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Optimization of Seed Rate through Seed Rate Compensation on Growth Parameters of Soybean

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ABSTRACT: The field experiment was conducted to optimize seed rate through seed rate compensation as seed rate and cost of soybean is very high and to the know the effect of seed rate compensation on growth parameters in JS335 and JS9560 soybean varieties during 2017-18 at NSP, University of Agricultural Sciences, Bangalore. The experimental material for the study comprised of 2 soybean varieties (JS335 and JS9560) procured from National Seed Project (NSP) and experimental field was laid out in factorial randomized complete block (FRCBD). The results revealed that, among the seed rate compensation levels, Seeds of 70 per cent germination with normal seed rate (62.5 kg/ha;C_1) recorded highest field emergence (86.19%), Plant height at 30Days after sowing (DAS), 60DAS and at harvest (25.80cm, 37.67cm and 45.92cm respectively) and the lowest was observed in aged seeds of 50 per cent germination with compensated seed rate (87.5 kg / ha;C_5) (69.51%, 17.61cm, 27.17cm and 35.55cm respectively). The number of days for 50% flowering and days to maturity was low in C_1(43.33 and 72.89 respectively) and treatment, C_5 took maximum number of days (52.33 and 85.60). From the results obtained it is concluded that, seed rate compensation can be carried out for the seeds whose seed germination percentage meets 65 and above and Seed rate compensation is not advisable for the seeds whose seed germination is below 65.

Keywords: Seed rate compensation, days to 50 % flowering, days to maturity, plant height, field emergence (%).

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is the important economic pulse cum oil seed crop and identified as important grain legume in the world, in view of total production and international trade. Soybean otherwise known as a "Miracle crop" with contains 40 per cent protein, 20 per cent oil, 85 per cent polyunsaturated fatty acid, 25-30 per cent carbohydrates, minerals, antioxidants, beta-carotene and isoflavonoids.

The soybean [*Glycine max* (L.) Merril] was originated from eastern Asia/China, it is a member of Leguminacae family and cultivated soybean (*Glycine max* L. Merril) was derived from a wild progenitor *Glycine ussuriensi*. Soybean has genome size of 1.1 to 1.15 Gb. Soybean (2n = 40) belongs to the family Fabaceae and originated from China and distributed across Asia, USA, Brazil, Argentina etc. Approximately around 85 per cent of the world's soybean processed into vegetable oil and soybean meal. The soybean producers are USA (36 %), Brazil (36 %), Argentina (18 %), China (5.0 %) and India (4.0 %). In World, soybean occupies 126.64 million hectare area and production 346.31 million tones and productivity of 2,735 kg per hectare. India occupies 10.56 million hectare area and production of 11.22 million tonnes with productivity of 1,153 kg per hectare (Anon., 2018).

Seed being a basic and crucial input, plays a pivotal role in seed production. Hence, the seed quality is a virtual means of improving the better seed yield. Maintenance of seed vigour and seed viability from harvest to next sowing is a crucial and important for success of crop production programme, as the sowing of deteriorated, dead or non-viable seeds leads to sub optimal plant population and crop. Seed vigour is explained as "the sum total of the attributes of a seed which determines the performance and level of activity of the seed or seed lot during germination and seedling emergence". The loss in viability of seed and seed vigour can affect the yield of crop by two ways. Firstly decline in seed vigour leading to sub-optimal plant population per unit area and secondly, low vigour seed may results in poor performance of plant (Gelmond *et al*., 1978).

Seed with good germination but of low vigour may reduce field stand, growth and yield. The farmers, who have been more discriminating with regard to use of high quality seed are now aware of the immense benefits of using high vigour seeds as planting material. Therefore comprehensive studies are needed to generate necessary data on which reliable recommendations could be made to soybean producers and traders. . Crop uniformity has been directly related to seed vigour (Cantarelli *et al.,*

2015) Therefore seed vigour is an important attribute for a seed quality to be considered, since the vigourous seeds will produce uniform and vigourous seedlings even under sub-optimal field conditions which ultimately give higher yield (Delouche and Baskin 1973). Since the minimum price and seed rate of soybean is high, seed rate compensation is an option. Seed rate compensation can be defined; as the germination reduces it would be compensated by increased seed rate.

Since the seed rate of soybean is high and it loses its viability and vigour at faster rate due to its delicate seed coat, seed rate compensation is an method for the farmers to use the saved seeds for sowing to compensate the germination and yield as well. Seed with good germination but of low vigour may reduce field stand, growth and yield which could be overcome by seed rate compensation. But proper adjustment in seed rate may be essential. So, the famers who have been discriminating withregard to use of high quality seed are now becoming more aware of the immense benefits of using high vigour seeds as planting material.

MATERIALS AND METHODS

The field experiment was conducted to optimize seed rate through seed rate compensation on growth, seed yield and quality in JS-335 and JS-9560 soybean varieties during 2017-18 at NSP, University of Agricultural Sciences, Bengaluru. The material for the study comprised of 2 soybean varieties (JS335 and JS9560) procured from NSP. The soybean varieties were sown in randomized complete factorial design during 2017-18 Kharif seasons. Each variety was sown in a single row of 3 meters length with a row spacing of 0.45 m and 0.2 m between plantswithin a row.

The experiment comprised 2 factors,

Factor-1: Varieties (V), V_1- JS335 and V_2- JS 9560

Factor-2: Seed rate compensation (C)

C_1: Seeds of 70 per cent germination with normal seed rate (62.5 kg/ha)

C_2: Aged seeds of 65 per cent germination with compensated seed rate (67.3 kg/ha)

C_3: Aged seeds of 60 per cent germination with compensated seed rate (72.9 kg/ ha)

C_4: Aged seeds of 55 per cent germination with compensated seed rate (79.5 kg/ ha)

C_5: Aged seeds of 50 per cent germination with compensated seed rate (87.5 kg/ha)

(a) Field emergence (%). The number of normal seedlings emerged three centimeters above the soil surface on 15th day after sowing were counted and expressed as field emergence in percentage.

It is calculated by formula,

$$\text{Field emergence (\%)} = \frac{\text{Number of seedlings emerged}}{\text{Total number of seeds used}} \times 100$$

(b) Plant height (cm). The mean heights of five randomly selected plants were recorded from base to plant tip on 30^{th} and 60^{th} day after sowing and at the time of harvest and expressed in centimeters.

(c) Days to 50% flowering. The number of days taken by 50 per cent of plants in each treatment plot for flowering from the date of sowing was counted and expressed as number of days to 50 per cent flowering.

(d) Days to maturity. The number of days taken for maturity was recorded from each treatment of five randomly selected and tagged plants.

The observations on field emergence, plant height at 30 DAS, 60 DAS and at harvest, days to 50 % emergence and days to maturity were recorded.

RESULTS AND DISCUSSION

(a) Field emergence (%). The field emergence differed significantly among the seed rate compensation and varieties. Among the varieties, the highest (80.51 %) field emergence was observed in V_1: JS -335 and the lowest was seen in V_2: JS - 9560 (76.26%). Among the seed Rate compensation, the highest field emergence was observed in seeds of 70 per cent germination with normal seed rate, 62.5 kg/ha (C_1: 86.19 %) and the lowest was seen in aged seeds of 50 per cent germination with compensated seed rate ,87.5 kg / ha (C_5: 69.51 %). Among the interaction V_1C_1 (89.22 %) recorded maximum field emergence followed by V_2C_1 (83.17 %) and the lowest field emergence was observed in V_2C_5 (69.00 %) followed by V_1C_5 (70.02 %) are presented in table 1.

The reduction in the field emergence might be due to age of seeds and invasion of storage fungi which resulted in the leakage of sugars and amino acids from slow germinating seeds. The results are similar with the findings of Kurdikeri (1992); Thimmanna (1994) observed that reduced the field emergence with increase in duration of ageing in maize and soybean respectively.

(b) Plant height (cm). The results of plant height at 30 DAS as influenced by the seed rate compensation on soybean varieties (JS - 335 and JS - 9560) are presented in Table 1 and Fig 1.

Among the varieties, V_2: JS - 9560 (23.36 cm) recorded the highest plant height at 30 DAS and the lowest was observed in V_1: JS - 335 (20.73 cm). Among the seed rate compensation, seeds of 70 per cent germination with normal seed rate, 62.5 kg/ha (C_1: 25.80cm) recorded the highest plant height (cm) and the lowest was observed in aged seeds of 50 per cent germination with compensated seed rate, 87.5 kg/ha (C_5: 17.61 cm) at 30 DAS. Among the interaction, V_2C_1 recorded the highest (27.60 cm) and V_1C_5 (15.63 cm) recorded the lowest plant height at 30 DAS.

The plant height (cm) at 60 DAS differed significantly among the seed rate compensation and varieties. Among the varieties and seed rate compensation, V_1: JS - 335 (34.29 cm) and seeds of 70 per cent germination with normal seed rate, 62.5 kg/ha (C_1: 37.67 cm) recorded the highest plant height at 60 DAS, the lowest plant height was recorded in V_2: JS - 9560 (30.16 cm) and in aged seeds of 50 per cent germination with compensated seed rate (87.5 kg/ha, C_5: 27.17 cm). Among the interaction, V_1C_1 recorded the highest plant height at 60 DAS (39.67 cm) followed by V_1C_2 and V_2C_1 (36.70 cm and 35.67 cm) and the lowest plant height at 60 DAS was observed in V_2C_5 (24.67 cm) followed by V_2C_4 (28.09 cm) and depicted in Plate 1.

V_1C_5 V_2C_5

Plate 1: Plant height at 60 DAS in JS-335 and JS-9560.

The plant height (cm) at harvest differed significantly among the seed rate compensation levels and varieties. Among the varieties JS - 335 recorded the highest plant height at harvest (43.11cm) and the lowest (39.70 cm) was observed in JS – 9560. Among the seed rate compensation C1 recorded the highest plant height at harvest (43.11cm) and the lowest was seen in aged seeds of 50 per cent germination with compensated seed rate, 87.5 kg/ha (C5: 35.55 cm). Among the interaction, V_1C_1 recorded the highest plant height at harvest (47.48 cm) followed by V_2C_1 and V_1C_2 (44.37cm and 44.00 cm) and the lowest plant height at harvest was observed in V_2C_5 (32.29 cm) followed by V_1C_5 (38.81cm) and are presented in Table 2 and Fig. 1.

Reduction in the plant height might be due to less supply of nutrients by the mother plant of less vigour seeds which fails to nourish the growing plants compare to high vigour seeds (Thimmanna, 1994; Venkatesh, 1990)

(c) Days to 50% flowering (Days). Among the varieties, JS - 335 recorded less days to 50 per cent flowering (46.2) and the maximum number of days for 50 per cent flowering was observed in JS - 9560 (50.2). Among the seed rate compensation levels, Seeds of 70 per cent germination with normal seed rate; 62.5 kg/ha recorded least (43.33) number of days for 50 per cent flowering and the maximum number of days for 50 per cent flowering was observed in aged seeds of 50 per cent germination with compensated seed rate, 87.5 kg/ha (C_5 -52.33).

Table 1: Effect of seed rate compensation on field emergence (%), plant height at 30 DAS, 60 DAS and after harvest.

Treatments	Field emergence (%)	Plant height (cm)	
		30 DAS	60 DAS
Varieties (V)			
V1 - JS – 335	80.51	20.73	34.29
V2 – JS – 9560	76.26	23.36	30.16
S.Em ±	1.12	0.68	1.08
C.D. (P = 0.05)	3.35	2.04	3.23
Seed Rate Compensation (C)			
C_1-Seeds of 70 per cent germination with normal seed rate (62.5 kg/ha)	86.19	25.80	37.67
C_2 -Aged seeds of 65 per cent germination with compensated seed rate (67.3 kg/ha)	84.60	24.67	34.72
C_3-Aged seeds of 60 per cent germination with compensated seed rate (72.9 kg/ha)	77.50	22.13	31.73
C_4-Aged seeds of 55 per cent germination with compensated seed rate (79.5 kg/ha)	74.11	20.00	29.84
C_5-Aged seeds of 50 per cent germination with compensated seed rate (87.5 kg/ha)	69.51	17.61	27.17
S.Em ±	1.77	1.08	1.71
C.D. (P = 0.05)	5.30	3.23	5.11
Interaction (V × C)			
$V_1 C_1$	89.22	24.00	39.67
$V_1 C_2$	87.87	23.18	36.70
$V_1 C_3$	79.67	21.48	33.83
$V_1 C_4$	75.78	19.33	31.59
$V_1 C_5$	70.02	15.63	29.67
$V_2 C_1$	83.17	27.60	35.67
$V_2 C_2$	81.33	26.16	32.74
$V_2 C_3$	75.33	22.77	29.63
$V_2 C_4$	72.44	20.67	28.09
$V_2 C_5$	69.00	19.59	24.67
S.Em ±	2.51	1.53	2.42
C.D. (P = 0.05)	7.49	4.56	7.22
CV (%)	7.77	12.02	13.01

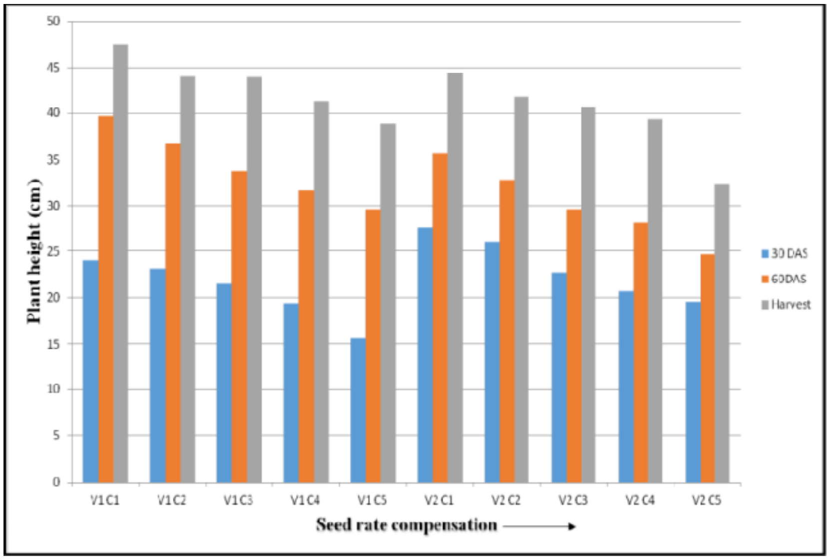

Fig. 1. Influence of seed rate compensation on plant height (cm) 30, 60 DAS and at harvest in soybean varieties

Among the interaction of seed rate compensation and varieties, V_1C_1 took 42.00 days for 50 per cent flowering followed by V_1C_2 and V_2C_1 took 44.67 days for 50 per cent flowering respectively. The maximum days for 50 per cent flowering taken by V_2C_5 (54.67) followed by V_2C_4 (53.00) and presented in Table 2 and Fig. 2.

(d) Days to maturity (Days). Days to maturity among the seed rate compensation and varieties differed significantly and presented in table 2. Among the seed rate compensation, C_1 took less number of days for maturity (72.89) and more number of days for maturity was observed in C_5 (85.60). Among the varieties, JS –335 recorded less number of days to maturity (76.24) and the maximum was observed in JS - 9560 (82.62). The interaction of seed rate compensation and varieties V_1C_1 recorded less number of days for maturity (71.11) followed by V_1C_2 (72.67). The maximum number of days for maturity was observed by V_2C_5 (87.78) followed by V_2C_4 (86.00) depicted in Fig. 2 and Table 2.

The number of days to 50 % flowering and days to maturity was more in less vigour seeds might be due to insufficient vegetative growth of plants raised from aged seeds to put forth the plants into reproductive phases. The present results are lined with the findings of Manjunath (1993) revealed that increased plant population as delayed flowering in compensated maize seed rate intern it leads to reduction in the quality parameters could be due to loss of cell membrane integrity which leads to loss of sugars, amino acids and proteins. These results are in confirmatory with Thimmanna (1994) in soybean and Narayanaswamy and Krishnamurthy (1996) in field bean .

It is not advisable to compensate the seed rate of vigour levels whose germination falls to 60% and below. It is advisable to compensate the seed rate of vigour levels whose germination is 65% and above.

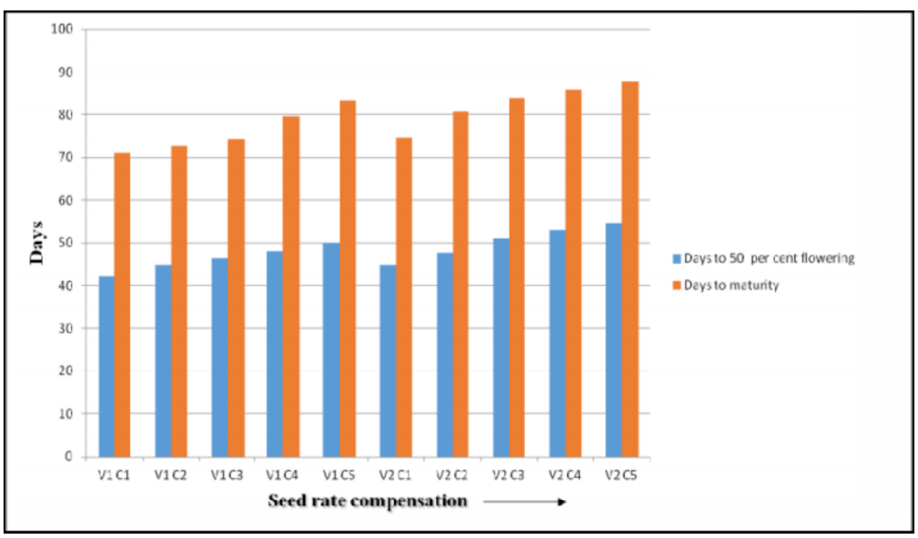

Fig. 2. Influence of seed rate compensation on days to 50 percent flowering and days to maturity in soybean varieties.

Table 2: Influence of seed rate compensation plant height at harvest (cm), Days to fifty percent flowering and days to maturity.

Treatments	Plant height at harvest (cm)	Days to fifty percent flowering	Days to maturity
Varieties (V)			
V_1 - JS – 335	43.11	46.25	76.24
V_2 – JS – 9560	39.70	50.23	82.62
S.Em±	0.87	1.04	1.68
C.D. (P=0.05)	2.61	3.10	5.01
Seed Rate Compensation (C)			
C_1-Seeds of 70 per cent germination with normal seed rate (62.5 kg/ha)	45.92	43.33	72.89
C_2 -Aged seeds of 65 per cent germination with compensated seed rate (67.3 kg/ha)	42.94	46.17	76.67
C_3-Aged seeds of 60 per cent germination with compensated seed rate (72.9 kg/ha)	42.29	48.67	79.17
C_4-Aged seeds of 55 per cent germination with compensated seed rate (79.5 kg/ha)	40.33	50.50	82.83
C_5-Aged seeds of 50 per cent germination with compensated seed rate (87.5 kg/ha)	35.55	52.33	85.60
S.Em ±	1.38	1.64	2.66
C.D. (P = 0.05)	4.12	4.91	7.92
Interaction (V × C)			
$V_1 C_1$	47.48	42.00	71.11
$V_1 C_2$	44.00	44.67	72.67
$V_1 C_3$	43.91	46.33	74.33
$V_1 C_4$	41.33	48.00	79.67
$V_1 C_5$	38.81	50.00	83.42
$V_2 C_1$	44.37	44.67	74.67
$V_2 C_2$	41.87	47.67	80.67
$V_2 C_3$	40.66	51.00	84.00
$V_2 C_4$	39.32	53.00	86.00
$V_2 C_5$	32.29	54.67	87.78
S.Em ±	1.95	2.33	3.76
C.D. (P = 0.05)	5.83	6.94	11.20
CV (%)	8.18	8.01	8.19

CONCLUSIONS

In the field experiment, it is revealed that highest field emergence, plant height obtained from treatment C_1 and the number of days for fifty percent flowering and days to maturity was less in C_1. Increased plant population in compensated seed rate delays days to flowering intern it leads to reduction in the yield and seed quality parameters which might be due to loss of cell membrane integrity and loss of sugars, amino acids and proteins.So, it is concluded that Seed rate compensation can be carried out for the seeds whose seed germination percentage meets 65 and above and Seed rate compensation is not advisable for the seeds whose seed germination is below 65.

FUTURE SCOPE

There is a need to evaluate the method of sowing like flat bed and raised bed method on different vigour levels of seed. Study on different amelioration seed treatments on different vigour levels of seed and their effect on growth, seed yield to be conducted.

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- Department of Seed Science and Technology, UAS (B), GKVK, Bangalore.

Conflict of interest

- To reduce the seed rate of soybean and to compensate seed rate with low vigour seeds
- To study the compensated seed rate effect on growth, seed yield and seed quality parameters of soybean.
- To utilise the low vigour seeds and compensating the seed rate.

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