Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 8 [3] February 2019 : 103-111

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

ORIGINAL ARTICLE **OPEN ACCESS**

Influence of off Season Climate by the different Planting date on Pod and seed Morphometric characteristics of Soybean (*Glycine max* L. Merrill) Cultivars

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ABSTRACT
A laboratory study was conducted during 2015-16 and 2016-17 at seed unit laboratory, UAS, Raichur to find out the cultivars response in terms of seedling vigour and biochemical activities to assess the suitable planting dates for quality seed production. In order to explain the effect of sowing date on soybean (Glycine max L. Merrill) seed morphometry characters, two varieties including JS 335 and DSb 21 were sown from Nov 1st fortnight, Nov 2nd fortnight, Dec 1st fortnight, Dec 2nd fortnight, Jan 1st fortnight, Jan 2nd fortnight, Feb 1st fortnight, Feb 2nd fortnight. The results of the experiment revealed that the below parameters significantly affected by sowing dates. The highest length of pod (91.25%), width of pod (21.32 cm), area of pod (20.17 cm), diameter of pod (41.49 cm), perimeter of pod (121.23 mg), length of seed (91.25%), width of seed (21.32 cm), area of seed (20.17 cm), diameter of seed (41.49 cm) and perimeter of seed (121.23 mg) were recorded for crop sown in Nov 1st fortnight. It was noticed that sowing date significantly affected the seed quality parameters and seeds from early sowings (Nov 1st fortnight sowing) had the good seed morphometry.
Key words: *Soybean, Varieties, Pod morphometry, Seed morphometry and Date of sowing.*

Received 11.12.2018 Revised 04.01.2019 Accepted 10.01.2019

INTRODUCTION

Soybean (*Glycine max* L. Merrill) is an important oil seed crop in the world contributing 25 per cent to the global vegetable oil production and also serving as the major source of protein (40 %) and oil (20 %) for both human and animal consumption. Globally, it is grown in an area of about 120 million ha with a production of 351 million tonnes and productivity of 2920 kg per ha. Though it is comparatively new crop to India, it occupies an area of 11.40 million ha with a production of 12 million tonnes and productivity of 1010 kg per ha. In Karnataka, it is grown in an area of 3.2 lakh hectares with an annual production of 2.54 lakh tonnes and productivity of 785 kg per ha [1].

In order to maintain genuineness and quality of seed, careful attention is needed at every stage of seed production of a variety. The proper variety identification serves the important goals of seed production. It insures whether the seed being produced or offered for sale is of the variety ought to be; whether it is pure or any kind of mixture; to know what to rogue out during seed production. Exchange of seeds is essential for plant breeders to improve genetic variability of available germplasm for recombination and selection of desired traits. Characterization and identification of plant varieties are thus, fundamental to the development, release and popularization of the crop varieties. Seed is the 'custodian' of genetic improvements in crop species takes place from time through research endeavours in plant breeding. For farmers to realize the full benefits of such improvements, availability of good quality seed is a pre-requisite in crop production. In this context, varietal description for identification of crop varieties has

attained a critical importance in national and international seed programmes and there is a considerable need for the development of reliable methods and identifiable characters for identification purpose.
Generally, the time of planting varies depending on the climatic conditions of the region and the variety to be grown. Different varieties of soybean are sensitive to changes in environmental conditions where the crop is being grown. Therefore, it is necessary to study the genotype × environment interaction to identify the varieties which are stable in different environments [2]. Impact of climate on seedling emergence, plant growth, reproductive parts development and yield concerned and production of quality of seeds are further fulfilment of the national food security. Even the seed size is one of the concept to analysis the seed quality because seed size will be included the size of the embryo and the capacity of the nutrients supply to growth and development of seedling. Seed size is very important to optimum growth and yield production in farm which influenced by many factors such as genetic characters, viability, germination percentage, vigour, moisture content, storage conditions, survival ability and seed health concern. Within the crop the different genotypes are shows there different characters of seed size, viability and survival ability. Some time climatic conditions are impact on genotypes and reduced the seed size.
Seed size in directly influences on the seed weight and also the moisture content of the seed. Here, thousand seed weight is directly consists the seed quality because the better seed germination, seed vigour, viability and finally influences on seed yield. Larger seeds of early sown crops are produced higher yield than smaller seeds under late-sown conditions [3]. Seed size not only influence emergence and establishment but also affected yield components and ultimately grain yield [4]. In view of the above facts, the study was carried out to investigate the influence of different date of sowings on seed morphometry and pod morphometry characters of soybean varieties.

MATERIAL AND METHODS

In order to study effect of different planting dates on plant growth and seed yield of soybean cultivars and experiment was conducted under semi arid climatic condition (Figure 1 and 2) in Agricultural Research Station, Bidar during 2015-16 and 2016-17. The soil type was a black clay loam, pH of 7.75 to 7.80 and the region with an annual precipitation of 847 mm. The experimental design was a factorial randomized completely block design with three replications. The experiment including 8 planting dates (Nov 1st fortnight, Nov 2nd fortnight, Dec 1st fortnight, Dec 2nd fortnight, Jan 1st fortnight, Jan 2nd fortnight, Feb 1st fortnight and Feb 2nd fortnight) as a first factor and 2 soybean cultivars (JS 335 and DSb 21) as a second factor. Crop management factors like land preparation, fertilizer, and weed control were followed as recommended for local area. All the plant protection measures were adopted to make the crop free from pest and diseases.
The crop was harvested at full maturity of all the fortnight sown crops and harvesting was done manually from each plot. Harvested crop seeds are clean and grade separately. After that seeds are carried out to seed science and technology department laboratory, university of agricultural sciences, Raichur. The following data were collected during the experimentation: length of pod, width of pod, area of pod, diameter of pod, perimeter of pod, length of seed, width of seed, area of seed, diameter of seed and perimeter of seed.
Ten pods of each genotype was measured using Biovis image analyser and ten seeds of each genotype was measured using Biovis image analyser. Biovis is a seed image analyser of new generation, based on digital image processing technology, easy to handle and to operate (Figure 3). The device comprises a scanner, which will scan the images and capture the same with their length, width, area, perimeter and roundness with coloured images (Figure 4 to 7). Thus it is suitable for the analysis of the seeds of many crops. The Biovis seed image analyser provides clearly more than a traditional counting device. It works fast, noiseless and easily operated. The special Biovis image analysis software offers a lot of possibilities, to adjust the recording of the analysis results and statistical interpretation according to the requirements and demands of the user. After irregularly distributing a seed sample on special measuring plane (image scanner), it will takes a picture of the objects to be explored is taken under optimal lighting conditions. This image is evaluated in the PC by special software on the basis of the digital images processing. Seeds of different shape and size will be counted fast and reliably, the measurements of their length and width is determined as well as their size infractions. The features of varieties are stored in a preconfigured, able to learn database for recognizing and identifying main seeds, foreign seeds and non-seed particles. The analysis data are entered and reported together with users-electable statistical information in a measuring protocol. Furthermore it is possible to transfer specific measuring data to a user-specific database.

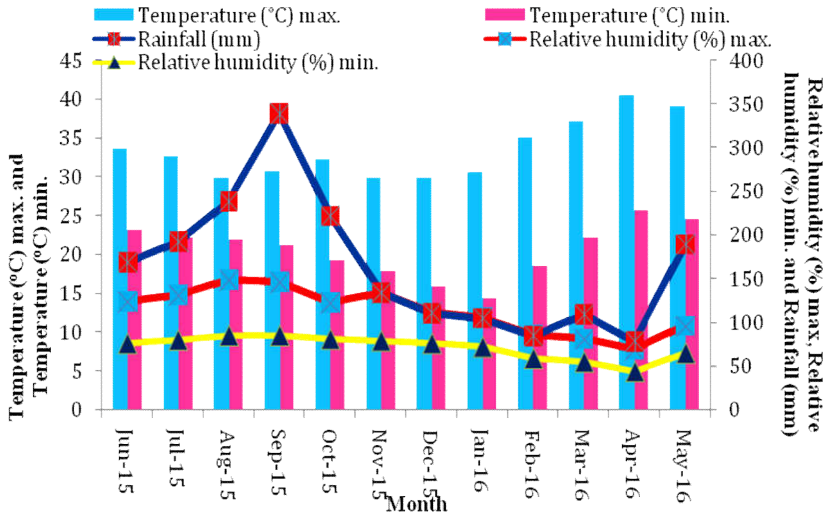


Figure 1. Mean Monthly meteorological data for the year 2015-16 at Agricultural Research Station Bidar

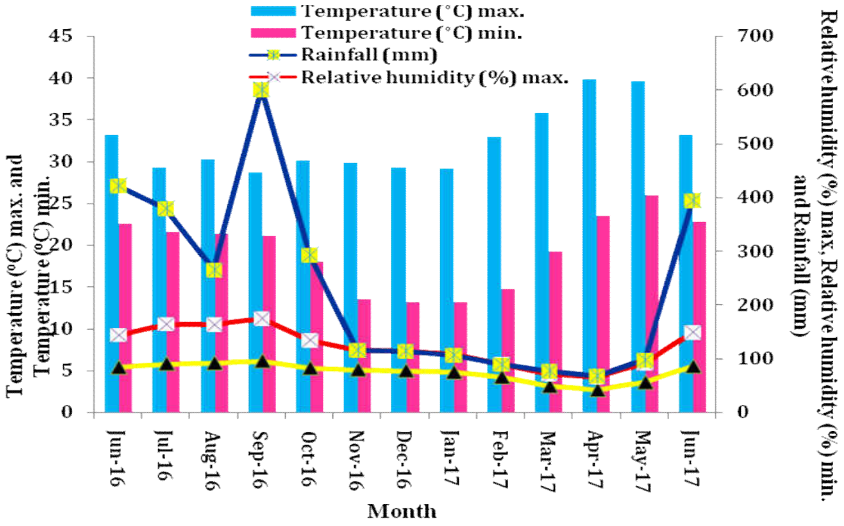


Figure . 2. Mean Monthly meteorological data for the year 2016-17 at Agricultural Research Station Bidar

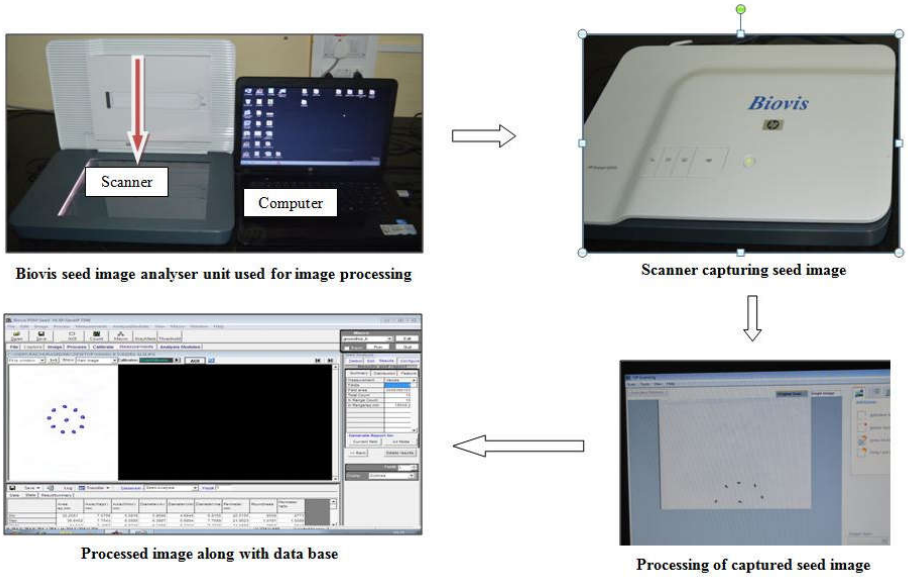


Figure 3. Seed image acquisition and data analysis by using Biovis seed image analyser

RESULT AND DISCUSSION

Morphometric Image analyser

In the present investigation, attempts were made to study the impact of off seasonal climate on soybean seed and pod morphometric characters through image analysis of seed like area of seed, length of seed, width of seed, diameter of seed, perimeter of seed and also pod characters like area of pod, length of pod, width of pod, diameter of pod and perimeter of pod in order to develop identification key which are reliable. The results obtained are discussed in this chapter.

Pod morphometric characters

The results are explained based on the pooled mean of 2015-16 and 2016-17. The varieties showed a significant difference in pod morphometric characters (Figure 4 and 5). Variety JS 335 (501.03 mm^2, 44.71 mm, 17.30 mm, 26.15 mm and 114.37 mm, respectively) showed significantly highest area of pod, length of pod, width of pod, diameter of pod and perimeter of pod respectively as compared to DSb 21 (469.06 mm^2, 43.11 mm, 16.73 mm, 24.93 mm and 110.93 mm, respectively) (Tables 1). The pod morphometric characters were found significantly higher (576.39 mm^2, 47.99 mm, 20.11 mm, 29.38 mm and 121.82 mm, respectively) in early sowings (S_1) (November 1st fortnight) and it was on par with November 2nd fortnight (S_2) (550.61 mm^2, 46.61 mm, 19.09 mm, 27.95 mm and 120.18 mm, respectively), followed by December 1st fortnight (S_3) (526.84 mm^2, 45.19 mm, 17.91 mm, 26.53 mm and 115.56 mm, respectively), while (S_8) February 2nd fortnight recorded significantly lowest pod morphometric characters (392.52 mm^2, 39.96 mm, 14.71 mm, 21.80 mm and 102.60 mm, respectively). The results are in line with those of Egli and Bruening [5] in case of soybean, who reported that different sowing dates and cultivars significantly affected the pod length. Physical appearance of the seed includes seed size and shape, seed coat and hilum color. Although some of these differences are determined by growing environments, others are genetic and stable and therefore can be used for cultivar identification [6].

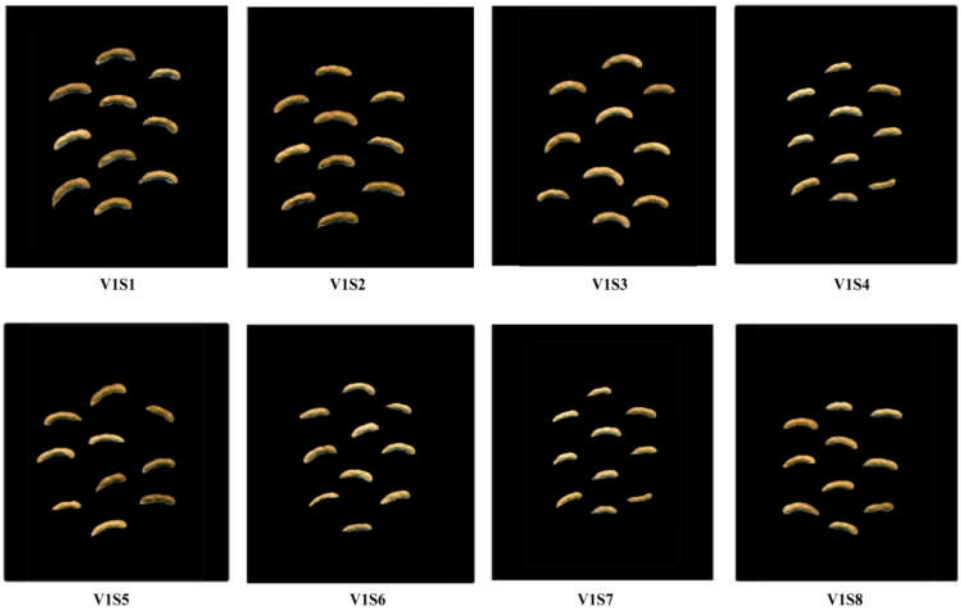


Figure 4. View of the pod morphometry observed through image analyser of JS 335 harvested at different date of sowings.

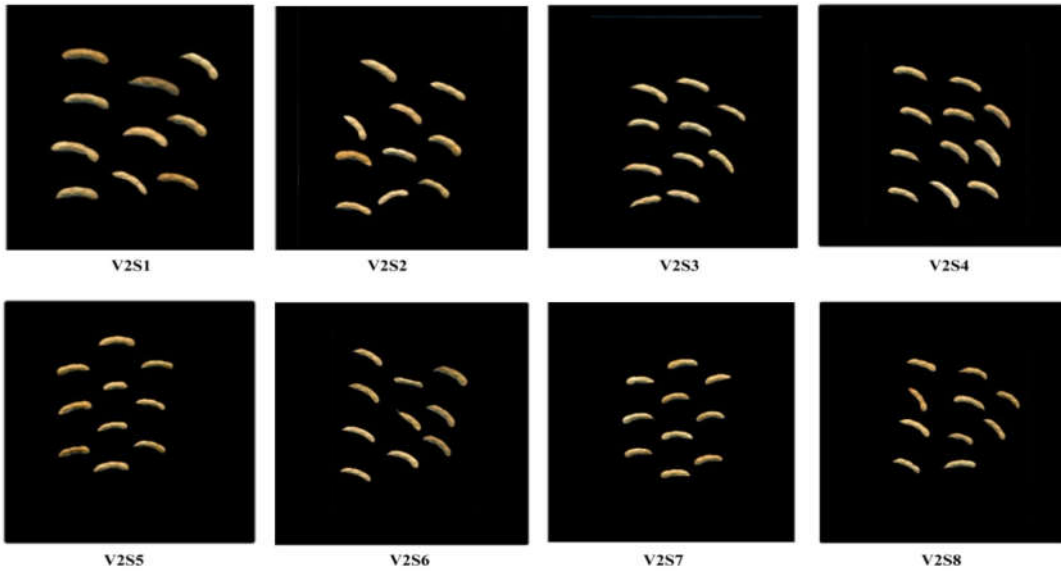
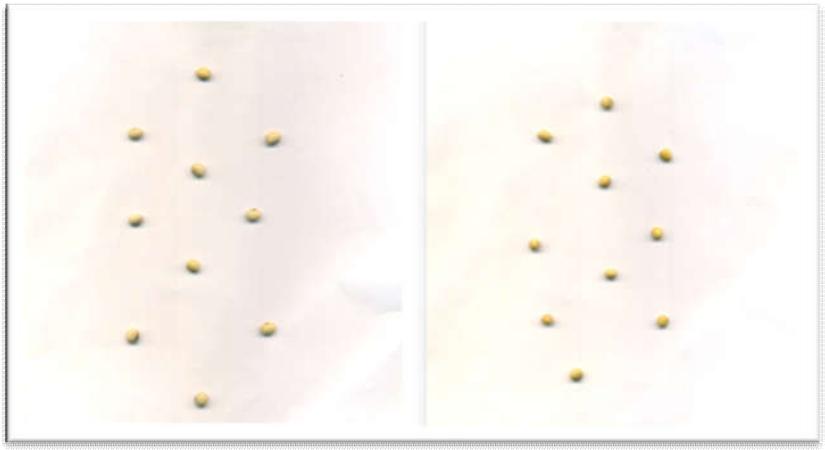
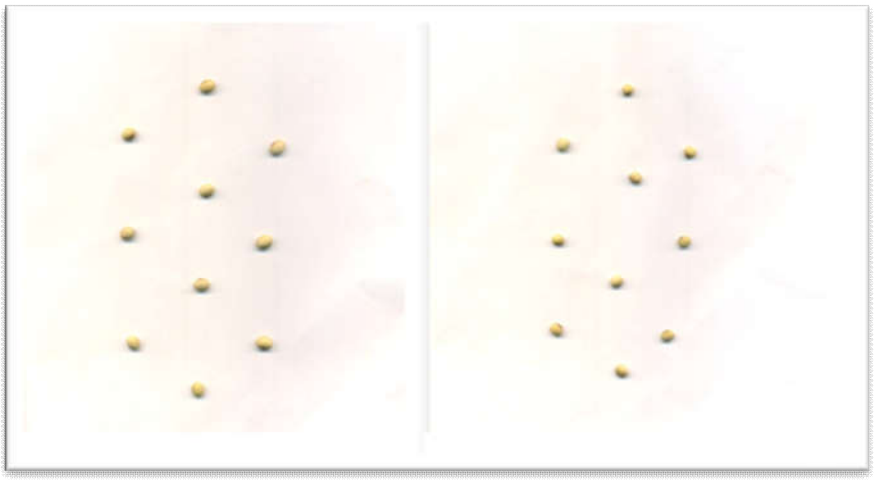


Figure 5. View of the pod morphometry observed through image analyser of DSb 21 harvested at different date of sowings.



V1S1 **V1S8**

Figure 6. View of the seed morphometry observed through image analyser of JS 335 harvested at different date of sowings.



V2S1 **V2S8**

Figure 7. View of the seed morphometry observed through image analyser of DSb 21 harvested at different date of sowings.

Seed morphometric characters

The results are presented based on the pooled mean of 2015-16 and 2016-17 data. The varieties showed a significant difference in seed morphometric characters (Figure 6 and 7) Variety JS 335 (77.36 mm^2, 10.50 mm, 9.44 mm, 9.35 mm and 31.79 mm, respectively) showed significantly highest area of seed, length of seed, width of seed, diameter of seed and perimeter of seed as compared to DSb 21 (74.89 mm^2, 10.18 mm, 9.16 mm, 9.08 mm and 30.67 mm, respectively). The results revealed that the area of seed, length of seed, width of seed, diameter of seed and perimeter of seed are significant (Table 2). The seed morphometric characters were found significantly higher (88.18 mm^2, 11.48 mm, 10.05 mm, 10.02 mm and 34.56 mm, respectively) in early sowing date (S_1) (November 1st fortnight) and it was on par with November 2nd fortnight (S_2) (83.94 mm^2, 11.13 mm, 9.89 mm, 9.72 mm and 33.31 mm, respectively), followed by December 1st fortnight (S_3) (78.37 mm^2, 10.61 mm, 9.51 mm, 9.39 mm and 32.39 mm, respectively), while (S_8) February 2nd fortnight recorded significantly the lowest seed morph metric characters (67.88 mm^2, 9.32 mm, 8.62 mm, 8.64 mm and 28.44 mm, respectively). Relatively higher seed size and shape was observed from sowing of November than December and this might be due to optimum climatic conditions during flowering, maturity and harvesting stages. Later sown crop matured early with less pod filling, improper seed development and seeds obtained from these sowings had relatively less moisture content and these seeds are of small seed size and shape.

Table.1 Effect of sowing dates on pod morpho-metry characteristics in soybean cultivars JS 335 and DSb 21

	Area of pod (mm2)			Length of pod (mm)			Width of pod (mm)		
	2015-16	2016-17	Pooled mean	2015-16	2016-17	Pooled mean	2015-16	2016-17	Pooled mean
V1	487.04	515.01	501.03	44.36	45.05	44.71	17.13	17.48	17.30
V2	461.23	476.89	469.06	42.92	43.31	43.11	16.59	16.87	16.73
S.Em±	3.02	3.16	3.09	0.27	0.27	0.27	0.11	0.12	0.11
CD@1%	11.71	12.27	11.99	1.03	1.06	1.04	0.43	0.45	0.43
S1	563.05	589.73	576.39	47.58	48.39	47.99	19.66	20.57	20.11
S2	534.95	566.28	550.61	45.76	47.45	46.61	18.61	19.58	19.09
S3	511.36	542.32	526.84	45.04	45.33	45.19	17.83	17.99	17.91
S4	481.32	518.41	499.87	44.39	44.54	44.47	16.97	17.04	17.01
S5	470.28	493.23	481.76	43.08	43.43	43.26	16.43	16.48	16.46
S6	437.45	457.75	447.60	42.09	42.82	42.46	15.66	15.72	15.69
S7	404.06	405.46	404.76	41.02	41.70	41.36	15.13	15.18	15.15
S8	390.62	394.43	392.52	40.17	39.76	39.96	14.57	14.85	14.71
S.Em±	7.39	7.75	7.57	0.65	0.67	0.66	0.27	0.28	0.27
CD@1%	28.68	30.06	29.37	2.50	2.60	2.55	1.06	1.10	1.05
V1S1	595.19	613.44	604.32	48.42	49.50	48.96	20.52	21.23	20.88
V1S2	552.04	602.28	577.16	46.96	48.81	47.89	19.10	20.32	19.71
V1S3	513.89	569.29	541.59	45.81	45.82	45.82	18.18	18.11	18.15
V1S4	495.03	542.97	519.00	45.49	45.14	45.31	17.03	17.13	17.08
V1S5	484.82	509.33	497.08	43.93	44.18	44.06	16.49	16.94	16.72
V1S6	457.29	475.70	466.50	42.48	43.75	43.11	15.81	15.89	15.85
V1S7	405.98	408.43	407.21	41.06	42.71	41.89	15.18	15.25	15.22
V1S8	392.07	398.67	395.37	40.76	40.47	40.62	14.70	14.96	14.83
V2S1	530.90	566.02	548.46	46.75	47.28	47.01	18.79	19.91	19.35
V2S2	517.85	530.28	524.07	44.56	46.09	45.33	18.12	18.84	18.48
V2S3	508.82	515.36	512.09	44.27	44.84	44.55	17.48	17.87	17.68
V2S4	467.61	493.85	480.73	43.29	43.95	43.62	16.91	16.95	16.93
V2S5	455.74	477.13	466.44	42.24	42.67	42.45	16.38	16.01	16.20
V2S6	417.61	439.81	428.71	41.70	41.90	41.80	15.51	15.54	15.53
V2S7	402.13	402.49	402.31	40.97	40.69	40.83	15.07	15.10	15.09
V2S8	389.17	390.19	389.68	39.58	39.05	39.31	14.44	14.74	14.59
S.Em±	10.45	10.96	10.70	0.92	0.95	0.93	0.39	0.40	0.38
CD@1%	NS	NS	NS	NS	NS	NS	NS	NS	NS

Conti.....

	Diameter of pod (mm)			Perimeter of pod (mm)		
	2015-16	2016-17	Pooled mean	2015-16	2016-17	Pooled mean
V1	25.60	26.71	26.15	113.65	115.10	114.37
V2	24.30	25.56	24.93	109.85	112.01	110.93
S.Em±	0.16	0.18	0.17	0.61	0.65	0.61
CD@1%	0.61	0.70	0.65	2.35	2.52	2.36
S1	28.16	30.61	29.38	120.08	123.55	121.82
S2	26.91	28.99	27.95	118.93	121.43	120.18
S3	25.72	27.34	26.53	114.32	116.80	115.56
S4	25.29	26.21	25.75	113.70	114.15	113.92
S5	24.17	25.38	24.78	110.96	112.44	111.70
S6	24.11	24.47	24.29	108.50	110.22	109.36
S7	23.68	24.01	23.84	105.49	106.65	106.07
S8	21.55	22.05	21.80	102.03	103.18	102.60
S.Em±	0.39	0.44	0.41	1.48	1.59	1.49
CD@1%	1.50	1.72	1.60	5.76	6.18	5.79
V1S1	30.05	31.97	31.01	121.10	124.86	122.98
V1S2	27.61	29.89	28.75	120.20	122.99	121.59
V1S3	26.28	28.15	27.22	115.48	117.46	116.47
V1S4	25.83	26.61	26.22	114.73	115.40	115.07
V1S5	24.83	25.66	25.25	113.40	114.07	113.74
V1S6	24.21	24.77	24.49	111.64	111.64	111.64
V1S7	23.99	24.18	24.08	108.77	109.47	109.12
V1S8	21.96	22.42	22.19	103.88	104.88	104.38
V2S1	26.26	29.26	27.76	119.06	122.24	120.65
V2S2	26.21	28.09	27.15	117.66	119.86	118.76
V2S3	25.16	26.52	25.84	113.16	116.14	114.65
V2S4	24.74	25.81	25.28	112.67	112.89	112.78
V2S5	23.50	25.10	24.30	108.53	110.81	109.67
V2S6	24.02	24.18	24.10	105.36	108.79	107.07
V2S7	23.37	23.84	23.61	102.21	103.83	103.02
V2S8	21.14	21.68	21.41	100.18	101.48	100.83
S.Em±	0.55	0.63	0.58	2.10	2.25	2.11
CD@1%	NS	NS	NS	NS	NS	NS

Table. 2 Effect of sowing dates on seed morpho-metry characteristics in soybean cultivars JS 335 and DSb 21

	Area of seed (mm2)			Length of seed (mm)			Width of seed (mm)		
	2015-16	2016-17	Pooled mean	2015-16	2016-17	Pooled mean	2015-16	2016-17	Pooled mean
V1	76.48	78.23	77.36	10.43	10.56	10.50	9.36	9.51	9.44
V2	74.08	75.70	74.89	10.12	10.24	10.18	9.10	9.22	9.16
S.Em±	0.50	0.57	0.50	0.06	0.07	0.07	0.06	0.06	0.06
CD@5%	1.94	2.21	1.95	0.25	0.25	0.25	0.21	0.23	0.22
S1	85.74	90.63	88.18	11.39	11.58	11.48	9.96	10.15	10.05
S2	82.63	85.24	83.94	11.09	11.16	11.13	9.80	9.98	9.89
S3	76.85	79.90	78.37	10.51	10.72	10.61	9.43	9.59	9.51
S4	76.07	76.40	76.23	10.33	10.40	10.36	9.26	9.39	9.32
S5	72.48	73.51	72.99	10.19	10.21	10.20	9.04	9.18	9.11
S6	71.48	72.02	71.75	9.81	9.91	9.86	9.02	9.11	9.07
S7	69.43	69.87	69.65	9.65	9.83	9.74	8.74	8.88	8.81
S8	67.57	68.19	67.88	9.23	9.41	9.32	8.60	8.64	8.62
S.Em±	1.22	1.40	1.23	0.16	0.16	0.16	0.14	0.14	0.14
CD@5%	4.75	5.41	4.77	0.62	0.63	0.62	0.52	0.55	0.53
V1S1	86.21	91.10	88.65	11.49	11.70	11.59	10.09	10.23	10.16
V1S2	83.39	85.94	84.67	11.11	11.18	11.15	9.91	10.09	10.00
V1S3	77.58	80.74	79.16	10.61	10.82	10.72	9.48	9.69	9.58
V1S4	77.32	77.58	77.45	10.40	10.48	10.44	9.33	9.53	9.43
V1S5	74.08	74.94	74.51	10.26	10.30	10.28	9.20	9.34	9.27
V1S6	72.86	73.69	73.27	10.14	10.24	10.19	9.19	9.28	9.24

V1S7	71.23	71.69	71.46	9.90	10.08	9.99	8.92	9.09	9.01
V1S8	69.17	70.19	69.68	9.51	9.69	9.60	8.78	8.84	8.81
V2S1	85.27	90.16	87.71	11.28	11.47	11.38	9.83	10.06	9.95
V2S2	81.87	84.54	83.21	11.07	11.14	11.11	9.70	9.88	9.79
V2S3	76.11	79.05	77.58	10.40	10.61	10.51	9.39	9.50	9.44
V2S4	74.81	75.22	75.02	10.25	10.32	10.29	9.18	9.25	9.22
V2S5	70.88	72.08	71.48	10.12	10.12	10.12	8.88	9.02	8.95
V2S6	70.09	70.36	70.23	9.49	9.59	9.54	8.86	8.94	8.90
V2S7	67.63	68.04	67.84	9.40	9.58	9.49	8.55	8.66	8.61
V2S8	65.97	66.18	66.08	8.94	9.12	9.03	8.42	8.44	8.43
S.Em±	1.73	1.97	1.74	0.23	0.23	0.23	0.19	0.20	0.19
CD@5%	NS	NS	NS	0.62	NS	NS	0.52	NS	NS

Conti.....

	Diameter of seed (mm)			**Perimeter of seed (mm)**		
	2015-16	**2016-17**	**Pooled mean**	**2015-16**	**2016-17**	**Pooled mean**
V1	9.30	9.40	9.35	31.44	32.13	31.79
V2	9.03	9.12	9.08	30.36	30.98	30.67
S.Em±	0.06	0.06	0.06	0.20	0.19	0.19
CD@5%	0.22	0.23	0.22	0.76	0.74	0.75
S1	9.92	10.13	10.02	34.35	34.78	34.56
S2	9.69	9.74	9.72	33.13	33.49	33.31
S3	9.35	9.42	9.39	31.84	32.95	32.39
S4	9.20	9.23	9.21	30.72	32.01	31.37
S5	8.98	9.07	9.02	30.24	30.70	30.47
S6	8.83	9.00	8.91	29.85	30.17	30.01
S7	8.74	8.84	8.79	29.23	29.31	29.27
S8	8.61	8.68	8.64	27.85	29.03	28.44
S.Em±	0.14	0.14	0.14	0.48	0.47	0.47
CD@5%	0.54	0.56	0.55	1.86	1.81	1.83
V1S1	9.99	10.20	10.09	34.69	35.31	35.00
V1S2	9.75	9.84	9.80	33.47	33.83	33.65
V1S3	9.48	9.55	9.51	32.18	33.39	32.78
V1S4	9.33	9.36	9.34	31.28	32.57	31.92
V1S5	9.12	9.21	9.16	30.80	31.26	31.03
V1S6	9.00	9.17	9.08	30.46	30.78	30.62
V1S7	8.93	9.02	8.97	29.92	30.01	29.96
V1S8	8.80	8.88	8.84	28.75	29.92	29.34
V2S1	9.85	10.06	9.95	34.01	34.25	34.13
V2S2	9.62	9.64	9.63	32.79	33.15	32.97
V2S3	9.23	9.30	9.26	31.50	32.52	32.01
V2S4	9.07	9.10	9.08	30.17	31.46	30.81
V2S5	8.84	8.93	8.88	29.68	30.15	29.91
V2S6	8.66	8.83	8.74	29.25	29.57	29.41
V2S7	8.56	8.65	8.60	28.53	28.61	28.57
V2S8	8.41	8.49	8.45	26.96	28.13	27.54
S.Em±	0.20	0.20	0.20	0.68	0.66	0.67
CD@5%	0.54	NS	NS	1.86	NS	NS

CONCLUSION

Pod morphometry and Seed morphometry are significantly higher in early sown crop of November 1st fortnight and was on par with 2nd fortnight of November sown crop during in both the seasons. Among the cultivars, JS 335 has recorded significantly higher pod morphometry parameters as compared to DSb 21 during both years of study. Environment is a concept that encompasses all the factors that affect on plant growth and development of reproductive parts like as flowering, pod formation and seed filling. This are the factors are directly influences on pod and seed morphometry.

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CITATION OF THIS ARTICLE

Venkatesh B, Basave Gowda, S.N. Vasudevan, C.R.Konda, Gururaj Sunkad, S.R. Doddagoudar, K. Lokesh. Influence of off Season Climate by the different Planting date on Pod and seed Morphometric characteristics of Soybean (*Glycine max* L. Merrill) Cultivars.. Bull. Env. Pharmacol. Life Sci., Vol 8 [3] February 2019: 103-111