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Symbiotic Effectiveness of Acid Tolerant Nodulating *Rhizobia* on Growth, Yield and Nutrient Uptake of Pigeon pea (*Cajanus cajan* L.) in Acidic *Alfisols*

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ABSTRACT

The symbiotic association between root nodulating bacteria viz. *Rhizobium* and pulses enhance the crop agronomic characteristics, productivity and quality depending upon the symbiotic effectiveness of the bacterial strain. To evaluate this effectiveness, a study was conducted during December, 2019–April, 2020 (*rabi*) at Central Farm of Odisha University of Agriculture and Technology, Bhubaneswar- 751003, Odisha aimed at evaluating the efficiency of seven isolated *rhizobial* strains of pigeon pea viz. BRP-2, BRP-4, BRP-8, BRP-20, BRP-28, BRP-56 and a local strain CHRS-7 in a randomized block design with four replications. The pigeon pea *cv* PRG-176 was used for study. The results revealed that seed inoculation with different *Rhizobium* strains enhanced the plant height (41.84–90.09 cm), relative growth rate (0.410–0.898 mm day^{-1}), nodular characteristics, nodular nitrogen (3.11 to 4.11%), pod and seed characteristics in pigeon pea. In addition to that the potentiality of pigeon pea producing only 408 kg seed ha^{-1} without any seed inoculation could be enhanced to produce 888 kg seed ha^{-1} by seed inoculation in a coastal agroecosystem. The findings also revealed a better uptake of nutrients by the crop in *Rhizobium* inoculated practices that performed in the order Control <BRP-20<BRP-8<BRP-4<BRP-56<BRP-28<BRP-2<CHRS-7. The performance of local isolated *rhizobial* strain (CHRS-7) was better over other strains and it gives cardinal importance for the enhancement of pigeon pea growth, productivity and economics in a coastal acidic *Alfisols*.

KEYWORDS: Economics, growth, nutrient uptake, pigeon pea, productivity, *Rhizobia*

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1. INTRODUCTION

Pulses, the "Poor man's meat" are the annual grain legume crop categorized under family Fabaceae that serve as the primary protein source in majority of the Indian diet,which contributes almost half of the per day protein required for the average adult human which amounts to 0.66 g of protein/ kg body weight (Anonymous, 1998). India accounting a global acreage and production of 32% and 23%, respectively, their production is more or less stagnant for the last four decades ranging from 11–13 million tons (Ali and Kumar, 2006). Starting from the International year of pulses, 2016, India is on the track to attainself-sufficiency in pulse production. Thus, apart from soil amendment and conditioning efforts to attain a favourable growing condition for the bacteria, thorough evaluation of the performance of the strains is also required in order to determine their efficiency in farmers' field (Khaitov et al., 2020).

Pigeon pea(*Cajanus cajan*),second most important crop after grams,ranks first in area and production in the world with 80% and 67% of world's acreage and production, respectively. It is mainly grown in states of Maharashtra, Uttar Pradesh, Gujarat, Andhra Pradesh constituting about 80–90% of the area. In Odisha, the arhar production about 1.28 lakh tons with a fairly low productivity of 415 kg ha^{-1} comparing to the national productivity of 700 kg ha^{-1} (Commodity profile for pulses- IIPR, 2019).

The *Rhizobium* is a gram-negative bacterium, fix the atmospheric nitrogen into plant available forms with the help of enzyme nitrogenase (Hardarson et al., 1993; Brockwell et al., 1995; Sullivan et al., 2014; Vitousek et al., 2013). Symbiotic nitrogen (N_2) fixation is an alternative farming system which is eco-friendly, resilient to climate change, enhance soil biodiversity and soil ecosystem management (Adissie et al., 2020). Rhizobia strains as inoculants have been considered as a common approach to improve the effectiveness of symbiotic nitrogen fixation and legume productivity (Adhikari et al., 2013; Taylor et al., 2008). Studies, however, revealed that inoculation of exotic rhizobia failed to achieve the desired response in different legumes and environments (Ahmad et al., 1981; Giller, 2001). The potential for improving N_2 fixation, in this case, can be to use native isolates that are effective as well as competitive for nodulation. These native rhizobia are more persistent and effective, well adapted to local conditions and this gives them added advantage of competing successfully than the introduced strains for nodule occupancy (Fening and Danso, 2002).

Indian soils, naturally lack effective and specific strains of *Rhizobium* (Shaktawat, 1998; Araujo et al., 2008) and when such strains are introduced, their survival, persistence and symbiotic relationship with the legumes are adversely affected by many biotic and abiotic factorsincluding soil acidity (Appunu et al., 2009). Under favourable conditions, this microbial process produces as high as 176 kg N ha^{-1}, contributing about 85% of the N requirements in legume crops (Gopalakrishnan et al., 2014), which reduces the economic and environmental cost of excessive use of chemical fertilisers. Slightly acidic to neutral soil reaction is optimum for growth and activity of rhizobia*l* species which could be achieved by liming practices in acid soil (Mkhonza et al., 2020). Another effort to tackle adverse edaphological conditions could be introduction of tolerant rhizobia*l* strains, e.g. acid tolerant strains (Sethi et al., 2019). Taking all the above points into consideration the present study was framed to conduct a field experiment to evaluate the performance of isolated acid tolerant rhizobia from arhar growing areas on growth, yield and nutrient uptake by pigeon pea in an acidic *Alfisols* of Odisha.

2. MATERIALS AND METHODS

A field experiment was conductedat the Central farm of Odisha University of Agriculture and Technology, Bhubaneswar, India (GPS:20°16'46" N, 85°47'57" E) during December, 2019–April, 2020 to assess the field performance of crop pigeon pea (arhar) cv. PRG-176 inoculated with six acid tolerant isolated arhar rhizobia strains viz., BRP-2, BRP-4, BRP-8, BRP-20, BRP-28, BRP-56 (supplied by All India Network Project on Biodiversity Biofertilizers, Bhopal, India) in addition to a local acid tolerant strain, CHRS-7 isolated from the root nodules of pigeon pea (*Cajanus cajan*). The experimental soil was sandy (83.2% sand, 7.8% silt and 9.0% clay) in texture and classified under Order *Alfisols.* It was strongly acidic in reaction having pH_w (1:2.5) of 4.60. The organic carbon status of the soil was low (3.38 g kg^{-1}). The available nitrogen (218 kg ha^{-1}), Bray's extractant phosphorus (10.60 kg ha^{-1}), Ammonium acetate extractable potassium (97.2 kg ha^{-1}) and extractable sulphur (6.05 kg ha^{-1}) was found to be low in status. Standard protocols were adopted (Page et al., 1982, Panda, 2019) to estimate the above soil parameters. The liming material ($CaCO_3$) was given to the designated treatment plots @ 0.2 LR. Soil test-based dose (STD) of fertilizer of 20-50-50-37.5 kg of N-P_2O_5-K_2O-S kg ha^{-1} as basal dose in the form of Navaratna (20-20-0-13), single super phosphate (SSP) and muriate of potash (MOP) were applied respectively. The organic (vermicompost @ 3 t ha^{-1}) was applied to each plot at the time of sowing of seeds. The STD and organics were common to all the treatments.

The arhar seeds were inoculated 2 hours before sowing with different *Rhizobium* strain inoculants @ 50 ml kg^{-1} as per the requirement, dried in shade and used for sowing immediately.Prior to seven days of the sowing, seeds were treated with Bavistin @ 2 gk g^{-1} to overcome the fungal pathogen attack.

The number of nodules per plant was counted and fresh weight of nodules was recorded. Fresh nodules weighing 0.5g were digested and nodular nitrogen was estimated by micro Kjeldahl distillation method (Anonymous, 1960). As per the method outlined by (Piper, 1950), concentration of individual nutrient calculated and was multiplied with dry matter production of seed and stover (Nayak et al., 2016; Pradhan et al., 2019) to get the respective amount of uptake (kg ha^{-1}). The economics (benefit: cost ratio) of using biofertilizers over STD was calculated considering the input costs at the time of conduct of experiment and the market value of the produce.

The experiment was laid out in Randomized Block Design with 9 (nine) treatments, replicated four times in which plots had a dimension of 5×4 m (20 m^2) with 1 m distance between the experimental plots as well as the replications to maintain the isolation distance. The details of the treatments adopted were as follows; T_1: Absolute control (Control), T_2: No *Rhizobium* inoculation of seed (Soil test dose of fertilizers –STD), T_3: Seed inoculated with S_1 strain of *Rhizobium* (BRP-2), T_4: Seed inoculated with S_2 strain of *Rhizobium* (BRP-4), T_5: Seed inoculated with S_3 strain of *Rhizobium* (BRP-8), T_6: Seed inoculated with S_4 strain of *Rhizobium* (BRP-20), T_7: Seed inoculated with S_5 strain of *Rhizobium* (BRP-28), T_8: Seed inoculated with S_6 strain of *Rhizobium* (BRP-56), T_9: Seed inoculated with S_7 strain of *Rhizobium* (CHRS-7).

To calculate the relative symbiotic effectiveness of the isolated strains the following formula was used (Purcino et al., 2000).

Relative symbiotic effectiveness=(Shoot dry weight of inoculated plots-Shoot dry weight of N fertilized plot/ "Shoot dry weight of N fertilized plot)×100

The analysis of variance (ANOVA) of different variables of different treatments was statistically calculated at p=0.05 level of significance (Panse and Sukhatme, 1985).

3. RESULTS AND DISCUSSION

3.1. Plant height and relative growth rate of pigeon pea

Plant growth and relative growth rate are important agronomic parameters that lead to sustainable crop production. Under the influence of seed inoculation with seven strains of *Rhizobium*, the test crop pigeon pea started growing differentially and attended height ranged from 49.33–107.53 cm by 120th day after sowing. During this phase the crop was growing @ 0.01–0.13 mm day^{-1} (Table 1). The mean height attended by the crop which varied between 69.33 and 107.53 cm in inoculated plots, lowest with no seed inoculation control and highest with seed inoculation with CHRS-7 inoculant. Based on the relative growth rate of the crop due to seed inoculation with various *Rhizobium* strains can be arranged as: BRP-20<BRP-56 =BRP-28, <CHRS-7<BRP-8<BRP-4<BRP-2<CHRS-7. These results are in conformity with the findings of Yadav et al. (2011) and Ramesh et al. (2016).

3.2. Nodular characteristics

The results related to the nodule characteristics of crop pigeonpea have been presented in Table 1. The test crop produced differential number of nodules plant^{-1} under the influence of seed inoculation with different strains of *Rhizobium*. The number of nodules plant^{-1}varied in the ranged from 10–27, lowest with no seed inoculation control and highest with seed inoculation of native strain CHRS-7.

The effective nodules per plant were varied from 6–26 per plant. The lowest number was observed in no seed inoculation control and highest with CHRS-7. The percent of effective nodules per plant varied from 53–96%, lowest in BRP-20 and highest in CHRS-7 strain. The mean fresh weight of nodules collected from five randomly selected plants from each treatment varied from 1.26–1.81 g plant^{-1}. The lowest nodule weight was measured in seed inoculation with BRP-20 and the CHRS-7 being the best strain to produce significantly higher fresh weight than all other *Rhizobium* strains. The nitrogen content in collected nodules ranged from 3.11–4.41%, lowest in control practice, receiving no seed inoculation and highest with CHRS-7 inoculation. This enhancement may be due to nitrogenous assets like ammonia that assimilates into organic nitrogenous compounds like amino acids in nodules (Trainer et al., 2010; Fujita et al., 2014). Similar findings were also reported by Tagore et al. (2013) and Choudhury et al. (2016).

3.3. Pod and seed characteristics

The results pertaining to the pod and seed characteristics of pigeon pea under the influence of *Rhizobium* seed inoculation of seven strains have been presented in the Table 1. The mean pod length of ten randomly selected pods from each treatment varied from 43–57 mm. The smallest pod length was recorded in control receiving no seed inoculation and seed inoculated with CHRS-7 had significantly larger pods. The number of seeds per pod ranged from 2.5–3.9, least in the control and highest due to CHRS-7. Similar trend was observed with filled seeds pod^{-1}. In the control practice, receiving no seed inoculation resulted in lowest number of filled seeds pod^{-1} (1.2 filled seeds pod^{-1}) which was 49% of the total seeds produced per pod and CHRS-7 inoculated crop produced highest number of filled seeds pod^{-1} which was 79% of the total number of seeds pod^{-1}. There was no significant difference in number of unfilled seeds pod^{-1}.

The 100-seed weight of pigeon pea under the influence of inoculation with seven *Rhizobium* strains had differential results. This varied between 11.2–21.2 g. The control having

Table 1: Change in plant height, relative growth rate (RGR), nodule, seed characteristics, productivity and economics during crop growth period under the influence of *rhizobium* strains

Treatments	Plant heights (cm)	RGR (mm day^{-1})	Nodular characteristics			
	120 DAS	120 DAS	No. of nodules Plant^{-1}	No. of effective nodules plant^{-1}	Nodule fresh weight (g plant^{-1})	Nodular nitrogen (%)
T_1: Control	49.33	0.01	10	6(60)*	1.28	3.27
T_2: STD	67.56	0.01	11	7(63)	1.39	3.11
T_3: BRP-2	99.90	0.13	13	9 (71)	1.62	3.70
T_4: BRP-4	95.66	0.12	16	11(68)	1.43	3.75
T_5: BRP-8	98.00	0.09	13	9 (70)	1.48	3.85
T_6: BRP-20	69.33	0.03	19	10 (53)	1.26	3.16
T_7: BRP-28	95.33	0.07	23	19 (83)	1.40	3.63
T_8: BRP-56	72.22	0.07	21	19 (91)	1.58	3.81
T_9: CHRS-7	107.53	0.08	27	26 (96)	1.81	4.41
LSD (p=0.05)	7.43	0.006	2.6	2.0	0.26	0.54

Table 1: Continue...

Treatments	Pod and seed characteristics					Productivity (kg ha^{-1})			HI (%)	RSE (%)	B:C ratio
	Pod length (mm)	Seeds pod^{-1} (nos.)	Filled pod^{-1} (nos.)	Unfilled seeds pod^{-1} (nos.)	100- Seed weight(g)	Seed	Stover	Total			
T_1: Control	43	2.5	1.2 (49)**	1.3	11.2	356	1564	1920	18.5	-	1.05
T_2: STD	48	2.8	1.7 (61)	1.1	14.5 (29)***	408	1787	2195	18.6	-	1.11
T_3:BRP-2	52	3.3	2.4 (74)	0.9	19.6 (75)	820	3452	4272	19.2	94.6	2.24
T_4: BRP-4	48	2.9	1.9 (66)	0.9	14.4 (29)	756	3519	4275	17.6	94.7	2.07
T_5: BRP-8	47	3.0	2.3 (75)	0.8	14.8 (32)	750	3416	4166	18.0	89.8	2.05
T_6: BRP-20	45	2.8	1.9 (64)	1.0	14.2 (27)	745	3440	4185	17.8	90.7	2.04
T_7: BRP-28	50	3.5	2.5 (71)	1.0	16.5 (47)	798	3230	4028	19.8	83.5	2.18
T_8: BRP-56	51	3.3	2.6 (81)	0.6	17.8 (59)	790	3035	3825	20.6	74.3	2.16
T_9: CHRS-7	57	3.9	3.1 (79)	0.8	21.2 (89)	888	3521	4409	20.1	100.9	2.43
LSD (p=0.05)	5.3	0.5	0.8	-	1.5	32	136	142	-	-	-

DAS: Days after sowing; *: Data in the parenthesis indicate effective nodule per cent,**Data in the parenthesis indicate % filled seed per pod; ***: Data in the parenthesis indicate % increase of 100-seed weight over no inoculation, RSE (%): Relative symbiotic effectiveness

no seed inoculation recorded lowest 100-seed weight and that of with CHRS-7 was highest. The performance of seed inoculation with *Rhizobium* strains influencing 100-seed weight was in the trend of BRP-20<BRP-4< BRP-8<BRP-28<BRP-56<BRP-2<CHRS-7. These results are also in line with the findings of Das et al. (2016) and Khaitov et al. (2020).

3.4. Productivity and relative symbiotic effectiveness of pigeon pea

Pigeon pea establishes a mutually beneficial symbiotic relationship with the rhizobia which in turn provides nitrogenous assets that assimilates into organic nitrogenous compounds like amino acids. (Trainer et al., 2010; Fujita et al., 2014). This symbiotic relationship leads to a better crop productivity in legumes (Ferguson et al., 2013). Hence a differential production pattern of seed, stover and the total dry matter production of pigeon pea under the influence of seed inoculation with *Rhizobium* strains are presented in Table 1. The seed yield variedfrom 356 kg ha^{-1}-888 kg ha^{-1} in different strains inoculation which was less than the stover yield that varied from 1564–3521 kg ha^{-1}. The lowest productivity was recorded with the control and highest with the CHRS-7 inoculated plots. However, total crop productivity ranged from 1920–4409 kg ha^{-1} with the similar trend. Seed inoculation with different strains of *Rhizobium* influenced the seed yield significantly compared over no inoculation. The response of local strain (T_9: CHRS-7) performed better over all other strains. The pigeon pea crop exhibited harvesting values (economic yield to total biomass production) ranging from 18.5–20.6%, lowest (18.5) with no seed inoculation (T_1: Absolute control) and highest (20.6) with seed inoculated with strain (BRP-56). The harvest index increased differentially under the influence of different *Rhizobium* strains which indicated relative increase in seed yield over total biomass yields due to inoculation. The relative symbiotic effectiveness (RSE) of different isolated strains showed a numerical variation among themselves in terms of shoot biomass yield. The higher RSE value was calculated in local isolated strains of *Rhizobium* (CHRS-7) which was 100.9%. These findings may be due to better biological nitrogen fixation by the local isolated strains (He et al., 2011).

3.5. Economics

The benefit cost ratio (B:C ratio) of the present experiment taking Pigeon pea as the test crop are presented at Table 1. Economics depends on cost of cultivation up to the stage of harvest and the cost of produce that include factor costs up to the stage of marketing of the produce. It reflects the best nutrient management practices with respect to crop productivity. This study revealed that the B:C ratio of different treatments varies from 1.05–2.43. However taking biofertilizers use into consideration, better economics was estimated in using local isolated strains at T_9 (2.43) over other inoculated treatments. But in STD treatments (T_2) the B:C ratio was much less (1.11) as compared to other inoculated treatments. Hence inoculation of biofertilizers with seeds and its integration with inorganic fertilizers through soil test dose (STD) could enhance productivity as well as economics of the crop Pigeon pea (Tagore et al., 2013).

3.6. Nutrients concentration and their uptake by pigeon pea

3.6.1. Nitrogen (N) concentration and uptake

The results pertaining to the nitrogen concentration, uptake by seed, stover and the plant as well as the extra N gain are presented in Table 2. The N concentration in the seeds ranged from 2.13–3.48% was comparatively higher than that ofstover, ranging between 1.01–1.50%. Such distribution of N in the crop resulted in uptake of 7.6–30.9 kg ha^{-1} through seed and 15.8–52.8 kg ha^{-1} through stover. The concentration of N was lowest in strain (T_6: BRP-20). Highest N concentration in seed (3.48%), stover (1.50%) helped the crop to remove 83.7 kg N ha^{-1} with inoculation of local isolated strain CHRS-7. The total uptake of N by the crop varied from 23.4–83.7 kg ha^{-1}, lowest in the control and highest in the seed inoculation with local strain CHRS-7. The N gain by the crop was improved by adopting seed inoculation practice with different *Rhizobium* strains. The extra N gain compared to the no seed inoculation (STD) ranged from 26.5–49.4 kg ha^{-1}. It was lowest in BRP-20 and highest in local isolated CHRS-7 strains.

3.6.2. Phosphorous (P) concentration and uptake

The data relating to concentration and uptake of P by the crop as well as extra P uptake are depicted in Table 2. The concentration of P was more in seeds ranging from 0.12–0.18%, lowest was in strain BRP-20 and highest in local isolated strain CHRS-7. The concentration in stoverwas less compared to seeds and it varied from 0.040–0.052%, lowest in BRP-4 and highest in local strain CHRS-7. Such distribution of phosphorous resulted in uptake of 0.4-1.6 kg ha^{-1} through seed and from 0.6–1.8 kg ha^{-1} through stover. The uptake of P through seed as well as stover was lowest in control and highest in the seed inoculated with the local isolated strain CHRS-7. The total uptake of phosphorous by pigeon pea varied from 1.0–3.4 kg ha^{-1} when the seeds were uninoculated and inoculated with local strain CHRS-7, respectively. The extra P uptake by the crop compared to the no seed inoculation (STD) varied from 0.9–1.9 kg ha^{-1}, lowest in the seed inoculated with BRP-4 and highest in that with CHRS-7.

3.6.3. Potassium (K) concentration and uptake

The results pertaining to concentration K and its uptake by seed and stover as well as extra K uptake over no inoculation (STD) are presented in Table 2. The potassium concentration was estimated low in seed (0.79–0.91%) as compared to that of stover (1.21–1.66%). It was lowest in uninoculated control and highest with local inoculated CHRS-7 strain. Such distribution of K resulted in uptake of K through seed that ranged from 2.8–8.1 kg ha^{-1} and through stover it ranged from 18.9–55.1 kg ha^{-1}, lowest in no seed inoculation control and highest in seed inoculation with local strain CHRS-7. The total K uptake by pigeon pea varied between 21.7–63.2 kg ha^{-1}. The extra potassium uptake by pigeon pea due to inoculation of different *Rhizobium* strains varied from 31.0–36.0 kg ha^{-1}. The lowest was with the inoculation of BRP-4 strain and highest was with local CHRS-7 strain.

The seed inoculation with *Rhizobium* strains had a positive impact on the N, P, and K uptake by pigeon pea. Better nutrient recycling occurring due to the introduction of the bacterial infection through inoculated *Rhizobium* strains in pigeon pea rhizopsheric ecosystem that enhanced the concentration of nutrients in seed and stover, as well as the their uptake (Choudhury et al., 2016; Suryakant et al., 2016; Nagar and Dashora, 2017).

Table 2: Concentration and uptake of nutrients (N, P, K) by pigeon pea under the influence of *rhizobium* strains

Treatments	Concentration of N (%)		Uptake of N by plant (kg ha^{-1})				Concentration of P (%)		Uptake of P by plant (kg ha^{-1})			
	Seed	Stover	Seed	Stover	Total	Extra N gain over STD	Seed	Stover	Seed	Stover	Total	Extra uptake over STD
T_1: Control	2.13	1.01	7.6	15.8	23.4	--	0.12	0.040	0.4	0.6	1.0	-
T_2: STD	2.94	1.25	12.0	22.4	34.3	--	0.14	0.048	0.6	0.9	1.5	-
T_3:BRP-2	3.19	1.42	26.2	49.4	75.5	41.2	0.13	0.049	1.1	1.7	2.8	1.3
T_4: BRP-4	3.22	1.19	24.4	42.1	66.4	32.1	0.13	0.040	1.0	1.4	2.4	0.9
T_5: BRP-8	2.94	1.15	22.1	39.7	61.8	27.5	0.15	0.042	1.1	1.4	2.5	1.0
T_6: BRP-20	2.82	1.15	21.0	39.8	60.8	26.5	0.12	0.046	0.9	1.6	2.5	1.0
T_7: BRP-28	3.17	1.30	25.3	42.4	67.7	33.4	0.17	0.048	1.4	1.6	3.0	1.5
T_8: BRP-56	3.19	1.36	25.2	41.3	66.5	32.2	0.17	0.050	1.3	1.5	2.8	1.3
T_9: CHRS-7	3.48	1.50	30.9	52.8	83.7	49.4	0.18	0.052	1.6	1.8	3.4	1.9
LSD (p=0.05)	0.30	0.23	2.5	8.3	9.0	--	0.05	0.007	0.4	0.3	0.5	-

Table 2: Continue...

Treatments	Concentration of K (%)		Uptake of K by plant (kg ha^{-1})			
	Seed	Stover	Seed	Stover	Total	Extra uptake over STD
T_1: Control	0.79	1.21	2.8	18.9	21.7	-
T_2: STD	0.81	1.34	3.3	23.9	27.2	-
T_3:BRP-2	0.91	1.47	7.4	50.8	58.2	31.0
T_4: BRP-4	0.83	1.40	6.3	49.1	55.4	28.2
T_5: BRP-8	0.85	1.36	6.4	46.7	53.1	25.9
T_6: BRP-20	0.92	1.32	6.9	45.5	52.3	25.1
T_7: BRP-28	0.91	1.61	7.3	52.1	59.4	32.2
T_8: BRP-56	0.89	1.55	7.0	47.1	54.1	26.9
T_9: CHRS-7	0.91	1.66	8.1	58.44	66.54	39.3
LSD (p=0.05)	0.06	0.18	0.5	2.8	6.7	-

4. CONCLUSION

Pigeon pea rhizobia strains confirmed that their inoculation with thehost crop stimulated the plant growth, nodular characteristics, pod and seed characteristics, productivity, economics and nutrient uptake. However, the local rhizobia inoculation significantly affected all the growth parameters, economics and productivity of pigeon pea over other strains. Relative symbiotic effectiveness showeda better response in local inoculated rhizobia stain (CHRS-7) over other strains that gives paramount importance for the enhancement of Pigeon pea productivity in a coastal acidic *Alfisols*.

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