International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 1201-1205

Received: 03-07-2017
Accepted: 05-08-2017

VJ Gimhavanekar
PG student Department of Agricultural Botany, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

AV Mane
Assistant Professor Department of Agricultural Botany, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

MM Burondkar
Associate Professor Department of Agricultural Botany, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

MC Kasture
Assistant Professor Department of Agricultural Botany, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

SS Desai
Assistant Professor Department of Agricultural Botany, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

Correspondence
VJ Gimhavanekar
PG student Department of Agricultural Botany, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

Influence of paclobutrazol on dry matter production and yield attributes of pigeonpea (*Cajanus cajan* (L.) Millsp) under Konkan condition

VJ Gimhavanekar, AV Mane, MM Burondkar, MC Kasture and SS Desai

Abstract
A field experiment was conducted to study the influence of paclobutrazol on physiological aspects of pigeonpea (*Cajanus cajan* (L.) Millsp) under konkan conditions during *Kharif* 2015-16 seasons. Plant growth regulators at different concentration were applied through foliar spray at 30, 40 and 60 DAS. The experiment consisted of thirteen treatment laid out in randomized block design with three replications comprising paclobutrazol (50, 75, 100, 125, 150 ppm) treatment imposed at 30, 40 and 60 DAS. Among the treatments soil application of paclobutrazol @ 50 ppm at 40 DAS recorded significant difference on dry matter production and yield parameter as compared to other treatments. Dry matter accumulation in leaves differed significantly between the treatments at all the stages, except 30DAS. Among the treatments, the dry weight increased with paclobutrazol treatments as compared to control. Yield and yield parameters such as number of pods per plant, weight of pods per plant and 100 grain weights showed significant differences among the treatments at harvest, which were significantly influenced by paclobutrazol treatments. The maximum yield and yield attributes were noticed in soil application of paclobutrazol @ 50 ppm at 40 DAS. All the paclobutrazol treatments increased the harvest index and yield per ha. Soil application of paclobutrazol @ 50 ppm at 40 DAS showed maximum harvest index and yield per ha compared to other treatments and control.

Keywords: yield parameters, paclobutrazol, pigeonpea.

Introduction
Pigeonpea (*Cajanus cajan*(L.) Millsp) is an important pulse crop of India which is originated in Africa. It is primarily cultivated in semi-arid tropics of Andhra Pradesh and Maharashtra states. It is a versatile crop and is ideally suited for drought prone areas. India is largest producer of pigeonpea constituting 75 per cent of world production. The production of tur in India is approximately 2.76 million tonnes (Anonymous 2013-14) [1]. Among the several constraints attributed for low yield in pulses, vegetative biomass uncertain with growth habit is considered as one of the major constraints in improving yield. Besides this, there are various constraints in pulses production as indeterminate growth habit, instability in performance, poor response to inputs etc. Particularly in recent year PGR (growth retardants) *viz.* paclobutrazol is widely tried in improving HI and yield through manipulating the vegetative growth also. Hence the present investigation was carried out with the objective to study the effect of paclobutrazol on dry matter production and yield attribute in pigeonpea.

Material and Methods
The experiment was conducted at the research farm of Department of Agricultural Botany, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra State, during *Kharif* 2015-16 season. The selection of the site was considered on the basis of suitability of the land for cultivation of pigeonpea. The soil of the experimental site was lateritic type. The experimental material for the study consisted of one variety of Pigeonpea i.e. Konkan Tur-1. The seeds of this variety were collected from Research farm, Department of Agril. Botany, College of Agriculture, Dapoli. The experiment comprised of single variety of pigeonpea laid out in randomized block design with three replications, provided with thirteen treatments of single growth retardant i.e. paclobutrazol, at different concentrations. The plot size was 3 × 2.70 m. Seeds of pigeonpea were sown at spacing of 60 cm between rows and 45 cm between

plants. Sowing was done in June, 2015. About 2-3 seeds were dibbled at each hill. To retain only one healthy seedling per hill, thinning was done ten days after sowing. Two weeding's were done at 20 days interval after sowing.For recording the growth observations, five plants were selected randomly in each plot. These five plants were tagged with alluminium foil. The below mentioned observations were recorded at an interval of 30 days starting, from 30 days after sowing and were continued up to harvest.

Results and Discussion

The present investigation was carried out with the central objective to study the effect of paclobutrazol on the dry matter production and yield attribute. The main constraint ascribed for low harvest index in pigeonpea are improper translocation of photo assimilate, reduced availability of photo-assimilates at the time of seed set and excessive vegetative growth, which leads to lower yield. The harvesting index of pigeonpea is estimated upto 20 per cent for Konkan region.

Plant growth regulators are known to regulate metabolism in the plant. Paclobutrazol coded as PP333, is recently introduced among other growth retardants, which counteract the gibberellin biosynthesis. The chemical was first used in England in 1978, followed by different European countries, including U.S.A.in 1982. However, in India, utility of this chemical was first reported on commercial scale for introduction of early and regular cropping in Alphonso mango by Burondkar *et al*. (1991) [3].

Dry Matter Accumulation and Partioning

Dry matter is the end result of assimilates from source organs via a transport path to the sink organs. The potential growth rate and potential capacity to accumulate assimilates has been shown to be an important parameter that quantatively reflects the sink strength of an organ (Kashid, 2008) [12].

In present study, dry matter accumulation in the leaf increased up to 150 DAS and slightly declined thereafter till harvest in all the treatments including control. This could be due to the translocation of stored photo-assimilates towards the development of reproductive organs and senescence. In general, the leaf dry weight was significantly higher in T_{11} (soil application of paclobutrazol @ 50 ppm at 40 DAS) due to beneficial effect of the growth retardant paclobutrazol on leaf development. Wasnik and Bagga (1996) [22] reported that the application of mepiquat chloride increased leaf dry weight in chickpea. Similarly, Nakul (2001) [14] reported that leaf dry weight was significantly higher with the application of lihocin (1000 ppm and 500 ppm) in safflower. Also observed significant increase in leaf dry weight with in foliar application of paclobutrazol @ 100 ppm in pigeonpea crop by (Sul, 2012) [19].

The stem which is the main translocation organ of the photo-assimilates, has great influence on the production of total dry matter Kashid (2008) [12]. The stem dry weight increased significantly due to application of paclobutrazol. It is further seen from the data that value for these parameter was more in T_{11} *i.e.* soil application of paclobutrazol @ 50ppm at 40 DAS at 60, 90,and 120 days as compared to control. At harvest, stem dry weight decreased slightly may be due to translocation of photo assimilates towards reproductive parts. Similar observations were also made in chickpea by Prabhakar (2002) [15], who reported increased stem dry weight due to application of lihocin (500 ppm) and mepiquat chloride (500 ppm) as compared to control. Similarly, Hanchinmath (2005) [8] reported that foliar application lihocin (1000 ppm) and mepiquat chloride (1000 ppm) increased stem dry weight as compared to control in cluster bean.

The data pertaining to total dry weight per plant indicated that, it increased continuously from 30 DAS to harvest. At later stages of the crop growth, the dry matter accumulation followed decreasing trend, which could be attributed to reduce source activity leading to lesser dry matter accumulation in leaf and stem. The application of paclobutrazol significantly increased the TDM and it was found more in T_{11} (soil application of paclobutrazol @ 50 ppm at 40 DAS) and the least TDM was found in T_{13} *i.e.* control. Jeyakumar and Thangaraj (1996) [10] reported that, application of growth retardant increases RUBP carboxylase enzyme activity, photosynthesis and dry matter partitioning in groundnut. The present data also indicated that the total dry matter was significantly higher in paclobutrazol treatments as compared to control, which could be attributed to higher leaf area, leaf dry weight, stem dry weight that have contributed to higher dry matter accumulation in reproductive parts.

The enhanced dry weight of reproductive parts by growth retardant may be due to increased translocation of assimilates from leaf and stem to the reproductive parts wizards weight of dry pod (97.00 g) T_{11} over the other treatment. The results of present investigation are in conformity with the results obtained by other workers in various crops viz. Mungbean and chickpea, (Singh *et al*., 1993 and Brar*et al*., 1992) [18] Chickpea, (Prabhakar, 2002) [15]; clusterbean; (Hanchinmath 2005) [8]; safflower (Nukul, 2001) and pigeonpea (Sul, 2012) [19] and (Jagadhane, 2014) [9]. Thus, it could be concluded that, the plant growth retardant had exerted profound influence on the production of dry matter. The amount of total dry matter (TDM) produced is an indication of the overall efficiency of the utilization of resources and better light interception.

Yield and Yield Parameters

The yield of crop plants is attributed to total assimilation achieved during the growing season and the way it is partitioned between the desired storage structures and rest of the plant. The growth retardants are capable of redistribution of dry matter in the plant there by bringing about improvement in yield (Chetti, 1991 and Chandrababu*et al*. 1995) [6].

In present study, T_{11} (soil application of paclobutrazol @ 50 ppm at 40 DAS), recorded significantly higher number of pods per plant, weight of pods per plant, 100 seed weight over the control. The increased pod yield per plant may be attributed to corresponding increase in pod weight per plant and 100seed weight. Significant increase in number of pods, number of seeds, seed size and yield per plant in chickpea due to application of cycocel (chlormequat) at 50 per cent flowering stage, was also reported by Arora *et al*. (1998) [2], and in rice reported by Bindu and Sankaran, (1998) [4] whereas Wagale, (2008) [21] found significant increase in yield and yield contributing characters in rice.

The increase in the yield (kg/ ha^{-1}) due to paclobutrazol (T_{11}) could also attributed to higher dry matter production and its distribution to reproductive parts, increased chlorophyll stability index, higher SLW, SLA, number of pods per plant, weight of pods per plant and 100seed weight. This could have been also supported due to its reduction in plant height which was found to be useful in increasing the efficiency of translocation of food material towards seed filling. Thus, yield per hectare found more in T_{11} (soil application of paclobutrazol @ 50 ppm at 40 DAS), similarly harvest index was highest in T_{11} (soil application of paclobutrazol @ 50 ppm at 40 DAS), followed by T_5 (foliar application of paclobutrazol @ 150 ppm at 30 DAS), T_{12} (soil application of paclobutrazol @ 50 ppm at 60 DAS) and T_7 (foliar application of paclobutrazol @ 75 ppm at 30 and 60 DAS). Similar results were also recorded by Koli (2008) [13] who observed maximum yield as compare to control in rice due to application of paclobutrazol at 750 ppm. Sul (2012) [19] also reported increase pod yield with the soil application of paclobutrazol @ 100 ppm in pigeonpea, Setia*et al*. (1995), also observed increased yield with application of paclobutrazol at 5, 10 and 20 g ml^{-1} concentrations.

Whipker and Mccall (2000) [23] also reported increased in bud count in sunflower, due to paclobutrazol drenches CCC @ 2 or 4 mg, per plant. Dambe*et al*. (2007) reported highest dry pod yield with 1500 ppm concentration registered significantly highest dry pod yield (35.19 q ha^{-1}), kernel yield (26.25 q ha^{-1}) and harvest index (42.60%) over the control in groundnut. Similar result in other pulse crops viz. groundnut with CCC (Kalyankar*et al*. 2007), in rice with CCC (Wagale*et al*. 2008) [21], lentil with CCC (Setia Neelam, 2009) [16] and in pigeonpea by Sul (2012) [19] and Udensi (2013) [20].

Table 1: Effect of paclobutrazol on mean stem dry weight (g plant 1) at different growth stages in Pigeon pea

Treatments	Mean stem dry weight (g $plant^{-1}$)				
	30 (DAS)	60 (DAS)	90 (DAS)	120 (DAS)	At Harvest
T_1 FA of PBZ @ 50 ppm at 30 DAS	3.569	8.068	30.390	41.201	75.03
T_2 FA of PBZ @ 75 ppm at 30 DAS	3.588	8.742	30.470	41.328	76.43
T_3 FA of PBZ @ 100 ppm at 30 DAS	3.479	7.872	30.438	40.104	78.17
T_4 FA of PBZ @ 125 ppm at 30 DAS	3.409	7.506	30.690	38.414	76.93
T_5 FA of PBZ @ 150 ppm at 30 DAS	3.550	8.644	31.681	39.849	74.80
T_6 FA of PBZ @ 50ppm at 30+60 DAS	3.539	9.167	30.129	39.874	72.76
T_7 FA of PBZ @ 75 ppm at 30+60 DAS	3.536	9.022	29.708	41.007	71.98
T_8 FA of PBZ @ 100 ppm at 30+60 DAS	3.514	7.596	31.232	41.384	78.94
T_9 FA of PBZ @ 125 ppm at 30+60 DAS	3.440	8.377	30.356	41.001	77.59
T_{10} FA of PBZ @ 150 ppm at 30+60 DAS	3.451	8.881	31.046	41.987	74.32
T_{11} SA of PBZ @ 50 ppm at 40 DAS	3.506	9.490	34.533	43.811	80.72
T_{12} SA of PBZ @ 50 ppm at 60 DAS	3.416	9.283	32.597	43.551	80.49
T_{13} (Control)	3.528	9.039	27.513	37.030	71.17
MEAN	3.501	8.59	30.82	40.81	76.10
S.E±	0.193	0.163	0.643	0.216	1.381
CD at 5%	NS	0.477	1.878	0.631	4.032

Table 2: Effect of paclobutrazol on mean leaf dry weight (g $plant^{-1}$) at different growth stages in Pigeonpea

Treatment	Mean leaf dry weight (g $plant^{-1}$)				
	30 (DAS)	60 (DAS)	90 (DAS)	120 (DAS)	At Harvest
T_1FA of PBZ @ 50 ppm at 30 DAS	1.63	3.139	10.174	21.592	8.784
T_2 FA of PBZ @ 75 ppm at 30 DAS	1.65	3.152	10.491	21.584	8.827
T_3FA of PBZ @ 100 ppm at 30 DAS	1.55	3.144	9.854	22.394	9.814
T_4 FA of PBZ @ 125 ppm at 30 DAS	1.49	3.381	10.878	22.333	9.390
T_5 FA of PBZ @ 150 ppm at 30 DAS	1.60	2.923	10.244	22.164	8.766
T_6 FA of PBZ @ 50ppm at 30+60 DAS	1.59	2.943	10.489	21.228	10.159
T_7 FA of PBZ @75 ppm at 30+60 DAS	1.59	2.737	9.798	20.056	9.209
T_8 FA of PBZ @100 ppm at 30+60 DAS	1.57	2.828	9.550	21.798	10.169
T_9 FA of PBZ @125 ppm at 30+60 DAS	1.51	3.512	9.289	19.954	9.870
T_{10} FA of PBZ @150 ppm at 30+60 DAS	1.55	3.394	10.141	20.819	7.826
T_{11} SA of PBZ @ 50 ppm at 40 DAS	1.57	3.602	11.342	23.537	10.454
T_{12} SA of PBZ @ 50 ppm at 60 DAS	1.50	3.431	11.247	23.229	10.349
T_{13} (Control)	1.58	2.732	8.000	17.589	6.691
MEAN	1.56	3.147	10.115	21.406	9.254
S.E±	0.132	0.175	0.202	0.129	0.202
CD at 5%	NS	0.512	0.590	0.377	0.591

Table 3: Effect of paclobutrazol on mean total dry weight (g $plant^{-1}$) at different growth stages in Pigeonpea

Treatments	Mean total dry weight (g $plant^{-1}$)				
	30 (DAS)	60 (DAS)	90 (DAS)	120 (DAS)	At Harvest
T_1 FA of PBZ @ 50 ppm at 30 DAS	4.944	11.496	40.564	62.200	83.813
T_2 FA of PBZ @ 75 ppm at 30 DAS	4.999	11.894	40.961	62.489	85.260
T_3 FA of PBZ @ 100 ppm at 30 DAS	4.806	11.017	40.292	62.729	87.987
T_4 FA of PBZ @ 125 ppm at 30 DAS	4.707	10.887	41.568	61.477	87.280
T_5 FA of PBZ @ 150 ppm at 30 DAS	4.944	11.568	41.926	61.309	83.568
T_6 FA of PBZ @ 50ppm at 30+60 DAS	4.918	12.769	41.376	60.991	88.548
T_7 FA of PBZ @ 75 ppm at 30+60 DAS	4.910	11.870	39.506	60.951	81.192
T_8 FA of PBZ @ 100 ppm at 30+60 DAS	4.820	10.423	40.782	62.992	82.150
T_9 FA of PBZ @ 125 ppm at 30+60 DAS	4.767	11.889	39.644	60.956	87.458

T_{10} FA of PBZ @ 150 ppm at 30+60 DAS	4.803	12.276	41.187	61.640	84.771
T_{11} SA of PBZ @ 50 ppm at 40 DAS	4.813	12.921	45.876	65.884	90.652
T_{12} SA of PBZ @ 50 ppm at 60 DAS	4.752	12.394	43.086	64.379	89.110
T_{13} (Control)	4.821	11.771	35.513	54.997	77.860
MEAN	4.846	11.782	40.944	61.768	85.357
S.E±	0.222	0.263	0.670	0.242	1.381
CD at 5%	NS	0.768	1.957	0.709	4.033

Table 4: Effect of paclobutrazol on yield attributes in Pigeonpea

Treatments	No. of pods per plant	Wt. of pod (gm)	100 grains wt. (gm)
T_1 FA of PBZ @ 50 ppm at 30 DAS	225.67	67.90	8.71
T_2 FA of PBZ @ 75 ppm at 30 DAS	227.33	66.93	8.34
T_3 FA of PBZ @ 100 ppm at 30 DAS	239.00	77.00	9.10
T_4 FA of PBZ @ 125 ppm at 30 DAS	235.33	67.73	8.61
T_5 FA of PBZ @ 150 ppm at 30 DAS	255.67	79.17	9.47
T_6 FA of PBZ @ 50ppm at 30+60 DAS	278.33	77.07	8.89
T_7 FA of PBZ @ 75 ppm at 30+60 DAS	229.33	67.91	8.52
T_8 FA of PBZ @ 100 ppm at 30+60 DAS	234.33	83.05	9.42
T_9 FA of PBZ @ 125 ppm at 30+60 DAS	239.33	81.10	9.22
T_{10} FA of PBZ @ 150 ppm at 30+60 DAS	244.33	66.97	8.41
T_{11} SA of PBZ @ 50 ppm at 40 DAS	283.67	97.00	9.93
T_{12} SA of PBZ @ 50 ppm at 60 DAS	247.00	91.57	9.62
T_{13} (Control)	216.67	62.44	8.20
MEAN	242.76	75.83	8.95
S.E±	0.371	0.239	0.018
CD at 5%	1.084	0.698	0.053

Table 5: Effect of paclobutrazol on Yield/ha (kg) and harvest index (%) attributes in Pigeonpea

Treatments	Yield/ha (Kg)	Harvest index (%)
T_1 FA of PBZ @ 50 ppm at 30 DAS	277.00	23.69
T_2 FA of PBZ @ 75 ppm at 30 DAS	166.17	21.95
T_3 FA of PBZ @ 100 ppm at 30 DAS	294.65	23.79
T_4 FA of PBZ @ 125 ppm at 30 DAS	193.63	21.88
T_5 FA of PBZ @ 150 ppm at 30 DAS	302.39	25.18
T_6 FA of PBZ @ 50ppm at 30+60 DAS	296.38	24.78
T_7 FA of PBZ @ 75 ppm at 30+60 DAS	296.71	25.10
T_8 FA of PBZ @ 100 ppm at 30+60 DAS	302.39	23.61
T_9 FA of PBZ @ 125 ppm at 30+60 DAS	317.70	24.11
T_{10} FA of PBZ @ 150 ppm at 30+60 DAS	289.44	24.32
T_{11} SA of PBZ @ 50 ppm at 40 DAS	329.84	25.60
T_{12} SA of PBZ @ 50 ppm at 60 DAS	304.12	25.16
T_{13} (Control)	106.27	20.96
MEAN	267.43	23.857
S.E±	1.458	0.535
CD at 5%	4.258	1.562

Conclusion

From the present investigations, amongst all paclobutrazol treatments tried, soil application of paclobutrazol @ 50 ppm at 40DAS significantly shortened the growth period and enhanced the dry matter production, yield and yield attributes with maximum harvest index of the pigeonpea crop under Konkan condition. Thus, this study encourages taking up for further research on use of paclobutrazol for boosting up yield in pulse crop like pigeonpea. Hence, this present investigations open wide scope for evaluation of paclobutrazol in pulse crop.

References

1. Anonymous. World, Area, Production. http//www.agropedia.iitk.ac.in. 2013-14.
2. Arora N, Balwinder Kaur, Parmil Singh, Usha P. Effect of IAA and cycocel on yield contributing parameters of chickpea (*Cicerarietinum* L.). Ann. Agril. Res. 1998; 19(3):279-281.
3. Burondkar MM, Gunjate RT. Regulation of shoot growth and flowering habit in Alphonso mango with Paclobutrazol, Acta Horticulturae. 1991; 291:79-84.
4. Bindu T, Sankaran S. Effect of paclobutrazol in conjunction with herbicide anilofos on aged seedlings of rice. Madras Agricultural Journal. 1998; 85(5/6):220-223.
5. Chandrababu R, Manian K, Nagarajan M, Ramachandran TK. Effect of mepiquat chloride on growth and yield of groundnut. Madras Agril. J. 1995; 82(3):229-230.
6. Chetti MB. Evaluation of Chamatkar on groundnut. Pestology. 1991; 25(8):43-50.
7. Dambe YP, Ulemale RB, Kubde KJ, Fiske AV, Rathod PK. Effect of polythene mulch and cycocel on growth and yield of Rabi groundnut. Ann. Plant Physiol. 2007; 21(2):164-170.
8. Hanchinmath PV. Effect of plant growth regulators, organics and nutrients on growth physiology and yield in cluster bean (*Cyamopsistetragonolaba* (L). Taub). M. Sc. (Agri.) Thesis, Univ. Agril. Sci., Dharwad, Karnataka, India. 2005.

9. Jagadhane RK. Studied 0n influence of paclobutrazol on physiological aspect of pigeonpea (Cajanuscajan L.) underkonkan condition. M.Sc (Ag.) thesis submitted to B.S.K.K.V. Dapoli (unpublished), 2014.
10. Jeyakumar P, Thangaraj M. Effect of mepiquat chloride on certain physiological and yield characteristics of groundnut (*Arachis hypogea* L.), Journal of Agronomy and Crop Science. 1996; 176(3):154-164.
11. Kalyankar SV, Hudge VS, Shete DM, Hudge BV, Deshmukh JD. Effect of plant growth regulators on growth and yield of soybean. Ann. Plant Physiol. 2007; 21(2):158-160.
12. Kashid DA. Effect of growth retardants on growth, physiology and yield in sunflower (*Helianthus annus* L.) M. Sc. (Agri.) Thesis, Univ. Agril. Sci., Dharwad, Karnataka, India. 2008.
13. Koli S. Physiological investigations into rice plant and manipulation its harvest index by paclobutrazol. M.Sc. (Agri.) Thesis, Dr. B. S. K. K. V. Dapoli. 2008.
14. Nakul HT. Influence of plant growth regulators, chemicals and nutrients of safflower (*Carthamustinctorius* L.) M.Sc. (Agri.) Thesis, Univ. Agril. Sci., Dharwad. 2001.
15. Prabhakar Reddy V. Effect of growth regulators on growth, physiology and yield in chickpea (*Cicerarietinum* L.). M.Sc. (Agri.) Thesis, Univ. Agril. Sci., Dharwad. 2002.
16. Setia Neelam, Setia RC, Sangeeta. Influence of paclobutrazol on yield components and seed quality in lentil (*Lens culinaris* Medic.) Environment and Ecology. 2009; 27(4A):1770-1772.
17. Setia RC, Gurmeet Bhathal, Neelam Setia. Influence of paclobutrazol on growth and yield of *Brassica carinata* A. Br. Plant Growth Regulation. 1995; 16(2): 121-127.
18. Singh J, Kaul JN, Brar ZS. Compartmentation of canopy, dry matter and seed yield of summer mung bean in relation to irrigation and cycocel regimes. Indian Journal of Pulses Res. 1993; 6(2):207-209.
19. Sul RS. Studied the physiological aspect Pigeonpea (Cajanuscajan L.) as influenced by growth retardant under konkan condition. M.Sc (Ag.) thesis submitted to B.S.K.K.V. Dapoli (unpublished). 2012.
20. Udensi OU, Edu EA, Ikpeme EV, Ntia MI. Response of Pigeon Pea Landraces [*Cajanuscajan* (L.) Millsp] to Exogenous Application of Plant Growth Regulators. Annual Review & Research in Biology. 2013; 3(4):762-776.
21. Wagale NA, Jadhav BB, Burondkar MM, Gawali SS. Growth analysis of rice (*Oryza sativa*L.) treated with paclobutrazol. International Journal of Plant Sciences (*Muzaffarnagar*). 2008; 3(1):50-52.
22. Wasnik KG, Bagga AK. Effect of mepiquat chloride on growth and yield of chickpea (*Cicerarietinum* L.), Indian Journal of Plant Physiology. 1996; 1(14):239-242.
23. Whipker BE, McCall I. Response of potted sunflower cultivars to daminozide foliar sprays and paclobutrazol drenches. Hort. Technology. 2000; 10(1):209-211.