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Growth Behavior of Pigeonpea [*Cajanus cajan* (L.) Millsp.] in Pigeonpea based Cropping System in Response to Integrated Nutrient Management Practices in Tarai region of Uttarakhand

Ashutosh Barthwal[1]*, V.K. Singh[1], Shambhoo Prasad[3], Naveen Singh Rawat[2] and M.P. Semwal[1]

[1]Department of Agronomy, [2]Department of seed Science and Technology, College of Agriculture, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttarakhand, India
[3]College of Forestry, Uttarakhand University of Horticulture and Forestry, Ranichauri, Tehri Garhwal, Uttarakhand, India

**Corresponding author*

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A B S T R A C T

A two year field experiment on Growth behavior of Pigeonpea [*Cajanus cajan* (L.) Millsp.] in Pigeonpea Based Cropping System in response to Integrated Nutrient Management Practices in *Tarai* region of Uttarakhand was conducted at Norman E. Borlaug Crop Research Centre, GBPUA&T, Pantnagar, Uttarakhand. Analysis of the two years average data indicated that Pigeonpea + Urd cropping system resulted in Maximum dry matter accumulation (g/plant), Crop growth rate (g/day), Relative growth rate (g/g/day) biological yield and yield of pigeonpea as compared to rest of the cropping system. Application of Recommended Dose of Fertilizer + vermicompost @ 2.5 t/ha found as effective as Recommended Dose of Fertilizer + Farm Yard Manure @ 5.0 t/ha and improved all the growth and yield parameters of pigeonpea than Recommended Dose of Fertilizer alone. Inoculation of seed with PSB attained significantly higher growth and yield parameters than that obtained without inoculation during both the years.

Introduction

Among pulses pigeonpea a [*Cajanus cajan* (L.) Millsp.] is the most important rainy season crop in India. The production of pigeonpea has increased over the years. The increase in production is a result of increase in area, however, the overall productivity of pigeonpea has remained stagnant for last several decades (Anonymous, 2016).

Growing of pigeonpea as a sole crop is not economically viable due to its low productivity and longer duration. Intercropping of short duration cereals and pulses provides an opportunity to utilize available resources more efficiently with enhancement of productivity and profitability

of the system. In India, pigeonpea is generally intercropped with maize, sesamum, soybean, mungbean and groundnut. In general, intercropping has been reported to be more productive than monocropping (Ghosh *et al.*, 2006) this might be through efficient use of light energy and other growth resources. Among the different factors of production, inadequate fertilizer management has remained major constraint forever. Component crops in intercropping systems use the same resources in different forms (Szumigalski and Acker, 2005). The greatest limitation of increasing the productivity of crops in intercropping system is inadequate supply of nutrients since most of the soils are poor in native fertility and continuous application of fertilizers even in balanced form may not sustain soil fertility and productivity.

Thus, balanced fertilization along with sound crop husbandry offers a great scope for increasing productivity. However, when crops are intercropped by increasing the overall density, nutritional deficiency is likely to occur. The optimum dose of nutrients plays an important role in increasing the productivity of these crops. Crop growth rate and Relative growth rate are used extensively in growth analysis of field crops and these physiological parameters are best measure of the total performance of the crop (Nataraja *et al.*, 2006). These growth parameters mainly depend on management practices and climatic condition. The growth attributes and vegetative characters are directly influenced by Resource utilization and availability of nutrients in the soil. With this background, present investigation was planned to investigate the "Growth behavior of Pigeonpea [*Cajanus cajan* (L.) Millsp.] in Pigeonpea Based Cropping System in response to Integrated Nutrient Management Practices" in *Tarai* region of Uttarakhand.

Materials and Methods

A two year (2010 and 2011) field experiment was conducted in D_6 block of Norman E. Borlaug Crop Research Centre, G. B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). The centre is situated at 29^0 N latitude, 79.3^0 E longitude and at the altitude of 243.83 metres above the mean sea level. It is located in the *tarai* belt of Uttarakhand, 30 Km southwards of foot hills of Shiwalik range of the Himalayas. The maximum temperature during the crop seasons ranged between 13.6 - 33.3^0C and 18.4-35.6^0C while the minimum temperature varied between 5.3-26.3^0C and 3.7-26.1^0C, respectively. The total rainfall of 1729.2 mm received during first year which was much lower than that of rainfall of 2032.8 received during second year.

The field was ploughed once, harrowed thrice and leveled properly with the help of tractor drawn implements. Pre–sowing irrigation was not applied as sufficient moisture was available in the soil during both the year. A composite soil sample was taken from the experimental plot before sowing of crops upto a depth 15 cm and analyzed for different constituents. The soil of the experimental plot was sandy loam in texture. The soil was found high in organic carbon, low in available nitrogen and medium in available phosphorus and potassium content with neutral in soil reaction.

The experiment plot (4.5 m X 4.0 m) was laid out in split plot design keeping three cropping system as main plot and three fertility status as sub plot with three replications. Among the treatments, Sole Pigeonpea, Pigeonpea + Urdbean (1:2) and Pigeonpea + Maize (1:2)} was selected as cropping system, whereas, Recommended dose of fertilizer (RDF), Recommended dose of fertilizer (RDF) + Farm Yard Manure (FYM) @ 5.0 t/ha and Recommended dose of fertilizer (RDF) +

Vermicompost @ 2.5 t/ha) was selected as fertility status during the course of investigation. The Row spacing for pigeonpea, maize urdbean were 90 cm, 45 cm and 30cm respectively.

Recommended dose of fertilizer (RDF) for both urdbean and pigeonpea *i.e.* 20 Kg N + 40 Kg P_2O_5 + 30 Kg K_2O/ha, was applied as basal at the time of sowing. However, in maize RDF was 120 Kg N + 60 Kg P_2O_5 + 40 Kg K_2O/ha. Half of the nitrogen i.e., 60 Kg N and full dose of P_2O_5 and K_2O was applied as basal. Remaining half of N (60 kg N/ha) was top dressed in two equal splits, one at knee high stage and another at tasseling stage of the crop. Urea (46% N), Single Super Phosphate (16% P_2O_5) and Muriate of Potash (60% K_2O) were used as source for nitrogen, phosphorus and potassium, respectively. FYM @ 5.0 t/ha and Vermicompost @ 2.5 t/ha was also applied as per treatment on dry weight basis one week before sowing. Fertilizers in intercropping treatments were given as per row arrangements.

Urdbean (Pant U 31) and maize (Surya) were intercropped with pigeonpea (UPAS 120) as per treatment during both the years of experimentation and the seeds of urdbean/pigeonpea were sown @ 15 kg/ha and of maize @ 20 kg/ha. Pigeonpea and maize were sown on the same day while urdbean was sown 15 and 22 days after pigeonpea and maize sowing in order to avoid the excessive growth. After 15 days of sowing thinning was done in each crop as well as each plot to keep the plant to plant distance at 20 cm in pigeonpea and maize and 10 cm in urdbean, during both the years of experimentation. Weeds were controlled manually with the help of *Khurpi*.

During the investigation morpho-metric traits *viz*., dry matter accumulation, Mean crop growth rate and Mean relative crop growth rate was calculated for both the year respectively. The following important parameters were calculated according to their formulas.

Dry matter accumulation

For dry matter accumulation two plants of pigeonpea were selected randomly from different rows from East side in 0.5m row length leaving at least one plant as border in each row of each side of each plot and cut at the ground level at 30, 60, 90 and 120 DAS and at maturity Pigeonpea. The samples were sun dried first and then kept in oven at 65 ± 5^0C till the constant weight was achieved. Later on dry matter accumulation per plant was worked out.

Growth analysis

Total dry matter (g/plant) was used to calculate different parameter of growth analysis. The sample size was three plants.

a) Mean crop growth rate

$$\overline{(CGR)} = \frac{(W2 - W1)}{(t2 - t1)}$$

Where, W_1 and W_2 are total dry weight per plant at time t_1 and t_2, respectively.

b) Mean relative crop growth rate

$$\overline{(RGR)} = \frac{\log_e w_2 - \log_e w_1}{t_2 - t_1}$$

The collected data for various studies in pigeonpea, urdbean and maize crops were subjected to the statistical analysis by using STPR-1, programme developed by department of statistics and mathematics, college of basic science and humanities. Comparison of treatment means was done using critical differences (CD) at 5 per cent level of significance.

Results and Discussion

Dry matter accumulation

Dry matter accumulation in the pigeonpea plant increased with advancement in crop age and reached to maximum at harvest (Table 1). In general, dry matter accumulation recorded during 2011 was higher as compared to that of 2010 at all growth stages. The highest rate of dry matter accumulation was recorded between 90 and 120 DAS and reduced slightly till the harvesting during both the years. All the treatments significantly affected the pigeonpea dry matter accumulation at all the stages of crop growth during both the years. Pigeonpea plants under pigeonpea + urdbean system accumulated significantly more dry matter at all stages during both the years than pigeonpea sole as well as pigeonpea + maize cropping systems. Sole planting of pigeonpea produced significantly more dry matter than pigeonpea + maize cropping system. Maximum dry matter accumulation was found with the application of RDF + vermicompost @ 2.5 t/ha during both the years. Fertility treatments viz. RDF + vermicompost @ 2.5 t/ha and RDF + FYM @ 5.0 t/ha being at par recorded more dry matter over RDF alone. Seed inoculation with PSB accumulated significantly more dry matter per plant of pigeonpea than no inoculation at all the stages during both the years.

Growth analysis

Mean Crop Growth Rate (CGR)

In general, mean crop growth rate increased with advancement in crop age upto 120 days and it was recorded maximum between 90-120 days. Year 2011 recorded higher CGR than 2010. Cropping system, fertility level and PSB inoculation influenced CGR significantly at all the stages of crop growth during both the years (Table 2). Pigeonpea + urdbean cropping system recorded significantly higher CGR over remaining two systems at all the growth stages during both the years except 0-30 day in 2011 and 90-120 day in 2010. Pigeonpea sole ranked second which attained significantly higher CGR than pigeonpea + maize at all the growth stages during both the years. Treatments RDF + vermicompost @ 2.5 t/ha and RDF + FYM @ 5.0 t/ha were statistically comparable and produced higher CGR over RDF alone at all the stage during both the years. Seed inoculation with PSB increased CGR significantly over no inoculation at all the growth stages of crop growth during both the years.

Mean Relative Growth Rate (RGR)

Under present investigation increasing trend in RGR was noticed with increase in crop age upto 60-90 days stage. Thereafter, it decreased at 90-120 days stage during both the years. The maximum RGR was calculated during 60-90 days stage during both the years. All the treatments (Cropping system, fertility level and PSB inoculation) brought significant differences in RGR at different crop stages during both the years (Table 3). On an averaged RGR was more during 2011 as compared to 2010. Pigeonpea + urdbean cropping system improved RGR of the pigeonpea plants significantly over remaining systems at different stages during both the years.

Pigeonpea + maize intercropping system recorded minimum RGR at all the stages during both the years. Application of RDF + vermicompost @ 2.5 t/ha being at par with RDF + FYM @ 5.0 t/ha produced significantly higher RGR of pigeonpea plant over RDF alone. Inoculation of seed with PSB attained significantly higher RGR than that obtained without inoculation during both the years.

Yield and its components

In present study, yield and yield component its components of pigeonpea significantly influenced by intercropping system (Table 4). Maximum pigeonpea grain yield (1216 and 1892 kg/ha) was recorded when intercropped with urd than sole pigeonpea (1025 and 1415 kg/ha) while statistically minimum pigeonpea grain yield (656 and 675 kg /ha) was recorded when intercropped with maize. Similar trend was observed for biological yield, no. of pods per plant, grain weight, straw yield during both the years. Application of RDF + vermicompost @ 2.5 t/ha significantly higher number of pods/plant (138.52 and 149.19), Grain weight (38.05 and 52.05 g/plant), straw yield (4567 and 6058 kg/ha), biological yield (5592 and 7447 kg/ha) and yield (1029 and 1376 kg/ha) significantly over RDF alone, during both the years respectively. However the difference between application of either FYM @ 5.0 t/ha or vermicompost @ 2.5 t/ha were remain non significant.

Crop growth analysis, one of the basic approaches to the analysis of yield influencing factors and plant development as net photosynthate accumulation is naturally integrated over time. Growth analysis is frequently used by plant physiologist and agronomists. Achieving higher growth attributes such as crop growth rate (CGR) is well governed by utilization of available resources, fertility levels, available nutrients and favorable climatic condition. Resource utilization had remarkable effect on most growth analysis of pigeonpea. Crop growth rate (CGR), the gain in weight of a community of plants on a unit of land in a unit time, is used extensively in growth analysis of crops. It is regarded as the most common representative of growth function because it represents the net results of photosynthesis, respiration and canopy area interaction.

In general, year 2011 recorded higher CGR, RGR, dry matter accumulation, yield attributes and yield than 2010. Here it may be pointed out that total rainfall of 1729.2 mm received during first year which was much lower than that of rainfall of 2032.8 received during second year. Sufficient moisture availability and favorable climatic condition during second year paved the way for better plant growth and yield of pigeonpea.

Dry matter accumulation plays significant role in plant proliferation. Dry matter accumulation in the pigeonpea plant increased with advancement in crop age and reached to maximum at harvest. While mean crop growth rate increased upto 120 days and it was recorded maximum between 90-120 days. Under present investigation increasing trend in RGR was noticed with increase in crop age upto 60-90 days stage. Thereafter, it decreased at 90-120 days stage during both the years. The maximum RGR was calculated during 60-90 days stage during both the years. Growth parameters value increased at the lowest rate at initial stage because of slow growth and development of pigeonpea at early stages and competition by intercrops. The increase in value was tremendous between 90 DAS to maturity in all the intercropping systems which was due to grand growth of pigeonpea during this period. The crop growth rate simply indicates the change in dry weight over a period of time. A possible justification could be increase in CGR values which directly related with an increase in dry matter accumulation values. However, relative growth rate (RGR) denotes the rate of growth per unit dry matter. It is similar to compound interest, wherein interest is also added to the principal to calculate interest.

The growth, yield attributes and yield of pigeonpea measured in terms of dry matter accumulation (g/plant) (Table 1), Crop growth rate (Table 2), Relative growth rate

(Table 3), yield attributes and yield (Table 4) was in superior order under pigeonpea + urdbean intercropping system as compared to pigeonpea sole and pigeonpea + maize. This might be due to the optimum utilization of growth resources which turn in maximum growth and development leads to higher crop growth rate. The beneficial effect of urdbean reflected on pigeonpea was probably due to addition of N in soil by decay of urdbean nodules and also due to insignificant crop competition persuaded by urdbean. Here it may be pointed out that, the competition between pigeonpea and maize for space, sunlight, nutrients, water etc. was more as compared to urdbean which resulted in poor growth and development of pigeonpea under pigeonpea + maize intercropping system. Lowest dry matter accumulation (g/plant), Crop growth rate, Relative growth rate, yield attributes and yield of pigeonpea with maize as intercrop might be due to more competition of component crops for growth resources early stages of plant growth. Reduction in these parameters of pigeonpea with such intercrops has also been reported by Saxena (1972), Saxena and Yadav (1975), Dubey *et al.,* (1991) and Rafey (1992). Similar findings have also been reported by Sharma *et al.,* (2010), Yadav *et al.,* (1997), Bajpai and Singh (1992), and Tewari *et al.,*(1989) In an intercropping system, Rao and Willey (1983) noticed that the sorghum reduced the total branch number in pigeonpea but had little effect on the number of pod bearing branches. Chaudhary and Thakur (2005) from Bihar reported significantly higher plant height and branches/plant in pigeonpea when grown as sole crop as compared to intercropping with maize.

Application of RDF + vermicompost @ 2.5 t/ha significantly higher growth parameter, yield attributes and yield over RDF alone. While reviewing the manurial work already done, it was postulated that, the crop of pigeonpea responded well to the application of FYM or vermicompost along with RDF as FYM or vermicompost, itself is a source of different primary, secondary and micronutrients. When these organic manures are applied with inorganic and biofertilizers, act as a slow release source of nutrient. It forms different complexes with the metal cations present in the soil and restricts their losses from the system. In view of these considerations, in the present study application of FYM @ 5.0 t/ha or vermicompost @ 2.5 t/ha along with recommended dose of fertilizer improved the dry matter accumulation (Table), The positive response of pigeonpea to FYM or vermicompost application have also been reported by Dubey and Gupta (1996), Singh *et al.,* (2008) and Nalatwadmath *et al.,* (2003), respectively. Sarkar *et al.,* (1997) also reported favorable response of pigeonpea to FYM and vermicompost application.

Inoculation of seed with PSB attained significantly higher Dry matter accumulation, CGR, RGR, yield attributes and yield than that obtained without inoculation during both the years. Here, it may be elucidated that, the establishment and growth of crop plants depend much on a sound root system and it is also true to postulate that plants with better developed root system are able to absorb nutrients from deeper layer of the soil profile and hence, they gain in weight and vigour. It may be pointed out that precipitated form of phosphorus i.e. Orthophosphate ($H_2PO_4^{-1}$ or HPO_4^{2-}), is adsorbed by Fe^{3+}, Ca^{2+} or Al^{3+} oxides in soil through legend exchange and become unavailable to plants. PSB solubilze the fixed phosphorus by production of low molecular weight organic acids siderophores (Vassilev *et al.,* 2006) and secretion of phenolic compounds and humic substances. Goldstein (1995) also reported that out of organic acids which solubulize fixed phosphorus, gluconic acid and ketogluconic acid are mainly produced by soil microorganisms.

Table.1 Effect of different treatments on plant dry matter accumulation (g/plant) of pigeonpea at different stages of crop growth states

Treatment	Dry matter accumulation (g/plant)									
	30 DAS		60 DAS		90 DAS		120 DAS		At harvest	
	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
Intercropping system										
Sole pigeonpea	2.31	2.92	8.21	9.67	28.88	29.63	56.75	57.89	75.71	80.09
Pigeonpea + Urdbean	2.88	3.62	11.52	14.06	41.13	41.26	66.05	94.06	112.37	117.27
Pigeonpea + Maize	1.77	2.24	6.07	7.62	22.62	24.79	48.16	49.69	67.64	63.14
SEm±	0.12	0.15	0.51	0.44	0.81	0.71	0.67	0.46	0.67	0.47
CD at 5%	0.47	0.62	2.03	1.75	3.17	2.79	2.65	1.80	2.65	1.83
Fertility level										
RDF	1.90	2.09	6.87	8.87	27.08	27.22	49.78	56.66	75.70	72.26
RDF + FYM @ 5 t/ha	2.44	2.60	9.16	10.93	32.26	33.40	59.91	71.29	89.34	92.89
RDF + Vermi. @ 2.5 t/ha	2.46	2.62	9.78	11.55	33.28	35.06	61.26	73.69	90.68	95.29
SEm±	0.09	0.08	0.46	0.51	0.71	1.03	1.09	1.20	1.10	1.22
CD at 5%	0.28	0.25	1.34	1.49	2.04	2.98	3.17	3.48	3.18	3.51
PSB Inoculation										
PSB	1.95	2.20	7.94	9.11	29.35	27.94	51.13	65.21	82.24	83.51
No PSB	2.58	2.67	9.27	10.99	31.39	32.84	58.84	69.85	88.24	89.12
SEm±	0.08	0.07	0.38	0.42	0.57	0.84	0.89	0.98	0.90	0.99
CD at 5%	0.23	0.21	1.09	1.21	1.67	2.43	2.59	2.84	2.61	2.62

Table.2 Effect of different treatments on mean crop growth rate (CGR) of pigeonpea at different stages of crop growth

Treatment	Crop Growth Rate (g/day)							
	0-30 days		30-60 days		60-90 days		90-120 days	
	2010	2011	2010	2011	2010	2011	2010	2011
Intercropping system								
Sole pigeonpea	0.077	0.076	0.197	0.246	0.689	0.664	0.928	0.943
Pigeonpea + Urdbean	0.091	0.092	0.292	0.376	0.987	0.908	0.829	1.260
Pigeonpea + Maize	0.060	0.075	0.143	0.176	0.594	0.573	0.851	0.828
SEm±	0.003	0.006	0.020	0.016	0.030	0.022	0.030	0.027
CD at 5%	0.010	NS	0.070	0.065	0.100	0.088	NS	0.106
Fertility level								
RDF	0.063	0.069	0.165	0.226	0.673	0.612	0.759	0.981
RDF + FYM @ 5 t/ha	0.082	0.087	0.223	0.277	0.770	0.749	0.921	1.260
RDF + Vermi. @ 2.5 t/ha	0.081	0.088	0.245	0.297	0.782	0.784	0.932	1.280
SEm±	0.003	0.003	0.015	0.017	0.031	0.035	0.045	0.055
CD at 5%	0.009	0.008	0.045	0.050	0.088	0.103	0.132	0.161
PSB Inoculation								
PSB	0.065	0.073	0.165	0.223	0.514	0.535	0.458	0.887
No PSB	0.087	0.090	0.256	0.311	0.970	0.895	1.281	1.460
SEm±	0.002	0.002	0.012	0.014	0.025	0.029	0.037	0.045
CD at 5%	0.007	0.007	0.037	0.041	0.072	0.084	0.108	0.131

Table.3 Effect of different treatments on mean Relative Growth Rate (RGR) of pigeonpea at different stages of crop growth

Treatment	Relative growth rate (g/g/day)							
	0-30 days		30-60 days		60-90 days		90-120 days	
	2010	2011	2010	2011	2010	2011	2010	2011
Intercropping system								
Sole pigeonpea	0.026	0.025	0.041	0.046	0.043	0.048	0.018	0.017
Pigeonpea + Urdbean	0.032	0.033	0.048	0.054	0.044	0.055	0.024	0.023
Pigeonpea + Maize	0.018	0.026	0.037	0.039	0.032	0.038	0.014	0.011
SEm±	0.001	0.002	0.002	0.002	0.002	0.001	0.001	0.001
CD at 5%	0.006	0.006	0.007	0.009	0.010	0.006	0.005	0.005
Fertility level								
RDF	0.020	0.023	0.033	0.039	0.032	0.040	0.015	0.019
RDF + FYM @ 5 t/ha	0.028	0.031	0.042	0.046	0.042	0.047	0.020	0.024
RDF + Vermi. @ 2.5 t/ha	0.027	0.031	0.044	0.047	0.042	0.048	0.021	0.024
SEm±	0.001	0.001	0.002	0.002	0.002	0.002	0.001	0.001
CD at 5%	0.004	0.003	0.008	0.006	0.008	0.006	0.004	0.004
PSB Inoculation								
PSB	0.021	0.025	0.038	0.044	0.040	0.045	0.017	0.023
No PSB	0.030	0.031	0.045	0.049	0.046	0.051	0.023	0.027
SEm±	0.001	0.001	0.002	0.001	0.002	0.001	0.001	0.001
CD at 5%	0.003	0.002	0.006	0.005	0.006	0.005	0.002	0.003

Table.4 Yield attributes and yield of pigeonpea as influenced by cropping system and fertility levels

Treatment	No. of pods/plant		Grain Weight (g/plant)		Straw Yield (kg/ha)		Biological Yield (kg/ha)		Yield (kg/ha)	
Intercropping system	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**	**2010**	**2011**
Sole pigeonpea	130.2	139.03	38.14	51.14	4777	6481	5802	7910	1025	1415
Pigeonpea + Urdbean	177.16	185.45	48.44	63.44	5419	8240	6641	10132	1216	1892
Pigeonpea + Maize	103.29	118.13	25.08	39.08	3444	3280	4098	3955	656	675
SEm±	1.08	2.06	0.94	0.93	86	26	135	66	35	26
CD at 5%	3.13	5.95	2.7	2.69	271	105	407	211	135	106
Fertility level										
RDF	134.6	144.85	35.57	49.57	4271	5873	5150	7076	826	1190
RDF + FYM @ 5 t/ha	137.93	148.58	38.04	52.04	4617	6071	5666	7473	1050	1389
RDF + Vermi. @ 2.5 t/ha	138.52	149.19	38.05	52.05	4567	6058	5592	7447	1029	1376
SEm±	1.13	1.28	0.95	0.94	98	26	148	66	70	40
CD at 5%	3.26	3.72	2.73	2.72	296	105	432	211	202	106
PSB Inoculation										
PSB	135.49	145.87	36.08	50.08	4555	5952	5395	7422	888	1283
No PSB	138.54	149.21	38.36	52.36	4641	6058	5654	7433	1044	1376
SEm±	0.92	1.05	0.73	0.77	74	26	111	52	61	13
CD at 5%	2.66	3.03	NS	NS	NS	79	NS	NS	NS	66

These organic acids are the source of biotical generated H^+ ions, which are able to dissolve the mineral phosphate and to make it available for the plants. Thus, PSB inoculation solubilizes native phosphorus, bringing more phosphorus to soil solution which ultimately increased P uptake and enhanced root and shoot growth and finally more dry matter accumulation. These results are in close conformity with those obtained by Singh and Yadav (2008) on pigeonpea.

To summarize the overall results of this study it is concluded that intercropping of pigeonpea with urdbean in combination with RDF+Vermicompost @ 2.5 t/ha along with seed inoculation with PSB accelerated the dry matter accumulation, Crop growth rate, relative growth rate yield attributes as well as yield of pigeonpea in *Tarai* region of Uttarakhand.

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