http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences, 2 (2): 452-454, 1999 *Research Article*

Role of Rhizobium Inoculation in Chickpea (*Cicer arietinum* L.) Under Water Stress Conditions

Rahat Parveen, M. Sadiq and Muzammil Saleem
Department of Botany, University of Agriculture, Faisalabad

Abstract

Two chickpea varieties viz., 90122 and 93081 were subjected to Rhizobium inoculation with BioPower under water stress conditions, imposed by withholding water. Stress reduced all the parameters including yield components and this effect was more pronounced by stress at reproductive stage as compared with vegetative stage. Rhizobium inoculation enhanced yield under both normal and stressed conditions, but its performance was better under normal than under stress. Rhizobium inoculation proved ineffective to recover loss caused by water stress. The two varieties exhibited statistically non-significant differences.

Introduction

Chickpea (*Cicer arietinum* L.) is the third most widely grown grain legume in the world (Anonymous, 1997). Being the cheapest and rich source of vegetable protein, fiber, carbohydrates and mineral matter it makes up the deficiency of cereal diets (Smartt, 1976).

In Pakistan chickpea crop is mostly grown in rainfed areas inhabited by low income people who cannot afford the use of costly chemical fertilizers. Biofertilizers like BioPower are proving good alternative for chemical fertilizers (Papastylianou, 1993). The micro-organisms like Rhizobium incorporated in the biofertilizers help in replenishing the soil fertility. Rhizobium inoculation in chickpea can increase seed yield upto 15 percent and improves nodulation, plant biomass and N content (Thukral and Mishra, 1993).

Water stress has significant reducing effect on number of leaves, fresh weight, number of nodules and seed yield (Akhtar *et al.,* 1997). The rainfed regions of Pakistan, sometimes undergo long dry periods and crops including chickpea have to face water stress cycles at various stages which adversely affects the plant growth. In such a situation Rhizobium inoculation may provide some relief to the plants. Keeping this probability, the present study was undertaken to investigate the role of Rhizobium inoculation in chickpea grown under water stress conditions.

Materials and Methods

This study was conducted during winter 1997-98 in the Botanical Garden, University of Agriculture, Faisalabad to evaluate the effect of Rhizobium inoculation under water stress conditions on the growth and yield of two chickpea (*Cicer arietinum* L.) varieties i.e., 90122(V_1) and 93081(V_2). It was carried out in pots in a Completely Randomized design (CRD).

Chickpea seeds of both varieties were divided into two lots; one lot was treated with BioPower. Then seeds of each normal and inoculated seed lot were sown in their respective pots. After complete germination thinning was practiced to maintain three plants in each pot. Each treatment comprised of nine repeats. Following treatment schedule was adopted to apply different water stress treatments imposed by withholding water till incipient wilting at different stages of crop growth.

T_1 = Without BioPower (R_0) + normal irrigation (S_0) (control)
T_2 = Without BioPower (R_0) + stress cycle at vegetation stage (S_1)
T_3 = Without BioPower (R_0) + stress cycle at reproduct stage (S_2)
T_4 = With BioPower (R_1) + normal irrigation (S_0)
T_5 = With BioPower (R_1) + stress at vegetative stage (S_1)
T_6 = With BioPower (R_1) + stress at reproductive st (S_2)

Data about various morphological and yield parameter were noted at the maturity of crop and subjected statistical analysis using analysis of variance technique while Duncan's New Multiple range test was applied compare means (Steel and Torrie, 1980).

Results and Discussion

Water stress treatments showed a decreasing trend in various parameters as compared with normal irrigation (Table 1). As a result reduction was encountered for all the vegetative and yield parameters. Water stress imposed reproductive stage most adversely affected plant dry weight and yield parameters while stress imposed at vegetative' stage moderately affected all these parameters. A striking difference was noted regarding number of pods set and seeds formed by plants stressed at two stages. During reproductive phase the stress was imposed at the start of flowering and continued through pod initiation to seed formation stage. Therefore, the number of pods produced and number of seeds initiated were markedly affected as compared with vegetative stage stress, which covered mainly the growth period before bloom of reproductive phase. In both cases plants got relieved from stress during the maturation of seeds. As such the difference in weight of seeds in both stress stages and control was not pronounced.

Table 1: Interactive effect of Rhizobium inoculation and water stress in chickpea

	Without Rhizobium (R_0)			With Rhizobium (R_1)		
	S_0	S_1	S_2	S_0	S_1	S_2
Plant height (cm)	45.40	39.20	34.10	48.70	39.60	34.30
No. of branches/plant	4.90bc	3.30d	4.30c	6.70a	3.50d	5.20b
Plant dry weight (g)	2.30b	1.81d	1.40c	2.99a	1.70cd	1.63cd
No. of pods/plant	4.70	4.20	2.50	6.00	4.80	3.00
No. of seeds/pod	1.60	1.40	1.30	1.70	1.50	1.30
100-seed weight (g)	17.68	16.54	15.18	17.03	16.08	14.85
Seed yield/plant (g)	1.21	0.88	0.51	1.40	1.06	0.64

S_0 = Normal irrigation; S_1 = Stress at vegetative stage; S_2 = Stress at reproductive stage

Table 2: Response of two chickpea varieties to Rhizobium inoculation and water stress

Parameters	V_1					V_2				
	R_o	R_1	S_0	S_1	S_2	R_o	R_1	S_0	S_1	S_2
Plant height (cm)	40.50b	38.40c	48.2a	38.4be	31.8d	38.6c	43.3a	45.9a	40.4b	36.6c
No. of branches/ plant	4.30b	4.10b	5.1	4.3	3.2	4.0b	6.2a	6.5	5.2	3.6
Plant dry weight (g)	1.91b	1.61c	2.35	1.63	1.31	17.6bc	2.60a	2.94	1.88	1.73
No. of pods/ plant	3.00	4.20	4.5	3.8	2.5	4.6	5.0	6.2	5.2	3.0
No. of seeds/pod	1.40	1.50	1.7	1.4	1.3	1.3	1.4	1.5	1.3	1.4
100-seed weight (g)	17.54	16.54	17.83	17.07	16.21	15.40	15.44	16.88	15.55	13.83
Seed yield/ plant (g)	0.78	0.91	1.09	0.91	0.54	0.96	1.15	1.52	1.03	0.61

Reduction in yield components consequently decreased final seed yield; thus stress at reproductive stage (S_2) showed 54.28 percent reduction, while stress at vegetative stage indicated 24.28 percent reduction from normal irrigated plants (S_0). These results agree with previous studies as Kpoghomou *et al.* (1990), reported that in soybean stress imposed at flowering stage reduced the number of pods/plant, seeds/pod and 100-seed weight more than that given at vegetative stage. It is a fact that stress at various stages of growth produces different results; stress during reproductive phase proves more detrimental than that at vegetative phase. Flowering and seed formation stages are the most critical ones in the life of a plant as yield components are directly related with these phases of plant growth (Plies-Balzer *et al.*,1995). In Rhizobium inoculated plants an enhancement was corded in all parameters except 100-seed weight over control plants. Rhizobium inoculation with BioPower proved economically better because it produced 13.57 percent greater seed yield than plants not treated with BioPower. Similar results have been reported by Rajput (1994). Rhizobium inoculation under both normal irrigation and water stress conditions performed better than non-inoculated plants in all parameters except 100-seed weight. However, Rhizobium inoculation under normal irrigation conditions exhibited better performance than that under stress conditions. This may be attributed to the fact that water stress decreased N-fixation and plant growth (Salama Sinclair, 1994). However, under water stress condition also inoculation performed better than control confirming various studies (Simon *et al.,* 1992). Rhizobium inoculated plants stressed at reproductive stage greatly reduced morphological and yield-related parameters than plants stressed at vegetative stage.

Both varieties were negatively affected by water stress (Table 2). Highest values for various parameters were recorded in normal irrigation and the lowest related to stress at reproductive stage. Reduction in seed yield during reproductive stage stress in variety 90122 (V_1) was 16.51 percent while that of variety 93081(V_2) was 32.23 percent which indicates that V_1, tolerated stress better than V_2. Varieties exhibited very small differences in their response to Rhizobium (Table 2). Variety 93081 (V_2) slightly excelled variety 90122(V_1) for the inoculation results, by producing 16.52 percent more seed yield than its non-inoculated control as against 14.28 percent in the latter variety. These results support the view that effectiveness of inoculation mainly depends on proper and efficient Rhizobium strain for each cultivar of a crop (Badr-El-Din and Moawad, 1991).

References

Akhtar, K., A.R. Rao and M. Ashraf, 1997. Genetic potential of xeric mungbean (*Vigna radiate* (L.) Wilczed) germplasm against drought stress. Suranaree J. Sci. Technol., 4: 15-20.

Anonymous, 1997. Agricultural Production Year Book. Vol. 51, Food and Agriculture Organization of the United Nations, Rome, Italy.

Badr-El-Din, S.M.S. and H. Moawad, 1991. Response of chickling vetch, *Lathyrus sativus* L. and forage peas, *Pisum* Spp. to inoculation with *Rhizobium leguminosarum* in North Sinai coastal soils. Egypt. J. Microbiol., 26: 223-229.

Kpoghomou, B.K., V.T. Sapra and C.A. Beyl, 1990. Sensitivity to drought stress of three soybean cultivars during different growth stages. J. Agron. Crop Sci., 164: 104-109.

Papastylianou, I., 1993. Response of chickpea to *Rhizobium* inoculation II. Grain yield. Miscellaneous Reports 56, Agricultural Research Institute, Nicosia, pp: 7.

Plies-Balzer, E., T. Kong, S. Schubert and K. Mengel, 1995. Effect of water stress on plant growth, nitrogenase activity and nitrogen economy of four different cultivars of *Vicia faba* L. Eur. J. Agron., 4: 167-173.

Rajput, A.L., 1994. of cowpea (*Vigna unguiculata*) to Rhizobium inoculation, date of sowing and phosphorus. Indian J. Agron., 39: 584-587.

Salama, A.M. and T.R. Sinclair, 1994. Soybean nitrogen fixation and growth as affected by drought stress and potassium fertilization. J. Plant Nutr., 17: 1193-1203.

Simon, T., S. Kalalova and M. Sindelarova, 1992. Study nodulation and yield parameters of soybean aft application of two types of inoculants in different conditions of irrigation. Scient. Agric. Bohemoslovaca, 24: 215-219.

Smartt, J., 1976. Tropical Pulses. Longman Group Ltd., London, pp: 38-45.

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.

Thukral, V. and C.M. Mishra, 1993. Studies of the effect of *Rhizobium* strains on the yield of chickpea. Bhartiya Krishi Anusandham Patrika, 8: 147-150.