INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560-8530/99/01-3-103-105

Influence of Effective Micro–organisms and Diazotroph on Rice and Wheat Yield, and Protein Contents

SHAKEEL A. ANWAR, MUHAMMAD A. AVAIS, NISAR AHMAD, KHALID M. BHATTI AND MUHAMMAD SAQIB
Agricultural Biochemistry Section, Ayub Agricultural Research Institute, Faisalabad, Pakistan

ABSTRACT

The pot experiments were conducted on wheat and rice crops to test efficiency of Effective Micro–organisms (EM) and Diazotroph in improving crop yield and quality .The treatments were 0, 30, 60 mg N/Kg soil and 1% each wheat straw, rice straw, green manure and farm yard manure. Treatments were applied with EM-4 and diazotroph separately, keeping one set as control. The results showed that EM-4 and diazotroph both increased the wheat and rice yield as well as protein contents. Application of fresh plant material resulted in lower crop yields and protein contents as compared to "N" fertilizer application.The residual effects of applied plant materials were more than that of "N" fertilizer application.

Key Words: Effective micro–organisms; Diazotroph; Rice; Wheat; Yield; Protein

INTRODUCTION

Chemical fertilizers which are commonly used to increase crop production are expensive. Therefore, new and cheap sources of plant nutrients which can replace inorganic fertilizers partially or wholly need investigation. Higa (1988) claimed that Effective Micro–organisms (EM) play an important role in improving crop yield. EM is a mixture of more than 10 genera and 80 species of co-existing micro–organisms (Photosynthetic, N-fixing and lactic acid producing bacteria, fungi, yeasts etc.), cultured in a liquid medium. These enhance the rate of decomposition of organic wastes and residues and thus increase the availability of plant nutrients. Hussain *et al.* (1993) reported that EM improved the efficiency of organic materials due to their decomposing ability and release of more plant nutrients for crop growth but still EM is not comparable with chemical fertilizers. Wheat grain yield was increased with use of EM (Rashid *et al.*, 1994a; Ibrahim *et al.*, 1994). Rashid *et al.* (1998) reported the benificial effect of Diazotrophic inoculum on wheat yield. This study was planned to investigate the effect of EM (cultured in Japan) and local Diazotroph inoculum (a mixed culture of Azotobactor and Azospirillum) on wheat and rice under conditions prevailing in Pakistan.

MATERIALS AND METHODS

A pot experiment was conducted during 1994-96 using wheat- rice-wheat crop rotation system with the following set of treatments.

1. Control, 2. 30 mg N/ kg soil, 3. 60 mg N/ kg soil,
4. Wheat straw 1% (providing about 40 mg N/kg soil)
5. Rice straw 1% (providing about 60 mg N/kg soil),
6- Green manure (Dhancha) 1% (providing about 200 mg N/kg soil) and 7. Farm yard manure (FYM) 1% (providing about 120 mg N/kg soil)

The treatments were applied with EM-4 and Diazotroph separately, keeping one set as control. Nitrogen and plant residues were incorporated in the soil 14 days before sowing. Plant materials were taken fresh, chopped into small pieces and dried. Each treatment was replicated four times. Diazotroph was applied as seed treatment while EM-4 as solution @ 25 g/kg seed and 2 ml EM/L of irrigation water with alternate irrigations, respectively. After harvesting, wheat yield data were recorded and rice was transplanted in the same pots during kharif to see the residual effects of the applied treatments. Rice nursery was treated with Diazotroph only. After harvesting the rice crop again, three sets of the above mentioned treatments were applied for wheat in the same pots. Yield data of both crops i.e; wheat and rice were recorded and the samples were analysed for crude protein.

RESULTS AND DISCUSSION

Yield

Wheat. The data (Table I) revealed that various treatments (fertility levels) had significant effects on the yields recorded. On the average, grain yield followed the order T3>T6>T7>T2>T4>T5>T1.The maximum grain yield was obtained by the application of 60 mg N/kg soil, while the minimum yield resulted when no "N" fertilizer was applied. The application of organic sources of "N" (wheat straw, rice straw, green manure and FYM) gave statistically lower yield of both the

wheat crops than the treatment where 60 mg N/kg soil was applied. Among the organic sources of "N" , green manure and FYM appeared to be better than wheat and rice straw. The reasons for higher yields from green manure and farm yard manure treated pots were possibly the favourable conditions for decomposition (temperature and moisture). In these conditions, soil inoculum diazotroph and EM-4 worked more efficiently and released more plant nutrients which ultimately resulted in the increased crop yield. Bremen and Van Kessel (1992) reported that the dynamics of soil microbial biomass after addition of plant residues had a considerable influence on the nutrient availability for plants. When the soil inocula were considered as a whole, they gave significantly higher yields than control but the effect of the both inocula did not differ significantly. The maximum grain yield was obtained from diazotroph followed by EM-4. Rashid *et al.,* (1994) reported significant increase of crop yield with EM-4 and diazotroph. Favourable effects of EM and diazotroph on wheat grain yield have also been noted by others (Ibrahim *et al.,* 1994; Hussain *et al.,* 1994).

Rice. The residual effect of all types of plant materials tested resulted in higher paddy yield as compared to "N" fertilizer application (Table I). Among the plant materials, FYM gave the highest paddy yield while lowest paddy yield was produced when rice straw was used but it was more than applied "N" and control treatments. The reason for higher yields from plant residues treatments is that the plant residues released the nutrients at slower rate than the fertilizer treatments. More plant nutrients from fertilizer were utilized by the first wheat crop, hence less residual effect was observed on rice. Similar findings about the residual effect has been reported by Ibrahim *et al.,* (1994) in the case of wheat crop. Both soil inocula increased rice yield significantly over control but when thier effect was compared no significant difference was noted. Diazotroph and EM-4 produced almost similar paddy yield. The explanation for inoculum effect on wheat grain yield most likely holds true for paddy yield.

Protein contents

Wheat. The crude protein contents of wheat grain in different treatments differed from one another (Table II). On an average, protein contents followed the order T3 >T6 >T2 >T7 >T4 >T5 >T1. Fertilzer application @ 60 mg N/kg soil gave highest protein contents in wheat. Among the organic sources of "N", green manure performed better than wheat straw, rice straw and FYM. When the both inocula were compared, they differed from control but non significantly with each other. Similar findings have been reported by Ibrahim *et al.* (1994). The reason for higher protein contents in grain, in inoculum treated pots could be that microbes released more "N" as a result of decomposition which was absorbed and assimilated by the plants.

Table I. Effect of Mico–organisms and Diazotroph on crop yield (g/plot)

Treat.	Wheat								Rice			
	1994–1995				1995–1996				1995			
	Contr.	EM	Diaz	Mean	Contr.	EM	Diaz	Mean	Contr.	EM	Diaz	Mean
Control	11.94	12.69	12.56	12.40 f	9.45	11.60	12.16	11.07 e	19.50	21.80	21.54	20.94 g
30 ppm N	15.15	15.42	16.01	15.52 d	20.43	21.80	22.00	21.41 b	22.51	23.37	23.67	23.19 f
60 ppm N	17.24	18.26	18.45	17.98 a	22.40	23.70	23.80	23.30 a	23.80	24.85	25.10	24.58 e
WS 1 %	13.13	15.04	15.23	14.47 e	15.05	19.30	19.15	17.83 d	26.45	28.10	28.35	27.63c
RS 1%	14.35	14.19	14.45	14.33 e	16.06	18.21	18.03	17.43 d	25.30	26.89	26.70	26.29 d
GM 1 %	16.80	17.49	17.56	17.28 b	19.39	20.45	20.60	20.15 c	28.30	30.25	30.40	29.65 b
FYM 1 %	15.35	17.25	17.20	16.60 c	19.13	20.30	20.08	19.83 c	29.50	31.85	31.90	31.08 a
Mean	14.85 b	15.76a	15.92 a		17.42 b	19.34a	19.40a		25.05 b	26.73a	26.81a	

WS= Wheat straw; RS= Rice straw; GM= Green manure; FYM= Farm yard manure; Contr.= Control; EM= Effective micro–organism; Diaz= Diazotroph

Table II. Effect of Mico–organisms and Diazotroph on protein content (%) of wheat and paddy

Treat.	Wheat								Rice			
	1994–1995				1995–1996				1995			
	Contr.	EM	Diaz	Mean	Contr.	EM	Diaz	Mean	Contr.	EM	Diaz	Mean
Control	10.21	11.25	11.76	10.91 e	10.15	11.50	11.80	11.15 e	10.10	10.30	10.35	10.25 f
30 ppm N	13.31	14.19	14.14	13.88 c	12.65	13.50	13.65	13.27 c	11.30	11.70	11.80	11.60 e
60 ppm N	14.19	15.31	15.51	15.00 a	13.60	15.40	15.60	14.87a	12.00	12.55	12.45	12.33 d
WS 1 %	12.21	13.41	13.48	13.04 d	11.64	12.75	12.80	12.40d	12.60	12.21	13.25	13.02 c
RS 1%	12.50	12.84	12.96	12.77 d	12.10	12.35	12.40	12.28d	12.40	12.70	12.85	12.65 d
GM 1%	13.55	14.60	14.72	14.29 b	12.90	13.80	14.10	13.60b	13.30	13.86	13.90	13.69b
FYM 1 %	13.46	14.49	14.58	14.18 bc	12.75	13.65	13.75	13.38bc	13.60	14.28	14.31	14.06a
Mean	12.78 b	13.73a	13.81 a		12.25b	13.28a	13.44a		12.19b	12.66a	12.70a	

WS= Wheat straw; RS= Rice straw; GM= Green manure; FYM= Farm yard manure; Contr.= Control; EM= Effective micro–organism; Diaz= Diazotroph

Paddy. The residual effect of applied plant materials on increasing the crude protein in paddy was more than the effect of previously applied "N" (Table II). Maximum crude protein was found in paddy grown with farm yard manure and minimum in the case of control. Even rice straw among the applied plant materials yielded the paddy with more crude protein than the "N" fertilizer. When the soil inocula were considered as a whole, significantly higher protein contents were noted than control. However, both the inocula did not differ significantly in this aspect. Results of the investigations by Ibrahim *et al.* (1994) are similar to those observed in this experiment.

CONCLUSIONS

Diazotroph and EM-4 both increased the paddy and wheat grain yield and the protein content. Residual effects of applied plant materials was greater than the residual effect of previously applied fertilizer "N". Application of fresh plant materials resulted in lower crop yield and protein content as compared to fertilizer "N".

REFERENCES

Bremen, E. and C. Van Kessel, 1992. Seasonal microbial biomass dynamics after addition of lentil and wheat residues.*Soil Sci. Soc. Am. J.*, 56: 1411–46.

Higa, T., 1988. Studies on the application of soil micro–organisms in nature farming. *In: Principles of nature farming with Effective Micro–organisms (Part-I).* Hussain,T., G. Jilani, M.A. Abbas and T. Higa (eds.). Intl. Nature Farming Res. Center, Univ. Agri., Faisalabad, Pakistan.

Hussain, A., M.A. Khan and M.Yousuf, 1994. Comparative effect of EM, Diazotroph, farm yard manure and NPK on the growth and yield of wheat and soil fertility under rainfed conditions. *Proc. 2nd Natl. Seminar on Nature Farming,* pp: 102–12. Univ. Agri., Faisalabad..

Hussain, T., A.K. Khan, G. Jilani, M.A. Abbas and M. Yaseen, 1993. Prospectus of using EM technology for wheat production. *J. Agri. Res.*, 31: 37–41.

Ibrahim, M., A. Khan, M.I. Khan and S.A. Anwar, 1994. Long term effect of EM application on yield and quality of rice and wheat. *Proc. 2nd Natl. Seminar on Nature Farming,* pp: 75–87. Univ. Agri., Faisalabad.

Rashid, A., G. Siddique, S.M. Gill and M. Aslam, 1994. Contribution of microbes in crop productivity. Effect of Diazotrophic and commercial EM-4 inoculation on yield and "N" economy of wheat. *Proc. 2nd Intl. Seminar on Nature Farming,* pp: 54–66. Univ. Agri., Faisalabad.

Rashid, A., P. Khan and M. Afzal, 1994a. Use of EM for cereal production in Peshawar Valley. *Abstr. 2nd Natl. Seminar on Nature Farming,* p. 10. Univ. Agri., Faisalabad.

Rashid, A., M. Aslam, M.R. Sajjad, G. Siddique, A. R. Jami, M.A. Gill, M.S. Cheema, M.S. Sindhu, M. Asghar and M.M. Nayyar, 1998. Response of wheat to Diazotrophic bacteria and nitrogen at different locations of Pakistan Punjab area. *Proc. Symp. Plant Nutrition Management for Sustainable Agricultural Growth,* pp: 139–46. NFDC, Islamabad, Pakistan.

(Received 03 June 1999; Accepted 22 June 1999)