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Performance of varieties with different dates of sowing and spray of growth regulators and their interaction on growth and yield of Dolichos Bean (*Lablab purpureus* L.) during offseason under shade net

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Abstract
The present investigation entitled "Performance of varieties with different dates of sowing and spray of growth regulators and their interaction on growth and yield of Dolichos Bean (*Lablab purpureus* L.) during offseason under shade net" was carried out during summer 2014-15 and 2015-16 at Horticultural Research Station, Ambajipeta, East Godavari District of Andhra Pradesh. The experiment was laid out with 36 different treatment combinations in a Factorial Randomized Block Design (FRBD) each replicated thrice in open field. The experiment was carried out with four varieties *viz.*, Arka Jay, Arka Amog, Arka Sambhram and Arka Sowmya with three different dates of sowing *viz.*, December 15th, January 1st and January15th with foliar spray of growth regulators *viz.*, NAA 25 ppm, Triacontanol 2 ppm and control. The data were recorded on various growth, and yield parameters and the data were statistically analyzed based on ANOVA. Arka Amog recorded significantly highest plant height (66.93 cm)) number of buds per node (4.26) whereas Arka Sowmya (V_4) recorded significantly highest leaf area (901.9 cm^2), pod weight (4.52g) and highest pod yield per ha (132.06 q) under shade net. January 1st sown crop recorded significantly the highest plant height (68.22cm) ,leaf area (870.1 cm$^{2)}$ number of buds per node (4.17), pod weight (4.37g)and highest pod yield per ha (129.26q) and number of days for 50 per cent flowering (40.60) was less in December 15th sowing. Triacontanol @2 pm foliar spray recorded significantly the highest leaf area (911.0 cm^2), number of buds per node (4.20), pod weight (4.37 g) and pod yield (125.72q/ha. Arka Sowmya recorded the highest pod yield per hectare (163.27q) when sown on January 1st and sprayed with Triacontanol 2 ppm foliar spray ($V_4S_2G_2$).

Keywords: Varieties, spray, growth regulators, *Lablab purpureus*, shade net

Introduction
In India, *Lablab* is a field crop mostly confined to the peninsular region and is cultivated to a large extent in Karnataka and adjoining districts of Tamil Nadu, Andhra Pradesh and Maharashtra. Karnataka contributes a major share, accounting for nearly 90 per cent in terms of both area and production in the country. In Andhra Pradesh, beans are cultivated in an area of 228000 ha with a production of 2277000 MT (National Horticulture Board Statistics 2017-18) [11]. The normal growing seasons for field bean are *Kharif* and *Rabi*. The beans are not available in Andhra Pradesh after February month. By growing beans in off season *i.e.*, summer, the produce will be made available to the consumers all throughout the year and also the farmers can fetch better price for their produce. Among the agronomic practices, optimum sowing time is considered as an important non-cash input, results in considerable increase in the yield and quality. Productivity in most of the vegetable crops depends on prevailing environmental conditions to which phenological stages of the crop are being exposed. The staggered dates of sowing may thus influence the crop growth, flowering and yield. The plant growth regulators are either natural or synthetic compounds applied to the target plants to modify either developmental or morphological structure or both by manipulating the hormonal levels in different plant organs at various growth stages of the plant in the life cycle so as to enhance its yield and quality (Setia *et al.*, 1991). The information on suitable varieties, optimum sowing date and growth regulators on off season production of field bean is scanty. Hence, the present study is conducted to find out the field bean varieties suitable for growing in off season for coastal Andhra Pradesh under shade net with optimum date of sowing and suitable growth regulator.

Materials and Methods

The investigation entitled "Performance of varieties with different dates of sowing and spray of growth regulators and their interaction on growth and yield of Dolichos Bean (*Lablab purpureus* L.) during offseason under shade net " was carried out during summer 2014-15 and 2015-16 at Horticultural Research Station, Ambajipeta, East Godavari District of Andhra Pradesh which is situated at 16.4^0 N latitude and 81.5^0 E longitudes with an altitude of 34 m above mean sea level. The experimental site receives an annual rainfall of 1186 mm. The pH of irrigated water was 7.3 and EC is of 0.7 dSm^{-1}. The experiment was laid out with 36 different treatment combinations in a Factorial Randomized Block Design (FRBD) each replicated thrice under shade net. The experiment was carried out with four varieties *viz.*, Arka Jay (V_1), Arka Amog(V_2), Arka Sambhram (V_3)and Arka Sowmya(V_4) with three different dates of sowing *viz.*, December 15th (S_1) January1st (S_2) and January15th (S_3) with foliar spray of growth regulators *viz.*, NAA 25 ppm (G_1), Triacontanol 2 ppm (G_2), and control(G_3). Growth regulators were sprayed at 30 DAS and 60 DAS. The experimental area was thoroughly ploughed and brought into a fine tilth. Recommended dose of FYM and basal dose of fertilizers were incorporated into the soil before the final ploughing. The recommended dose of N, P and K (20:60:50 kg per ha) were applied in the form of urea, single super phosphate and muriate of potash respectively. Nitrogen was applied in 2 splits, half of the nitrogen (*i.e.* 10 kg) was applied as basal dose and the remaining half of the nitrogen (*i.e.* 10 kg) was applied as top dressing at 30 days after sowing. The entire dose of phosphorus and potash were applied at the time of sowing as basal dose.The various observations on growth and yield parameters were recorded on five plants which were tagged. Days to 50% flowering was calculated as number of days taken from the date of sowing to the day when 50 per cent of the plants in a plot were flowered. The two years data were recorded on various growth and yield parameters and the pooled data were statistically analyzed based on ANOVA.

Results and Discussion

The data regarding the effect of sowing time and growth regulators and their interaction on growth characters of field bean varieties under shade net condition was presented in Table 1. Significant differences were found among the varieties for plant height at harvest. Arka Amog (V_2) recorded significantly the highest plant height (66.93 cm) and it was on par with Arka Jay (V_1) (65.83). The differences in plant height among the varieties could be attributed to their genetic character and their adaptability to 50 per cent shade. Similar results in differences in plant height among the varieties when grown under shade net were reported by Vethamoni and Natarajan (2008) [20] in chilli, Nooprom *et al.* (2013) [12] in broccoli and by Guha *et al.* (2016) [5] in coriander.Dates of sowing showed significant effect on plant height at harvest. January 1st sown crop (S_2) recorded the highest plant height (68.22 cm) and it was on par with January 15th sown crop (S_3) (67.16 cm). The increase in plant height particularly for the crop sown on January 1st may be attributed to the favourable environmental factors especially optimum temperature. These results are in consonance with those of Ranjith *et al*. (2013) [15] in cauliflower, Bibi *et al*. (2012) [2] in tomato and by Ranjit *et al.* (2015) [16] in french bean when grown under shade net.Growth regulators were found to have non-significant influence on plant height at harvest.Significant differences for plant height were observed among VxS interactions. At harvest, Arka Amog recorded the highest plant height (70.87 cm) when sown on January 1st (V_2S_2). The interaction between varieties and growth regulators, sowing dates and growth regulators, varieties, sowing dates and growth regulators on plant height was found to be non significant.

The data pertaining to the effect of varieties, dates of sowing, growth regulators and their interactions on leaf area under shade net are presented in Table 1.The data was found significant with regard to leaf area per plant with different varieties, dates of sowing and growth regulators and their interactions. Significantly the highest leaf area per plant (901.9 cm^2) at harvest was observed by Arka Sowmya (V_4).Leaf area was significantly increased due to greater assimilation of food material by the plant which resulted in greater meristematic activities of cells. Similar results have been reported by Esakkiammal *et al.* (2015) [4] in dolichos bean and Prakash *et al* (2015) [13] in french bean. The influence of dates of sowing on leaf area was significant. Significantly the highest leaf area per plant (870.1 cm^2 at harvest respectively was observed by January 1st sowing (S_2). Sowing on January 1st resulted in significant increase in leaf area might be due to favourable environmental conditions during this period such as temperature, day length and light intensity. Similar results were obtained by Mulualem *et al*. (2012) [9] in faba bean and Abido and Seadh (2014) [1] in dolichos bean.The influence of growth regulators on leaf area was also significant. Significantly the highest leaf area per plant (911.0 cm^2 at harvest respectively) was recorded with Triacontanol 2 ppm. The increase in leaf area per plant with Triacontanol foliar spray might be due to enhanced photosynthetic activity and efficient assimilation of photosynthetic products.

Among VxS interactions, significant differences for leaf area was observed at harvest. At harvest, the highest leaf area per plant (934.2 cm^2) was recorded by Arka Amog sown on January 1st (V_2S_2). Among VxG interactions significantly the highest leaf area per plant (966.8 cm^2 at harvest) was observed by Arka Sowmya sprayed with Triacontanol 2 ppm (V_4G_2). Among SxG interactions, non-significant differences for leaf area was observed. Among VxSxG interactions, significantly the highest leaf area per plant was observed by Arka Sambhram (974.45 cm^2) at harvest when sown on December 15th with Triacontanol 2 ppm foliar spray ($V_3S_1G_2$).

Varieties, dates of sowing, growth regulators and their interactions showed significant effect on number of buds per node and days to 50% flowering and data are presented in Table 2.The effect of variety on number of buds per node was found non-significant. The highest number of buds per node was observed in Arka Amog (V_2) (4.26) and the lowest in Arka Jay (V_1) (3.56). Similar variation in number of buds per node was reported by Das *et al*. (2012) [3] in country bean. Further, the effect of dates of sowing on number of buds per node was also significant. The highest number of buds per node were observed in January 1st sown crop (S_2) (4.17) followed by December 15th (S_1) (4.14). The crop sown on January 15th (S_3) recorded the lowest number of buds per node (3.48).The effect of growth regulators on number of buds per node was significant. The plants sprayed with Triacontanol 2 ppm (G_2) recorded the highest number of buds per node (4.20), followed by NAA 25 ppm spray (G_1) (3.96) and control (3.63).

The effect of VxS interaction was significant for number of buds per node. The highest number of buds per node was observed in Arka Sambhram sown on January 1st (V_3S_2)

(5.20) and the lowest number of buds per node (3.12) were noticed in Arka Jay sown on January 15th (V_1S_3). The effect of VxG interaction was significant for number of buds per node. The highest number of buds per node (4.57) were observed in Arka Amog in combination with Triacontanol 2 ppm spray (V_2G_2) and was on par with Arka Sambhram sown on January1st (V_3G_2)(4.24). The lowest number of buds per node (3.25) was observed in Arka Jay without spray (V_1G_3). The effect of SxG interaction was non-significant for number of buds per node. The effect of VxSxG was found significant for number of buds per node. The highest number of buds per node were observed in Arka Sambhram sown on January1st in combination with Triacontanol 2 ppm spray ($V_3S_2G_2$) (5.61)

The varieties did not differed significantly for days to 50 per cent flowering. The influence of dates of sowing on days to 50 per cent flowering was significant. December 15th sowing (S_1) took the least number of days for 50 per cent flowering (40.60), and it was on par with January 1st sowing (40.94), followed by January 15th sowing (S_3) (42.11 days). The reason for variation in days to 50 per cent flowering might be due to variation in growing conditions due to different sowing times as reported by Nooprom *et al.* (2013) [12] in broccoli.The influence of growth regulators on days to 50 per cent flowering was non-significant and also the interaction of varieties and sowing dates, varieties and growth regulators, sowing dates and growth regulators and varieties, sowing dates and growth regulators showed non-significant influence on days to 50 per cent flowering.

Varieties, dates of sowing and growth regulators showed significant effect on pod weight. Interaction of VxS, SxG VxG and VxSxG also showed significant effect on pod weight and the data are depicted in Table 3. The highest pod weight (4.52 g) was noticed in Arka Sowmya (V_4) and it was on par with Arka Sambhram (V_3) (4.37). Pod weight was lowest in Arka Jay (V_1) (3.79 g). It might be due to the genotypic variation among the varieties and their interaction with environmental factors reaction with the plant which accelerates the vegetative and reproductive growth phases ultimately promoting pod weight. The findings are in agreement with the findings of Khattak *et al.* (2007) [7] in tomato and Vethamoni and Natarajan (2008) [20] in chilli. Dates of sowing showed significant effect on pod weight and the highest pod weight was recorded in January 1st sown crop (S_2) (4.37 g). The lowest pod weight (4.11 g) was recorded in December 15th sowing (S_1). This could be attributed to enhanced plant growth coupled with adequate reserved food material which facilitated adequate vegetative growth and subsequently higher weight of pod. These results are in consonance with the findings of Abido and Seadh (2014) [1] in dolichos bean.Growth regulators showed significant effect on pod weight. Highest pod weight was recorded with Triacontanol 2 ppm spray (G_2) (4.37g) and control recorded the lowest pod weight (3.97 g). Increased supply of photosynthetic materials and its efficient mobilization in plants gives rise to increased stimulation of pod growth ultimately increases pod weight. Similar results of increased fruit weight with Triacontanol was reported by Khan *et al.*(2009) [6] in tomato.In VxS interaction, Arka Sowmya sown on January 1st (V_4S_2) recorded the highest pod weight(4.89 g) and was on par with Arka Sambhram sown on January 1st (V_3S_2) (4.72 g) and Arka Amog sown on January 1st (V_2S_2) (4.63 g). The interaction between varieties and growth regulators and sowing dates and growth regulators was found to be non significant for pod weight. Among VxSxG interaction, Arka Sowmya sown on January 1st with NAA spray ($V_4S_2G_1$) showed the highest pod weight (5.01 g) and the lowest pod weight (2.99 g) was recorded in Arka Jay sown on January 1st without growth regulator spray ($V_1S_2G_3$).

The results on pod yield per hectare in field bean as influenced by varieties, dates of sowing and growth regulators are presented in Table 3.The varieties recorded significant differences for pod yield per hectare. Arka Sowmya (V_4) recorded significantly highest pod yield per ha (132.06 q) and the lowest pod yield per hectare was recorded in Arka Jay (V_1) (96.02 q). The increasing yield may be due to more number of branches, more leaf area and more number of pods. These characters favour the maximum conversion into yield of the plant and also depend on the genetic characters of the variety. The findings corroborate with the results obtained by Vethamoni and Natarajan (2008) [20] in chilli, Nooprom *et al.* (2013) [12] in broccoli and Ranjith *et al*. (2013) [15] in cauliflower when grown under shade net.The results on pod yield per hectare differed significantly due to sowing dates. The crop sown on January 1st (S_2) recorded significantly the highest pod yield per hectare (129.26 q) and the crop sown on December 15th (S_1) recorded the lowest pod yield per hectare (107.67 q). The effect of sowing dates on pod yield per hectare was reported by Bibi *et al*. (2012) [2] in tomato, and Ranjit *et al.* (2015) [16] in french bean when grown under shade net conditions.The results on pod yield per hectare differed significantly due to growth regulators. Triacontanol 2 ppm (G_2) recorded the highest pod yield per hectare (125.72 q) followed by NAA 25 ppm spray (G_1) (115.97 q). The lowest pod yield per ha was recorded in control (G_3) (103.48 q). The positive influence of Triacontanol on plant yield might be due to its impact on the carbon cycle in plant *i.e* higher CO_2 fixation and their efficient translocation (Menon and Srivastava, 1984) [8]. Increase in yield due to Triacontanol has been reported by Ries *et al.* (1978) [17], Sharma (1994) [18] in capsicum; Nargis Jahan *et al.* (1997) [10] in okra; Tripti Shrivastava *et al.* (2001) [19] in chickpea. The increase in yield due to NAA was reported by Prateek *et al.* (2017) [14] under shade net grown capsicum.

In the interaction of VxS, pod yield per ha differed significantly. Arka Sowmya sown on January 1st (V_4S_2) recorded the highest pod yield per ha (153.52 q) and Arka Jay sown on January 1st (V_1S_2) recorded the lowest yield per ha (91.05 q). The interaction of varieties and growth regulators and sowing dates and growth regulators was non-significant for pod yield per hectare. VxSxG interactions significantly influenced pod yield per ha. Arka Sowmya sown on January 1st sprayed with Triacontanol 2 ppm foliar spray ($V_4S_2G_2$) recorded the maximum pod yield per ha (163.27 q) and it was on par with Arka Sowmya sown on January 1st sprayed with NAA 25 ppm ($V_4S_2G_1$) (154.86 q) and Arka Jay sown on January 1st without growth regulator spray ($V_1S_2G_3$) recorded the lowest yield per ha (79.85 q).

Table 1: Effect of varieties, dates of sowing, growth regulators and their interaction on plant height in field bean at harvest under shade net.

Varieties (V)	Plant Height (cm) at harvest				Leaf area par plant at harvest (cm^2)				
	Dates of sowing (S)				Dates of sowing (S)				
	S_1	S_2	S_3	Mean	Varieties (V)	S_1	S_2	S_3	Mean
V_1	63.99	65.82	67.69	65.83	V_1	723.0	857.5	730.20	770.02
V_2	62.41	70.87	68.50	66.93	V_2	892.80	934.20	860.30	895.8
V_3	60.28	67.06	67.06	64.80	V_3	904.20	842.70	769.40	838.0
V_4	59.14	69.11	65.41	64.55	V_4	917.20	846.10	942.50	901.9
Mean	61.20	68.22	67.16	--	Mean	859.30	870.10	825.60	--
Varieties (V)	**Growth Regulators (G)**			**Mean**	**Varieties (V)**	**Growth Regulators (G)**			**Mean**
	G_1	G_2	G_3			G_1	G_2	G_3	
V_1	65.43	66.73	66.34	65.83	V_1	795.60	855.50	658.60	770.02
V_2	66.40	67.76	66.62	66.93	V_2	902.60	933.10	851.70	895.8
V_3	64.75	65.60	64.05	64.80	V_3	831.80	888.40	796.50	838.0
V_4	62.72	64.50	66.44	64.55	V_4	888.10	966.80	850.80	901.9
Mean	64.83	66.15	65.61	--	Mean	855.0	911.0	790.0	--
Dates of sowing(S)	**Growth Regulators (G)**			**Mean**	**Dates of sowing (S)**	**Growth Regulators (G)**			**Mean**
	G_1	G_2	G_3			G_1	G_2	G_3	
S_1	60.80	61.54	61.27	61.20	S_1	857.0	916.0	805.0	859.30
S_2	67.74	68.75	68.16	67.16	S_2	867.0	936.0	808.0	870.10
S_3	65.94	68.16	67.39	68.22	S_3	840.0	881.0	756.0	825.60
Mean	64.83	66.15	65.61	--	Mean	855.0	911.0	790.0	-
Interaction (VxSxG)	**Growth Regulators (G)**				**Interaction (VxSxG)**	**Growth Regulators (G)**			
	G_1	G_2	G_3			G_1	G_2	G_3	
V_1 S_1	64.70	63.77	63.48	--	V_1 S_1	745.71	821.75	601.49	--
V_1 S_2	65.18	67.11	65.16	--	V_1 S_2	897.55	948.87	726.03	--
V_1 S_3	66.40	69.30	67.37	--	V_1 S_3	743.47	795.83	651.15	--
V_2 S_1	61.09	62.72	60.40	--	V_2 S_1	893.98	911.29	873.24	--
V_2 S_2	69.10	71.80	71.70	--	V_2 S_2	930.71	958.07	913.90	--
V_2 S_3	69.01	68.74	67.74	--	V_2 S_3	883.15	929.91	767.81	--
V_3 S_1	60.31	60.26	60.24	--	V_3 S_1	875.67	974.45	862.35	--
V_3 S_2	66.92	68.56	65.69	--	V_3 S_2	831.34	864.61	832.02	--
V_3 S_3	66.99	67.98	66.19	--	V_3 S_3	788.36	826.01	693.93	--
V_4 S_1	57.08	59.38	60.95	--	V_4 S_1	912.29	957.62	881.57	--
V_4 S_2	69.74	67.50	70.08	--	V_4 S_2	807.67	970.86	759.70	--
V_4 S_3	61.34	66.61	68.26	--	V_4 S_3	944.22	971.98	911.24	--
Source	**SE.m ±**		**C.D at 5 %**		**SE.m ±**			**C.D at 5 %**	
V	0.54		1.52		8.95			24.99	
S	0.47		1.31		7.75			21.64	
G	0.47		NS		7.75			21.64	
VxS	0.94		2.63		15.51			43.29	
VxG	0.94		NS		15.51			43.29	
SxG	0.81		NS		13.43			NS	
VxSxG	1.63		NS		26.86			74.99	

Varieties (V)	Dates of sowing (S)	Growth Regulators (G)
V_1 - Arka Jay	S_1 - December 15th	G_1 - NAA 25 ppm
V_2 - Arka Amog	S_2 - January 1st	G_2 - Triacontanol 2 ppm
V_3 - Arka Sambhram	S_3 - January 15th	G_3 - Control
V_4 - Arka Sowmya		

Table 2: Effect of varieties, dates of sowing, growth regulators and their interaction on number of buds/node and days to 50% flowering in field bean under shade net.

Varieties (V)	Number of buds/node				Days to 50% flowering				
	Dates of sowing (S)				Dates of sowing (S)				
	S_1	S_2	S_3	Mean	Varieties (V)	S_1	S_2	S_3	Mean
V_1	4.11	3.43	3.12	3.56	V_1	41.70	40.20	41.07	40.99
V_2	4.67	4.39	3.72	4.26	V_2	40.40	40.87	41.65	40.98
V_3	3.15	5.20	3.70	4.01	V_3	39.61	41.50	42.60	41.24
V_4	4.65	3.66	3.38	3.89	V_4	40.69	41.19	43.11	41.66
Mean	4.14	4.17	3.48		Mean	40.60	40.94	42.11	
Varieties (V)	**Growth Regulators (G)**				**Varieties (V)**	**Growth Regulators (G)**			
	G_1	G_2	G_3	Mean		G_1	G_2	G_3	Mean
V_1	3.63	3.79	3.25	3.56	V_1	40.60	40.96	41.41	40.99
V_2	4.35	4.57	3.87	4.26	V_2	40.44	41.10	41.39	40.98
V_3	3.95	4.24	3.85	4.01	V_3	41.15	41.00	41.56	41.24
V_4	3.92	4.19	3.57	3.89	V_4	41.55	41.80	41.64	41.66
Mean	3.96	4.20	3.63		Mean	40.93	41.22	41.50	

Dates of sowing(S)	Growth Regulators (G)			
	G_1	G_2	G_3	Mean
S_1	4.15	4.33	3.95	4.14
S_2	4.11	4.63	3.78	4.17
S_3	3.63	3.64	3.17	3.48
Mean	3.96	4.20	3.63	

Date of sowing (S)	Growth Regulators (G)			
	G_1	G_2	G_3	Mean
S_1	40.28	40.67	40.85	40.60
S_2	40.52	40.59	41.71	40.94
S_3	42.00	42.39	41.93	42.11
Mean				--

Interaction (VxSxG)		Growth Regulators (G)			
		G_1	G_2	G_3	
V_1	S_1	4.06	4.58	3.69	--
	S_2	3.55	3.73	3.02	--
	S_3	3.30	3.06	3.02	--
V_2	S_1	4.73	4.75	4.54	--
	S_2	4.26	4.89	4.04	--
	S_3	4.06	4.07	3.02	--
V_3	S_1	3.16	3.26	3.02	--
	S_2	5.07	5.61	4.93	--
	S_3	3.63	3.85	3.61	--
V_4	S_1	4.66	4.74	4.54	--
	S_2	3.55	4.28	3.15	--
	S_3	3.55	3.57	3.02	--

Varieties (V)		Growth Regulators (G)			
		G_1	G_2	G_3	
V_1	S_1	41.40	41.68	42.02	--
	S_2	39.99	39.79	40.80	--
	S_3	40.40	41.41	41.41	--
V_2	S_1	39.99	40.19	41.00	--
	S_2	39.59	41.41	41.61	--
	S_3	41.73	41.68	41.54	--
V_3	S_1	39.39	39.92	39.51	--
	S_2	41.00	40.87	42.62	--
	S_3	43.03	42.21	42.55	--
V_4	S_1	40.32	40.87	40.87	--
	S_2	41.48	40.26	41.81	--
	S_3	42.83	44.26	42.21	--

Source	SE.m ±	C.D at 5 %	SE.m ±	C.D at 5 %
V	0.04	0.11	0.43	NS
S	0.03	0.10	0.37	1.04
G	0.03	0.10	0.37	NS
VxS	0.07	0.20	0.74	NS
VxG	0.07	0.20	0.74	NS
SxG	0.06	NS	0.64	NS
VxSxG	0.12	0.34	1.29	NS

Varieties (V)	Dates of sowing (S)	Growth Regulators (G)
V_1 - Arka Jay	S_1 - December 15th	G_1 - NAA 25 ppm
V_2 - Arka Amog	S_2 - January 1st	G_2 - Triacontanol 2 ppm
V_3 - Arka Sambhram	S_3 - January 15th	G_3 - Control
V_4 - Arka Sowmya		

Table 3: Effect of varieties, dates of sowing, growth regulators and their interaction on pod weight and pod yield per hectare in field bean under shade net.

Varieties (V)	Pod weight (g)			
	Dates of sowing (S)			
	S_1	S_2	S_3	Mean
V_1	4.02	3.22	4.12	3.79
V_2	4.09	4.63	3.85	4.19
V_3	4.11	4.72	4.29	4.37
V_4	4.21	4.89	4.51	4.52
Mean	4.11	4.37	4.19	

Pod yield per hectare (q)				
Dates of sowing (S)				
Varieties (V)	S_1	S_2	S_3	Mean
V_1	98.07	91.05	98.92	96.02
V_2	103.37	134.77	97.22	111.79
V_3	109.75	137.69	113.62	120.36
V_4	119.49	153.52	123.19	132.06
Mean	107.67	129.26	108.54	--

Varieties (V)	Growth Regulators (G)			
	G_1	G_2	G_3	Mean
V_1	3.73	4.00	3.63	3.79
V_2	4.29	4.20	4.09	4.24
V_3	4.44	4.56	4.12	4.37
V_4	4.81	4.73	4.02	4.54
Mean	4.21	4.37	3.97	

Varieties (V)	Growth Regulators (G)			
	G_1	G_2	G_3	Mean
V_1	94.12	106.00	87.93	96.02
V_2	112.45	116.99	105.92	111.79
V_3	117.56	134.55	108.96	120.36
V_4	139.74	145.34	111.10	132.06
Mean	115.97	125.72	103.48	

Dates of sowing(S)	Growth Regulators (G)			
	G_1	G_2	G_3	Mean
S_1	4.13	4.29	3.89	4.11
S_2	4.44	4.42	4.24	4.37
S_3	4.38	4.41	3.76	4.19
Mean	4.32	4.37	3.97	

Date of sowing (S)	Growth Regulators (G)			
	G_1	G_2	G_3	Mean
S_1	108.24	118.67	96.10	107.67
S_2	129.02	139.08	119.68	129.26
S_3	110.65	119.42	94.65	108.54
Mean	115.97	125.72	103.48	--

Interaction (VxSxG)		Growth Regulators (G)			
		G_1	G_2	G_3	
V_1	S_1	3.87	4.35	3.83	--
	S_2	3.32	3.36	2.99	--
	S_3	4.01	4.29	4.07	--
V_2	S_1	4.08	4.03	4.14	--
	S_2	4.59	4.65	4.66	--
	S_3	4.18	3.90	3.47	--
V_3	S_1	4.14	4.23	3.95	--
	S_2	4.86	4.67	4.64	--

Varieties (V)		Growth Regulators (G)			
		G_1	G_2	G_3	
V_1	S_1	92.92	112.16	89.15	--
	S_2	93.06	100.25	79.85	--
	S_3	96.39	105.58	94.78	--
V_2	S_1	103.91	103.93	102.28	--
	S_2	131.80	141.50	131.02	--
	S_3	101.66	105.55	84.47	--
V_3	S_1	107.18	121.30	100.78	--
	S_2	136.38	151.28	125.43	--

	S_3	4.33	4.78	3.76	--		S_3	109.14	131.06	100.66	--
V_4	S_1	4.43	4.56	3.66	--	V_4	S_1	128.96	137.30	92.20	--
	S_2	5.01	4.98	4.69	--		S_2	154.86	163.27	142.42	--
	S_3	4.97	4.65	3.72	--		S_3	135.41	135.47	98.68	--

Source	SE.m ±	C.D at 5 %	SE.m ±	C.D at 5 %
V	0.07	0.20	2.09	5.84
S	0.06	0.17	1.81	5.05
G	0.06	0.17	1.81	5.05
VxS	0.12	0.34	3.62	10.11
VxG	0.12	NS	3.62	NS
SxG	0.10	NS	3.13	NS
VxSxG	0.21	0.60	6.27	17.52

Varieties (V)	Dates of sowing (S)	Growth Regulators (G)
V_1 - Arka Jay	S_1 - December 15th	G_1 - NAA 25 ppm
V_2 - Arka Amog	S_2 - January 1st	G_2 - Triacontanol 2 ppm
V_3 - Arka Sambhram	S_3 - January 15th	G_3 - Control
V_4 - Arka Sowmya		

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