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Improvement in Biological Nitrogen Fixation and Yield of Groundnut By the Application of Effective Microorganisms

M.S. Iqbal and G. Jilani[1]
Department of Biological Sciences, Quaid-i-Azam University, Islamabad
[1]Department of Soil Science, University of Arid Agriculture, Rawalpindi, Pakistan

Abstract: This study was to find out whether the application of Effective Microorganisms (EM) improves biological nitrogen fixation (BNF) and yield in groundnut under rainfed conditions. Treatments in main plots were two varieties; V_1 = 1CG-2261 V_2 = 1CGV-86550. It was concluded that yield and BNF were increased by EM, by both ways of application and variety V_1 gave better and BNF then V_2.

Key word: BNF (biological nitrogen fixation), EM (effective microorginisms)

Introduction

The yield of groundnut under commercial production in Pakistan is between 930 and 1136 kg ha^{-1}, whereas current on the farm yield with present varieties is about 1500 kg ha^{-1} (Khan, 1996). The improvement in the genotype of groundnut is already at practice in different research institutions. Further progress can be achieved only through artificial hybridization in groundnut (Nigam *et al*., 1990). The agronomic practices like proper fertilization and especially the capacity to improve the biological nitrogen fixation (BNF) in groundnut will cause its higher yields. The EM inoculation is known to increase crops yield. A Japanese scientist Prof. Dr. Teruo Higa developed the EM Biotechnology in 1982. Some of the important microorganisms in EM are, lactic Acid Bacteria, Photosynthetic bacteria, N-fixing bacteria, yeast, Ray fungi, moulds and some other naturally existing microorganism. Sangakkara and Higa (1994) reported the positive effect of EM on nodulation parameters and yield of bush bean and mung bean on soil. Chetti *et al*. (1995) reported that both nitrogen inoculation had significant positive effect on nitrogen utilization efficiency, total dry matter production, pod yield, kernel 100 seed weight and shelling percent was observed that at 50 kg N ha^{-1} there was an increase in yield components over the control. Wiandhare *et al*. (1995) found that in groundnut the number and dry weight of nodules $plant^{-1}$, the plant height, root length, dry weight per plant, P-uptake and mycorrhizal colonization and flowering was highest with *G. fasiculatum, Rhizobium* and 50 percent P of the recommended dose. Fu *et al*. (1995) found that in groundnut plants isolated with NH_{14} strain of Rhizobium nodule weight, above ground dry weight nitrogen contents nodule number and N-fixing activity were also higher. Mehta and Rao (1996) analyzed that seed inoculation with MH-4 significantly increased groundnut pod yield by application of 15 kg. N.pod yield increased with up to 75 kg P 205. Kumar and Rao (1997) found that legumes are known to increase the number of soil rhizobia by multiplication and the release of rhizobia from plant nodules. The number of effective nodules present was responsible for dinitrogen fixations. Therefore, the following study was conducted with the major objective to see the positive effect (if any) of EM application and its mode of application on BNF and yield of groundnut.

Materials and Methods

The study was carried out at the research farm of University of Arid Agriculture, Rawalpindi, during 1998 on sandy clay loam soil. The crop was grown under rainfed condition with conventional agronomic practices. The experiment was laid out according to randomized complete black design with three replications. The individual plot size was 3m × 4m. A basal dose of NPK at the rate of 20-80-40 Kg ha^{-1} respectively was applied in the field at the time of seeded preparation. Sowing was carried out with Dibbler method keeping 50 cm distance between rows and 20 cm between plants with seed rate of 70 kg ha^{-1}. Two varieties were tested in main plot treatments. V_1 = ICG-2261, V_2 = ICGV-86550. Whereas the subplot treatments were as in the following. T_1 = Control. T_2 = Seed inoculation with EM (500 times diluted) T_3 = T_2 + EM spray (1:500) on soil 20 days after sowing. Data as mentioned in the discussion were recorded during the course of the experiment. Kjeldhal's method was used for N-determinations (Jackson, 1962). Statistical analysis was carried out by analysis of variance (ANOVA) technique (Steel and Torrie, 1980) and treatment means were compared by Duncun multiple range test (DMRT) as according to Duncan (1955).

Results and Discussion

Data on total biomass of root per plant showed that varieties have non-significant difference with each other (Table 1). The effect of EM treatments was positive and significant. Fresh weight of root in non rhizobium (Control) was less as compared to (seed inoculation of EM) and (Seed inoculation + EM spray on soil after 20 days). Seed inoculation of EM shows statistically significant increase in fresh weight over control but less then seed inoculation of EM + EM spray on soil after 20 days. However, the difference between seen inoculation of EM and EM spray on soil after 20 days was nonsignificant. Wiandhare *et al*. (1995) have also reported increased root growth due to microbial inoculation of groundnut seed.

Table 1: Effect of EM application on the total biomass of root (g $plant^{-1}$)

Treatment/Varieties	V1	V2	Average
Non rhizobium	7.6b	7.1b	7.4 B
Seed inoculation of EM	10.4a	9.3 ab	9.9 A
Seed inoculation of EM + EM spray on soil after 20 days	12.6a	11.2a	11.9 A
Average	10.2 A	9.2 A	

Means bearing similar letters are statistically similar at 5% probability level

Weight of effective nodules in non rhizobium was less as compared to seed inoculation but the difference was statistically non-significant (Table 2). Seed inoculation of EM + EM spray on soil after 20 days showed more increase and there was statistically significant difference with non rhizobium and seed inoculation of EM

This reflects that applications of EM on the soil (Seed inoculation of EM + EM spray on soil after 20 days) had favoured the growth of rhizobia to cause more effective nodulations. The difference between the varieties is also significant where V_1 gave higher nodule weight compared to V_2. Sangakkara and Higa (1994) also reported the positive effect of EM on nodulation parameters and yield of mung bean and bush bean.

Table 3 shows that varieties had significant difference in the diameter of effective nodule. Treatments have also statistically significant difference. In control (Non rhizobium) there was statistically small diameter of nodules as compared to seen inoculation of EM and seed inoculation of EM + EM spray on soil after 20 days. There was statistically non-significant difference between Seed inoculation of EM + EM spray on soil after 20 days. Fu *et al*. (1995) observed that in groundnut plants inoculated with strain NH_4 nodule weight was increased and also diameter was increased.

Table 4 shows that non rhizobium gave less number of pods per plant as compared with seed inoculation of EM + EM spray on soil after 20 days. See inoculation of EM showed an increase over non rhizobium but the difference was statistically non-significant. In seed inoculation of EM + EM spray on soil after 20 days much increase was observed than with seed inoculation of EM and there was statistically significant difference between seed inoculation of EM and seed inoculation of EM + EM spray on soil after 20 days. Mehta and Rao (1996) and Rasu and Ghosh (1996) reported that seed inoculation increased the pod yield of groundnut.

Table 5 Shows statistically low percent contents of N in roots as with seed inoculation of EM and seed inoculation of EM + EM spray on soil after 20 days. There was statistically non-significant difference between seed inoculation of EM and seed inoculation of EM + EM spray on soil after 20 days. Both the varieties had statistically similar N content in the roots. Fu *et al*. (1995) reported that in groundnut plants inoculated with NH_{14} strain nodule weight, above ground dry weight and Nitrogen contents were higher than inoculated with strain 147.3.

Table 2: Effect of EM application on the average weight of effective noduls (g nodule^{-1})

Treatment/Varieties	V_1	V_2	Average
Non rhizobium	0.04 c	0.04 c	0.040 B
Seed inoculation of EM	0.05 b	0.04 c	0.045 B
Seed inoculation of EM + EM spray on soil after 20 days	0.06 a	0.05 b	0.055 A
Average	0.050 A	0.043 B	

Means bearing similar letters are statistically similar at 5% probability level

Table 3: Effect of EM application on the average diameter of effective nodules (mm)

TreatmentNarieties	V_1	V_2	Average
Non rhizobium	1.4 b	1.3 c	1.35 B
Seed inoculation of EM	1.5 a	1.4 b	1.45 A
Seed inoculation of EM + EM spray on soil after 20 days	1.5 a	1.5 a	1.50 A
Average	1.47 A	1.40 B	

Means bearing similar letters are statistically similar at 5% probability level

Table 4: Effect of EM application on the number of pods (# plant)

Treatment/Varieties	V_1	V_2	Average
Non rhizobium	15.0 c	12.0c	13.5 B
Seed inoculation of EM	17.3 bc	16.6bc	16.9 B
Seed inoculation of EM + EM spray on soil after 20 days	26.3 a	20.3bc	23.33 A
Average	19.5 A	16.3 B	

Means bearing similar letters are statistically similar at 5% probability level

Table 5: Effect of EM application on Nitrogen contents in roots (%)

Treatment/Varieties	V_1	V_2	Average
Non rhizobium	0.65 d	0.63 d	0.64 B
Seed inoculation of EM	0.79 b	0.74 c	0.77 A
Seed inoculation of EM + EM spray on soil after 20 days	0.84 a	0.81ab	0.83 A
Average	0.76 A	0.73 A	

Means bearing similar letters are statistically similar at 5% probability level

Table 6: Effect of EM application on Nitrogen contents in shoots (%)

Treatment/Varieties	V_1	V_2	Average
Non rhizobium	0.70 c	0.70 c	0.70 B
Seed inoculation of EM	0.74 b	0.726c	0.71 B
Seed inoculation of EM + EM spray on soil after 20 days	0.79 a	0.74 b	0.77A
Average	0.74 A	0.72 A	

Means bearing similar letter are statistically similar at 5% probability level

Table 7: Effect of EM application on the yield of groundnut (kg ha^{-1})

Treatment/Varieties	V,	V2	Average
Non rhizobium	1206 b	1092 b	1149.0 C
Seed inoculation of EM	1383 a	1214 b	1298.5 B
Seed inoculation of EM + EM spray on soil after 20 days	1471 a	1336ab	1403.5 A
Average	1353.3A	1214.0 B	

Means bearing similar letter are statistically similar at 5% probability level

In Table 6 data shows treatments had statistically significant difference non rhizobium shows less nitrogen contents in shoots compared to seed inoculation of EM however the difference was non-significant. Seed inoculation of EM + EM spray on soil after 20 days shows much increase as compared to seed inoculation of EM and it was statistically higher then with non rhizobium and seed inoculation of EM between the varieties is non-significant. Dineshkumar and Rao (1997) found that groundnut plants treated with inorganic nitrogen had maximum plant height and plant nitrogen. The ground nut yield was statistically different in both the varieties where V_1 gave the better yield (Table 7). Similarly, the yield

was also affected by EM treatments id which seed inoculation of EM + EM spray on soil after 20 days produced statistically higher yield than under seed inoculation of EM and non rhizobium EM application through seed inoculation of EM also proved to be statistically better than non rhizobium This shows that EM application on the soil through spray enhances the rhizobium activity and strengthens the seed inoculation benefits. Similar effects of increased yield by EM application on mungbean and bush bean have been reported by Sangakkara and Higa (1994). Other scientists like Chetti *et al*. (1995) and Mehta and Rao (1996) have reported an increase in groundnut yield through rhizobial inoculation on seed.

References

Chetti, M.B., E. Antony, U.V. Mummigatti and M.B. Dodamani, 1995. Role of nitrogen and Rhizobium on nitrogen utilization efficiency and productivity potential in groundnut genotypes. Farming Syst., 11: 209-216.

Dineshkumar, T.K. and A.R.M. Rao, 1997. Screening for Rhizobium Isolates for Symbiotic Efficiency in Pot Culture. In: Microbial Biotechnology: Professor K.S. Bilgrami Commemoration Volume, Reddy, S.M., H.P. Srivastava, D.K. Purohit and S.R. Redd (Eds.). Scientific Publisher, Jodphur, India, pp: 75-78.

Duncan, D.B., 1955. Multiple range and multiple F tests. Biometrics, 11: 1-42.

Fu, G., J. Zhu, G. Zhou, F. Zhu and J.C. Zhou, 1995. Constriction of a N-fixing ground nut Rhizobium strain NH 14. J. Huzzhong Agric. Univ. China, 14: 207-212.

Jackson, M.L., 1962. Soil Chemical Analysis. Prentice-Hall Inc., Englewood Cliffs, NJ., USA.

Khan, A.R. 1996. Maximizing the research benefits of groundnut on farmer's fields. Pakistan Agricultural Research Council, Islamabad, pp: 5.

Kumar, T.K.D. and A.R.M. Rao, 1997. Effect of Host Plant on Rhizobial Populations. In: Microbial Biotechnology, Bilgrami, K.S. and S.M. Reddy (Eds.). Scientific Publishers, Jodhpur, India, pp: 79-82.

Mehta, A.K. and D.S.R.M. Rao, 1996. Effect of Rhizobium inoculation nitrogen and phosphorus application on yield attributes of groundnut. Legume Res., 19: 151-154.

Nigam, S.N., M.J. Vasudeva Rao and R.W. Gibbons, 1990. Artificial hybridization in groundnut. Information Bulletin No. 29, International Crops Research Institute for the Semi-Arid Tropics, Patancheru, India, pp: 5. http://pdf.usaid.gov/pdf_docs/PNABF536.pdf.

Rasu, M.S. and P.K. Ghosh, 1996. The Status of Technologies used to Active Groundnut Yields in India. In: Achieving High Groundnut Yields, Gowda, C.C., S.N. Nigam and C. Johansen (Eds.). International Crops Research Institute for the Semi-Arid Tropics, Shandong, China, pp: 27-40.

Sangakkara, U.R. and T. Higa, 1994. Effect of EM on nitrogen fixation by bush bean and mung bean. Proceedings of the 2nd International Conference on Kyusei Nature Farming, October 7-11, 1991, Luiz de Queiroz College of Agriculture, University of Sao Paulo, Piracicaba, SP., Brazil, pp: 111-118.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: A Biometrical Approach. 2nd Edn., McGraw Hill Book Co., New York, USA., ISBN-13: 9780070609266, Pages: 633.

Wiandhare, V.K., H.B. Kalbhor and P.L. Patil, 1995. Effect of VA Mycbrrhiza. Rhizobium and Phosphorus on summer groundnut. J. Maharashtra. Agric. Univ., 20: 261-262