rate of catalytic reactions of enzymes (Evans and Wildes, 1971).

Total soluble carbohydrate increased with plant age (Tabe-6). All the primers increased the total soluble carbohydrate. Higher accumulation of total soluble carbohydrate was found with GA_3 100 ppm followed by GA_3 50 ppm and K_2HPO_4 at all the stages. A slight increase in total soluble carbohydrate was found with water soaking treatment as compared to control but it was statistically non significant. Higher concentration of GA_3 and K_2HPO_4 showed inhibitory effect on total soluble carbohydrate concentration over their lower dose. Farooq *et al.*, (2005) explained that the priming resulted in improved root proliferation that improved nitrogen uptake and enhanced amylase activity that increased starch hydrolysis which resulted in increased contents of total and reducing sugars. Similar results were also obtained by many other workers (Singh and Kumar, 1989 and Kaur *et al.*, 2005). Acharya *et al.*, (1990) reported that starch hydrolysis and activities of enzymes such as alpha-amylase, beta amylase, maltase and invertase were increased by seed priming. Possibly GA_3 brings about two effects. It promotes proliferation of ER leading to increased translation. Secondly, it also increases the synthesis of mRNA specific for alpha-amylase. Both effects appear to run parallely and both would contribute to increased alpha-amylase synthesis (Jones and Macmillan, 1984) which ultimately hydrolysis the starch into simple sugar.

Table 1. Effect of seed primers on root length (cm) of rainfed rice.

Treatments	**Days after sowing**		
	30	**50**	**70**
Control	27.03	29.87	32.70
Water soaking	28.17	30.95	33.20
GA_3 50 ppm	31.10	33.97	36.03
GA_3 100 ppm	31.97	35.27	37.43
GA_3 150 ppm	30.10	33.05	35.20
K_2HPO_4 300ppm	29.60	32.50	34.70
K_2HPO_4 400ppm	30.73	33.82	35.60
K_2HPO_4 500ppm	29.10	31.90	34.10
CD at 5%	**2.93**	**N.S.**	**N.S.**

Table 2. Effect of seed primers on shoot dry weight (g/plant) of rainfed rice.

Treatments	Days after sowing		
	30	50	70
Control	8.03	14.39	20.70
Water soaking	8.61	15.10	21.30
GA_3 50 ppm	10.20	17.12	23.42
GA_3 100 ppm	10.67	17.82	24.10
GA_3 150 ppm	9.78	16.48	22.73
K_2HPO_4 300ppm	9.40	16.14	22.42
K_2HPO_4 400ppm	9.87	16.65	22.94
K_2HPO_4 500ppm	9.10	15.65	22.04
CD at 5%	**0.98**	**1.85**	**2.26**

Table 3. Effect of seed primers on root dry weight (g/plant) of rainfed rice.

Treatments	Days after sowing		
	30	50	70
Control	0.80	1.68	2.71
Water soaking	0.94	1.84	2.87
GA_3 50 ppm	1.21	2.29	3.31
GA_3 100 ppm	1.30	2.40	3.80
GA_3 150 ppm	1.16	2.24	3.26
K_2HPO_4 300ppm	1.08	2.07	3.18
K_2HPO_4 400ppm	1.19	2.19	3.25
K_2HPO_4 500ppm	1.01	1.99	3.00
CD at 5%	**0.09**	**0.19**	**0.27**

Table 4. Effect of seed primers on total chlorophyll content (mg/g fresh weight) in leaves of rainfed rice.

Treatments	Days after sowing		
	30	50	70
Control	0.89	1.55	0.98
Water soaking	0.93	1.59	0.99
GA_3 50 ppm	1.06	1.78	1.03
GA_3 100 ppm	1.10	1.87	1.05
GA_3 150 ppm	1.02	1.67	1.01
K_2HPO_4 300ppm	0.96	1.64	1.01
K_2HPO_4 400ppm	0.99	1.70	1.02
K_2HPO_4 500ppm	0.95	1.62	1.00
CD at 5%	0.09	0.16	N.S.

Table 5. Effect of seed primers on nitrate reductase activity (n mole NO_2 produced/g fresh wt./hr.) in leaves of rainfed rice.

Treatments	Days after sowing		
	30	50	70
Control	10.00	18.50	12.30
Water soaking	11.40	20.60	13.43
GA_3 50 ppm	18.60	23.84	21.17
GA_3 100 ppm	19.50	24.50	21.87
GA_3 150 ppm	13.20	22.01	18.73
K_2HPO_4 300ppm	11.40	21.03	15.30
K_2HPO_4 400ppm	16.17	23.11	20.33
K_2HPO_4 500ppm	12.30	20.17	15.77
CD at 5%	0.89	1.13	1.09

Table 6. Effect of seed primers on total soluble carbohydrate (mg/g dry wt.) in shoots of rainfed rice.

Treatments	**Days after sowing**		
	30	**50**	**70**
Control	115.33	122.63	131.10
Water soaking	122.48	130.57	140.20
GA_3 50 ppm	150.63	167.10	187.00
GA_3 100 ppm	161.03	169.70	189.03
GA_3 150 ppm	143.97	152.27	179.30
K_2HPO_4 300ppm	141.00	150.60	166.77
K_2HPO_4 400ppm	148.63	156.63	185.97
K_2HPO_4 500ppm	138.57	144.20	160.30
CD at 5%	10.70	13.97	16.23

REFERENCES

Acharya UT, Prakash K and Prathapasenan G (1990). Effect of gibberellic acid on seedling growth and carbohydrate metabolism during germination of rice (Oryza sativa L.) Var. GR-3 under saline condition. *J. Agron. and Crop Sci.* 165:6-13.

Arnon DI (1949). Copper enzymes in isolated chloroplast polyphenol oxidose in Beta vulgaris. *Plant Physiology* 24 : 1-15.

Evans HJ and Wildes RA (1971). Potassium and its role in enzyme activation. *Proc. 8th Int. Potash Inst. Bern,* pp. 13-39.

Evins WH and Varner JE (1971). Proc. Nat. Acad. Sci. (U.S.). 73: 138.

Farooq M and Basra Shahzad MA (2005). Rice cultivation by seed priming, Dawn group of Newspaper (August 19). Rajab 23, 1426.

Gupta US (1984). Note on physiological approach for increasing early salt tolerance of green gram (*Vigna radiata*). *Curr. Agric.* 8 (3-4): 182-185.

Jaworski K. (1971). Nitrate reductase assay in intact plant tissues. *Biochem. Biophysics Res. Comm.* 43: 1274-1279.

Jones RL and Mac Millan (1984). In Advanced Plant Physiology, Wilkins, M.D. (ed.) Pitman, P.21.

Kaur S, Gupta AK and Kaur N (2005). Seed priming increases crop yield possibly by modulating enzymes of sucrose metabolism in chickpea. *Journal of Agronomy and Crop Science* 199 (2) : 81-87.

Krishnasamy V and Srimathi P (2001). Seed management for rainfed agriculture-land use planning and watershed management, pp. 140-144. Edited by Dr. M. Balusamy, Dr.C.R. Chinnamuthu and Dr. A. Velayutham, TNAU.

Muhammad A (2005). Effect of seed priming on emergence, yield and storability of soybean, NWFP Agricultural University/Faculty of Crop Production Sciences, P. 192.

Pandey, Savita and Srivastava HS (1992). Cytokinin effects on nitrate reductase activity in Leucaena leucocephola seedlings in the presence of different nitrogenous salts. *Indian J. Plant Physiol.* 35 (1) : 64-72.

Panse VG and Sukhatme PV (1978). Statistical method for Agricultural workers.

Sharma S, Dey SC and Chaudhary AK (1995). Effect of seed hardening, potassium levels and antitranspirant on proline content and NR-activity in rice (Oryza sativa L.). *Journal of Potassium Research* 11 (3-4) : 373-376.

Singh H, Darra BL and Jain N (1974). Role of some hormones as a pre-soaking seed treatments on growth and yield attributes of wheat. *Annls. Aridzone* 13 (2) : 84-93.

Singh T and Kumar V (1989). Nodulation and plant growth as influenced by growth regulators in some legumes. *Acta Bot Indica* 17: 177-181.

Singhvi NR and Chaturvedi HK (1984). Effect of zeatin on seedling growth and chlorophyll contents in Raphanees sativum L. *Physiology and Ecology* 14 (3) : 169-179.

Suelter CH (1970). Enzymes activated by monovailent cations. Science 168: 789-795.

Yemm EW and Willes AJ (1954). The estimation of carbohydrates in plant extracts by anthrone. *Biochem. J.* 57 : 508-514.

Zaidi PH and Singh BB (1993). Alleviation of salinity responses on proline accumulation and nitrate assimilatory enzymes by growth regulators in soybean (Glycine max L. Merrill). *New Agriculturist* 4 (1) : 41-46.

Zhao Ke-J, Li Ming-liance and Liu-Jia Jau (1986). Reduction by GA3 of NaCl induced inhibition of growth and development in Sceaeda Ussuriensis. Aust. *J. Plant Physiol* 13: 547-551.