The Pharma Innovation Journal 2022; 11(7): 2476-2479

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(7): 2476-2479

www.thepharmajournal.com
Received: 18-03-2022
Accepted: 22-06-2022

G Sandeep
P.G. Scholar, Department of Agronomy, Agricultural College, Mahanandi, Andhra Pradesh, India

Dr. U Vijaya Bhaskar Reddy
Associate Professor, Department of Agronomy, Agricultural College, Mahanandi, Andhra Pradesh, India

Dr. PV Ramesh Babu
Assistant Professor, Department of Agronomy, Agricultural College, Mahanandi, Andhra Pradesh, India

Dr. P Kavitha
Associate Professor and Head, Department of Soil Science & Agricultural Chemistry, Agricultural College, Mahanandi, Andhra Pradesh, India

Dr. M Srinivasa Reddy
Associate Professor and Head, Department of Agronomy, Agricultural College, Mahanandi, Andhra Pradesh, India

Corresponding Author:
G Sandeep
P.G. Scholar, Department of Agronomy, Agricultural College, Mahanandi, Andhra Pradesh, India

Cultivar and sowing date effect on growth attributes and yield of redgram (*Cajanus cajan* L.)

G Sandeep, Dr. U Vijaya Bhaskar Reddy, Dr. PV Ramesh Babu, Dr. P Kavitha and Dr. M Srinivasa Reddy

Abstract
A field investigation on "Cultivar and sowing date effect on productivity of redgram (*Cajanus cajan* L.)" was conducted during *kharif*, 2019 at college farm, Agricultural College, Mahanandi of Acharya N. G. Ranga Agricultural University. The experimental site was sandy loam soil and it was neutral in reaction with a pH of 7.38, EC of 0.20 ds m^{-1}. The experiment was laid out in randomized block design with factorial concept (FRBD) having twelve treatments and three replications. The experiment comprised three redgram cultivars *viz.*, C_1: LRG-52; C_2: PRG-176 and C_3: ICPL-87119 and four sowing dates *viz.*, D_1: 2nd FN of June; D_2: 1st FN of July; D_3: 2nd FN of July and D_4: 1st FN of August. Among the cultivars tried, C_3 (ICPL-87119) recorded significantly highest plant height (287.0 cm), number of branches $plant^{-1}$ (21.1), dry matter accumulation (7698 kg ha^{-1}) and leaf area index (3.49), seed yield (1405 kg ha^{-1}) and haulm yield (5352 kg ha^{-1}) than other cultivars, which is on par with C_1 (LRG-52) at harvest.. The highest harvest index (15.51%) was found in C_2 (PRG-176) than other cultivar, which is on par with C_3 (ICPL-87119). Among the sowing dates, D_1 (2nd fortnight of June) produced significantly higher plant height (294.2 cm) and number of branches $plant^{-1}$ (22.1), which was however on par with D_2 (1st fortnight of July). Dry matter accumulation (7684 kg ha^{-1}), leaf area index (3.32) seed yield (1432 kg ha^{-1}), haulm yield (5342 kg ha^{-1}) and harvest index (15.66%) recorded significantly higher in the crop sown during D_2 (1st fortnight of July), which was however on par D_1 (2nd fortnight of June).

Keywords: Cultivars, sowing dates, redgram, pods $plant^{-1}$, grains POD^{-1}, test weight, seed yield, haulm yield, harvest index

Introduction
Redgram [*Cajanus cajan* L.] commonly known as pigeonpea, arhar or tur. It is most drought tolerant crop among pulses with deep root system, often cross pollinated, C3 plant and short day plant. Redgram is one of the important pulse crop grown in India under different agro-climatic conditions. It is the second most important pulse crop after the gram and an important *kharif* crop within the country. India ranks first in area and production within the world with 80 and 77% of world's area and production, respectively. Pigeonpea is especially cultivated and consumed in developing countries of the globe. Pigeonpea could be a more protein made staple food. It contains 22% of protein, which is nearly 3 times that of cereals. Pigeonpea provides a major share of protein demand of vegetarian population of the country

Various factors responsible for low yield of redgram at the farmer's fields are unawareness of farmers about optimum sowing date, suitable variety, improper plant population, insufficient plant protection and imbalanced use of fertilizers. Time of seeding and appropriate variety is most important agronomic factors for realizing the yield potential of improved varieties.

Time of sowing is a non-monetary input, which will influence the growth and yield of the redgram. Sowing time has prominent influence on vegetative and reproductive stages of pigeonpea. It also depends on crop duration and vigor of genotype. Date of sowing determines time of flowering and dry matter accumulation, seed set and seed yield. Redgram is known to be sensitive to photoperiod and temperature. Early sowing produces more number of pods $plant^{-1}$ and seeds pod^{-1}, which results in higher yields. Hence, it is necessary to identify the best sowing time which are suited to changes in the environment on sustained production. Delayed sowing beyond the optimum period produced less grain yields of pigeonpea (Kumar *et al.*, 2008).

Besides appropriate sowing date, cultivars are utmost importance for yield potential in any crop and for the better utilization of the resources. Cultivars may vary in productivity and are equally important in realizing the potential yield of crop.

Materials and Methods

The field experiment was conducted to study the "Cultivar and sowing date effect on productivity of redgram (*Cajanus cajan* L.)" at college farm, Agricultural College, Mahanandi during *kharif* season of 2019. The experiment was conducted in Agricultural college farm, Mahanandi campus of Acharya N. G. Ranga Agricultural University, which is situated geographically at $15^0.51'$ N latitude and $78^0.61'$ E longitude with an altitude of 233.5 meters above the mean sea level in scarce rainfall zone of Andhra Pradesh and according to Troll's classification, it falls under Semi-Arid Tropics (SAT). The experimental site was sandy loam and it was neutral in reaction with a P^H of 7.38, EC of 0.20 ds m^{-1}, low in organic carbon and available nitrogen, medium in available phosphorus and high in available potassium. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) having twelve treatments and three replications. The experiment comprised three redgram cultivars *viz.*, C_1: LRG-52; C_2: PRG-176 and C_3: ICPL-87119 and four sowing dates *viz.*, D_1: 2nd FN of June; D_2: 1st FN of July; D_3: 2nd FN of July and D_4: 1st FN of August. The weekly mean maximum temperature during the crop period (24-06-2019 to 18-02-2020) ranged from 28.7 ºC to 34.4 ºC, with an average of 30.9 ºC. The weekly mean minimum temperature ranged from 17.9 ºC to 26.5 ºC, with an average of 22.2 ºC. The weekly mean relative humidity during the crop period ranged from 74.7 percent to 98.5 percent, with an average of 93.3 percent. The rainfall received and number of rainy days during the crop growth period was 1355 mm and 49, respectively.

Results and Discussion

The result of present investigation, cultivars and sowing dates significantly influence plant height, number of branches plant^{-1}, dry matter accumulation, leaf area index, seed yield, haulm yield and harvest index presented in Table 1 and Table 8.

Cultivar C_3 (ICPL-87119) recorded significantly higher growth parameters like plant height (56.3, 154.5 and 287.0 cm), number of branches plant^{-1} (5.8, 17.6 and 21.1), dry matter accumulation (105, 4169 and 7698 kg ha^{-1}) and leaf area index (0.15, 3.48 and 3.49) than other cultivars of redgram at 45, 90 DAS and at harvest of crop, respectively. While lowest plant height (49.5, 142.6 and 245.3 cm), number of branches plant^{-1} (5.2, 16.1 and 19.4), dry matter accumulation (76, 3321 and 5274 kg ha^{-1}) and leaf area index (0.12, 3.12 and 2.29) were obtained in C_2 (PRG-176) at 45, 90 DAS and at harvest of crop, respectively. Among cultivars, similar findings of maximum plant height and highest number of branches by C_3 (ICPL-87119) was also reported by Parameshwarappa (2002) [6] and Egbe *et al.* (2013) [2]. The highest plant height due to its genetical potential of the cultivar helped in producing more number of leaves resulted in more accumulation of photosynthates.

Sowing of redgram during D_1 (2nd fortnight of June) produced significantly higher plant height (57.1, 155.6 and 294.2 cm) and number of branches plant^{-1} (5.9, 20.0 and 22.1) at 45, 90 DAS and at harvest, respectively over other dates of sowing, which was however on par with D_2 (1st fortnight of July) having plant height (54.4, 154.3 and 288.0 cm) and number of branches plant^{-1} (5.7, 18.2 and 21.3) at 45, 90 DAS and at harvest, respectively. The early sown crop was produced significantly highest plant height over other sowing dates. This might be due to availability of sufficient time and enjoy the favourable conditions of environment at vegetative growth and development in the early sown crop that enhanced the accumulation of more photosynthates. The similar results of highest plant height were also reported by Mishra *et al.* (2006) [5], Ram *et al.* (2011) [10], Wilson *et al.* (2012) [12] and Dahariya *et al.* (2018) [1]. Dry matter accumulation (103, 4322 and 7684 kg ha^{-1}) and leaf area index (0.18, 4.18 and 3.32) recorded significantly higher in the crop sown during D_2 (1st fortnight of July), which was however on par with dry matter accumulation (102, 4251 and 7671 kg ha^{-1}) and leaf area index (0.17, 4.13 and 3.30) of D_1 (2nd fortnight of June) over other sowing dates at 45, 90 DAS and at harvest, respectively. While lowest plant height (49.1, 138.6 and 226.0 cm), number of branches plant^{-1} (4.8, 14.4 and 18.4), dry matter accumulation (70, 3119 and 5196 kg ha^{-1}) and leaf area index (0.08, 2.31 and 2.18) were recorded in D_4 (1st fortnight of August) at 45, 90 DAS and at harvest. More dry matter accumulation was produced by early sown over delayed sowings. This might be due to more plant height, number of leaves, number of branches plant^{-1} attributed to genetic makeup of cultivar and effective utilization resources such as water, nutrient, light and space in crop environment. The similar results of highest dry matter accumulation were also reported earlier by Patel *et al.* (2000) [7], Kittur and Guggari (2017) [3] and Dahariya *et al.* (2018) [1]. Early sown crop exhibited highest leaf area index over delayed sowing dates. This might be due to high number of leaves and ultimately high leaf area which resulted in increased transfer of photosynthates to sink. A similar result was concluded by Kittur and Guggari (2017) [3] and Dahariya *et al.* (2018) [1].

The interaction among different cultivars and sowing dates on growth attributes at harvest was significant. The treatment C_3D_1 (61.4, 165.6 and 313.3 cm) recorded highest plant height, which was on par with C_3D_2 (59.0, 164.6 and 310.2.2 cm) treatment at 45, 90 DAS and at harvest than other treatment combinations. The number of branches plant^{-1} were highest in C_3D_1 (6.4) at 45 DAS, C_3D_2 (21.3) at 90 DAS and C_2D_1 (23.3) at harvest. Dry matter accumulation (129, 4919 and 8870 kg ha^{-1}) and leaf area index (0.19, 4.37 and 4.08) were significantly highest in C_3D_2 treatment at 45, 90 DAS and at harvest over other treatments. The lowest plant height (46.7, 132.6 and 213.9 cm) at 45, 90 DAS and at harvest, was recorded in C_2D_4 treatment. The number of branches plant^{-1} were lowest in C_2D_4 and C_3D_4 (4.8) at 45 DAS, C_3D_4 (14.2) at 90 DAS and C_2D_4 (16.2) at harvest. Lowest dry matter accumulation (67, 2741 and 4193 kg ha^{-1}) was observed in C_2D_4 treatment. Lowest leaf area index was recorded in C_1D_4 (0.06) at 45 DAS and C_2D_4 (1.90 and 1.61) treatment at 90 DAS and at harvest.

Among cultivars, C_3 (ICPL-87119) cultivar recorded highest seed yield (1405 kg ha^{-1}) and haulm yield (5352 kg ha^{-1}) which is statistically superior over C_1 (LRG-52) and C_2 (PRG-176). Significantly highest seed and haulm yield was obtained in early sown redgram over delayed sowings. The results are in close association with the findings of Parameshwarappa (2002) [6], Pramod *et al.* (2010) [9] and Kumar *et al.* (2018) [4]. The highest harvest index (15.51) was produced in C_2 (PRG-176), which is on par with C_3 (ICPL-87119).

The crop sown during D_2 (1st fort night of July) produced highest seed (1432 kg ha^{-1}) and haulm yield (5342 kg ha^{-1}), which is on par with seed (1401 kg ha^{-1}) and haulm yield (5336 kg ha^{-1}) of D_1 (2nd fort night of June) than other sowing dates, while lowest seed (799 kg ha^{-1}) and haulm yield (3503

kg ha^{-1}) were recorded by D_4 (1st fortnight of August). This might be due to favorable weather conditions like light, temperature, precipitation, which promoted better growth and inherited genetic makeup of cultivar resulting in higher growth parameters and yield attributing characters like number of pods plant^{-1}. It may be the result of maximum translocation of photosynthates towards seed formation in early sown crop. The results are in same line with the results of Vijaykumar (1997) [11], Dahariya *et al*. (2018) [1] and Kumar *et al*. (2018) [4]. The highest harvest index (15.66%) was found in D_2 (1st fort night of July), which is in parity with D_1 (2nd fort night of June) (15.36%) than rest of sowing dates, while lowest harvest index was recorded by D_4 (1st fortnight of August) (13.24%). Harvest index was significantly highest in early sown crop over other sowing dates. This might be attributed to high assimilate use efficiency with increased sink capacity for a longer period of time. These results are closely in conformity with the findings of Pramila and Rajireddy (2010) [8].

Statistically significant interaction existed among the cultivars and sowing dates on seed yield, haulm yield and harvest index. The C_3D_2 (1914 kg ha^{-1}) treatment recorded highest seed yield, which is on par with C_3D_1 (1879 kg ha^{-1}) treatment. The C_1D_2 (6058 kg ha^{-1}) recorded highest haulm yield, which is on par with C_3D_2 (5995 kg ha^{-1}) and C_3D_1 (5936 kg ha^{-1}) while C_2D_4 (550 kg ha^{-1}) and C_2D_3 (2545 kg ha^{-1}) recorded lowest seed and haulm yield, respectively. The treatment C_2D_3 (18.03%) recorded highest harvest index, which is on par with C_3D_2 (17.78%) and C_3D_1 (17.49%), while lowest harvest index was recorded in C_1D_3 (8.53%).

Table 1: Cultivar and sowing date effect on growth attributes of redgram

	Plant height (cm)			Number of branches plant $^{-1}$			leaf area index			Dry matter accumulation (kg ha^{-1})		
Cultivars (C)	**45 DAS**	**90 DAS**	**At Harvest**	**45 DAS**	**90 DAS**	**At Harvest**	**45 DAS**	**90 DAS**	**At Harvest**	**45 DAS**	**90 DAS**	**At Harvest**
C_1: LRG-52	53.1	146.7	257.4	5.3	16.7	20.3	0.14	3.31	2.78	87	3641	6916
C_2: PRG-176	49.5	142.6	245.3	5.2	16.1	19.4	0.12	3.12	2.29	76	3321	5274
C_3: ICPL-87119	56.3	154.5	287.0	5.8	17.6	21.1	0.15	3.48	3.49	105	4169	7698
SE (m)±	0.91	1.22	1.85	0.07	0.27	0.32	0.008	0.024	0.029	3.0	20.7	54.6
CD (p =0.05)	2.7	3.6	5.4	0.2	0.8	0.9	0.02	0.07	0.08	9	61	160
Sowing date (D)												
D_1: 2nd FN of June	57.1	155.6	294.2	5.9	20.0	22.1	0.17	4.13	3.30	102	4251	7671
D_2: 1st FN of July	54.4	154.3	288.0	5.7	18.2	21.3	0.18	4.18	3.32	103	4322	7684
D_3: 2nd FN of July	51.2	143.1	244.8	5.3	14.5	19.2	0.13	2.59	2.60	82	3151	5967
D_4: 1st FN of August	49.1	138.6	226.0	4.8	14.4	18.4	0.09	2.31	2.18	70	3119	5196
SE (m)±	1.05	1.41	2.13	0.08	0.31	0.37	0.009	0.028	0.033	3.5	23.9	63.0
CD (p 0.05)	3.1	4.1	6.3	0.2	0.9	1.1	0.03	0.08	0.10	10	70	185
(Interaction) C X D												
SE (m)±	NS	2.44	3.7	0.15	0.54	0.63	0.016	0.048	0.057	6.1	41.5	109.2
CD (p 0.05)	NS	7.1	10.9	0.4	1.6	1.9	0.05	0.14	0.17	18	122	320

Table 2: Interaction among cultivars and sowing dates on higher plant height, number of branches plant $^{-1,}$ leaf area index, and dry matter accumulation at 45 DAS.

Treatments	Plant height (cm)					Number of branches plant $^{-1}$					Leaf area index					Dry matter accumulation (kg ha^{-1})				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**
C_1	57.5	53.7	51.7	49.7	53.1	5.6	5.5	5.2	4.8	5.3	0.19	0.20	0.09	0.06	0.14	96	97	79	76	87
C_2	52.5	50.4	48.4	46.7	49.5	5.6	5.3	5.2	4.8	5.2	0.13	0.14	0.11	0.09	0.12	84	84	70	67	76
C_3	61.4	59.0	53.6	51.0	56.3	6.4	6.3	5.4	4.9	5.8	0.18	0.19	0.13	0.09	0.15	125	129	97	69	105
Mean	57.1	54.4	51.2	49.1		5.9	5.7	5.3	4.8		0.17	0.18	0.13	0.09		102	103	82	70	

Table 3: Interaction among cultivars and sowing dates on higher plant height, number of branches plant $^{-1,}$ leaf area index, and dry matter accumulation at 90 DAS

Treatments	Plant height (cm)					Number of branches plant $^{-1}$					leaf area index					Dry matter accumulation (kg ha^{-1})				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**
C_1	153.0	151.7	142.4	139.7	146.7	19.4	18.1	14.7	14.6	16.7	3.95	4.06	2.40	2.84	3.31	4148	4210	2940	3267	3641
C_2	148.3	146.7	142.8	132.6	142.6	20.5	15.1	14.4	14.3	16.1	4.12	4.12	2.34	1.90	3.12	3751	3837	2957	2741	3321
C_3	165.6	164.6	144.1	143.6	154.5	20.3	21.3	14.5	14.2	17.6	4.32	4.37	3.04	2.21	3.48	4854	4919	3555	3349	4169
Mean	155.6	154.3	143.1	138.6		20.0	18.2	14.5	14.4		4.13	4.18	2.59	2.31		4251	4322	3151	3119	

Table 4: Interaction among cultivars and sowing dates on higher plant height, number of branches plant $^{-1,}$ leaf area index, and dry matter accumulation at harvest

Treatments	Plant height (cm)					Number of branches plant $^{-1}$					leaf area index					Dry matter accumulation (kg ha^{-1})				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**	**D_1**	**D_2**	**D_3**	**D_4**	**Mean**
C_1	290.3	287.6	237.5	214.4	257.4	21.9	20.8	19.4	19.1	20.3	3.10	3.12	2.71	2.19	2.78	8031	8057	6337	5239	6916
C_2	278.1	264.7	222.2	213.9	245.3	23.3	20.1	17.8	16.2	19.4	2.82	2.74	1.95	1.61	2.29	6120	6126	4659	4193	5274
C_3	313.3	310.2	274.9	249.7	287.0	21.1	22.9	20.5	20.1	21.1	3.96	4.08	3.17	2.75	3.49	8862	8870	6904	6155	7698
Mean	294.2	288.0	244.8	226.0		22.1	21.3	19.2	18.4		3.30	3.32	2.60	2.18		7671	7684	5967	5196	

Table 5: Cultivar and sowing date effect on yield parameters of redgram

Treatments	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest Index (%)
Cultivars (C)			
C_1: LRG-52	1002	5001	12.74
C_2: PRG-176	986	3329	15.51
C_3: ICPL-87119	1405	5352	14.92
SE (m)±	14.2	54.8	0.2
CD (p = 0.05)	42	161	0.60
Sowing date (D)			
D_1: 2nd FN of June	1401	5336	15.36
D_2: 1st FN of July	1432	5342	15.66
D_3: 2nd FN of July	893	4061	13.30
D_4: 1st FN of August	799	3503	13.24
SE (m)±	16.4	63.2	0.2
CD (p = 0.05)	48	185	0.69
(Interaction) C X D			
SE (m)±	28.4	109.5	0.4
CD (p = 0.05)	83	321	1.2

Table 6: Interaction among cultivars and sowing dates on seed yield (kg ha^{-1})

Treatments	Seed yield				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**
C_1	1153	1183	591	1080	1002
C_2	1170	1200	1025	550	986
C_3	1879	1914	1063	766	1405
Mean	1401	1432	893	799	

Table 7: Interaction among cultivars and sowing dates on haulm yield (kg ha^{-1})

Treatments	Haulm yield				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**
C_1	5920	6058	4788	3237	5001
C_2	4153	3942	2545	2678	3329
C_3	5936	5995	4850	4593	5352
Mean	5336	5342	4061	3503	

Table 8: Interaction among cultivars and sowing dates on harvest index (%)

Treatments	Harvest index				
	D_1	**D_2**	**D_3**	**D_4**	**Mean**
C_1	12.55	12.81	8.53	17.06	12.74
C_2	15.63	16.37	18.03	11.59	15.51
C_3	17.49	17.78	13.34	11.07	14.92
Mean	15.36	15.66	13.30	13.24	

Conclusion

The cultivar C_3 (ICPL-87119) recorded higher plant height, number of branches plant $^{-1}$, leaf area index, dry matter accumulation, seed and haulm yield over other cultivars. Among the sowing dates, D_2 (1st fort night of July) gave better growth attributes like plant height, number of branches plant $^{-1}$, leaf area index, dry matter accumulation and yields, which is on par with D_1 (2nd fort night of June) over other sowing dates. Cultivar C_3 (ICPL-87119) sown on D_2 (1st fort night of July) produced significant higher yields, which is on par with sown on D_1 (2nd fort night of June) than other combinations. C_3D_1 recorded highest plant height, number of branches plant $^{-1}$ and dry matter accumulation which is on par with C_3D_2.

References

1. Dahariya L, Chandrakar DK, Chandrakar M. Effect of dates of planting on the growth characters and seed yield of transplanted pigeonpea (*Cajanus cajan* L. Mill Sp.) International Journal of Chemical Studies. 2018;6(1):2154-2157.
2. Egbe MO, Ambi A, Seyi O. Effect of planting dates on the performance of pigeonpea varieties in southern guinea savanna ecology of Nigeria. Journal of Biology, Agriculture and Health Care. 2013;3(8):22-28.
3. Kittur CN, Guggari AK. Effect of sowing time and planting geometry on growth and yield of pigeonpea in northern dry zone (Zone 3) of Karnataka. Journal of Farm Science. 2017;30(3):334-337.
4. Kumar A, Dhanoji MM, Meena MK. Phenology and productive performance of pigeonpea as influenced by date of sowing. Journal of Pharmacognosy and Phytochemistry. 2018;7(5):266-268.
5. Mishra A, Rai G, Singh VS, Swarnkar GB. Performance of ridge planted pigeonpea varieties under different dates of sowing. Indian Journal of Pulses Research. 2006;19(2):257-258.
6. Parameshwarappa SG. Performance of pigeonpea cultivar in medium black soils of northern transitional zone of Karnataka under rainfed conditions. Karnataka Journal of Agricultural sciences. 2002;15(3):502-503.
7. Patel NR, Mehta AN, Shekh AM. Radiation absorption, growth and yield of pigeonpea cultivars as influenced by sowing dates. Experimental Agriculture, 2000.
8. Pramila RB, Rajireddy D. Performance of pigeonpea in sole and inter cropping system in vertisols of Krishna - Godavari zone in Andhra Pradesh. Indian Journal of Agricultural Research. 2010;44(3):225-228.
9. Pramod G, Pujari BT, Basavaraja MK, Mahantesh V, Gowda V. Yield, yield parameters and economics of pigeonpea (*Cajanus cajan* (L.) Millsp) as influenced by genotypes, planting geometry and protective irrigation. International Journal of Agricultural Sciences. 2010;6(2):422-425.
10. Ram H, Singh G, Sekhon HS, Khanna V. Effect of sowing time on the performance of pigeonpea. Journal of Food Legumes. 2011;24(3):207-210.
11. Vijaykumar N. Sesamum based cropping systems in Dryland Alfisols. M.Sc. (Ag) Thesis, Acharya N.G. Ranga Agricultural University, Hyderabad, Andhra Pradesh, 1997.
12. Wilson C, Dafeng H, Emeka N, Jun W, Deng Q, Desh D *et al*. Effects of planting dates, densities and varieties on ecophysiology pigeonpea in south- eastern United States. Agricultural Sciences. 2012;3(2):147-152.