Physiology of seed yield variation in soybean [*Glycine max* (L.) Merrill]

Abstract

The experiment was conducted at AICRP Soybean, Seed Breeding Farm, Department of Plant Breeding and Genetics, College of Agriculture, JNKVV, Jabalpur (M.P.).The experimentwas consisting of 90genotypes to study the difference in growth, morpho-physiological characterization and yield response of soybean. The genotype JS 21-72 followed by JS 22-18 and PS-1613 recorded the highest number of leaves per plant. AGS-48 showed maximum plant height among all other genotypes. Genotype DS 31-09 followed by JS 22-16 produced the maximum number of pods per plant. DS 31-09 followed by JS 22-16 produced maximum number of pods per plant with respects to all another genotypeEarly work with infrared thermometers proved successful in monitoring plant Evaporative rate. The canopy temperature in the current study ranged from 32.13 in JS 23-03 to 36.15 in JS 22-49. In yield attributing characters genotype highest seed yield was produced by JS 21-72 whereas JS 24-35 followed by JS 24-37 theshows highest number of seed per pod and 100 seed weight. Genotype NRC-137 followed by JSM 259 showeda higher range of harvest index. It is concluded that the six genotypes viz., JS 21-72, JS 24-35, JS 24-37, JS 22-16 AGS-48 and NRC- 137 found best to describe the morpho-physiological characterization in thepresent study.

Keywords: Canopy Temperature, LAI, LAD and Morpho-physiology.

Introduction

Soybean [Glycine max (L.) Merrill.] is one of the miraculous crops due to its extraordinary qualities. It has transformed the agricultural economy through its enormous potential for food, fuel, and a variety of industrial products. Its production has a very complex character; it is reliant on a variety of physiological and genetic elements that interact with the environment. Genetic yield potential is static as a result of unclear productivity restrictions, such as decreasing sink demand, which invites a huge gap in critical yield status. It is vitally necessary to determine the potential key physiological variables that are the physiological determinant and connected with the seed yield of crop in light of the rapid depletion of agricultural resources. This may be the sole glimmer of hope for choosing the genotype that is best for Madhya Pradesh.Currently, soybean has emerged as a key agricultural product, contributing to roughly 25% of the world's production of edible oil as well as two-thirds of the protein concentrate used in animal, poultry, and fish feed Agrawal *et al.,* (2013).In India, soybeans are the main oilseed crop farmed in the Kharif season (10.93 mt production and 10.83 M Ha area), and the nation ranks fifth globally in soybean production behind the United States, Brazil, China, Argentina, and USA Anonymous(2020). In India, soybean genotypes and cultivars exhibit limited genetic diversity Agrawal *et al.,* (2013), Barela et al., (2022) and Mehra *et al.,* (2020).There are limitations of knowledge regarding the physiological growth characteristics (such as relative growth rate, leaf area ratio, specific leaf area ratio, and shoot/root) that correspond to the responses of various soybean genotypes to various plant densities.

Materials and methods

The present investigation was carried out during kharif 2021,it was conducted at AICRP Soybean, Seed Breeding Farm, Department of Plant Breeding and Genetics, College of Agriculture, JNKVV, Jabalpur (M.P.). The experiment was laid out in Randomized Block Design (RBD) with three replications and 90 genotypes.The experimental site had uniform topography, medium black soil with 7.5 pH and wasfree

from water-logged conditions. Leaf area index is the leaf area existing on unit ground was proposed by Watson (1952) and was calculated by the following formula:

$$LAI = \frac{Leaf\ area\ per\ plant\ (cm^2)}{Ground\ area\ per\ plant\ (cm^2)}$$

Power *et al.*,(1967) integrated LAI with time and this was known as leaf area duration. LAD takes into account both the duration and the extent ofphotosynthetic tissue of the crop canopy. The LAD is expressed in days. The LAD was calculated for 60 DAS and 90 DAS as LAD1 and LAD 2 respectively using the formula as follows:

$$LAD = \frac{(LA2 + LA1) \times (t2 - t1)}{2}$$

Where LA1 and LA2 represent the leaf area at two successive time intervals (t1 and t2)

Harvest index (HI) was determined from the mean value of seed yield per hectare and biological yield per hectare at the time of harvest using a formulagiven by Donald (1962).

$$Harvest\ Index = \frac{Economic\ yield}{Biological\ yield} \text{x}100$$

Results and discussion

The results highlighted the increased trends in plant height, which is statistically significant at all the growth stages of the crop (Table 1). JS 22-41followed by JS 22-43 and JSM-259 recorded a significant

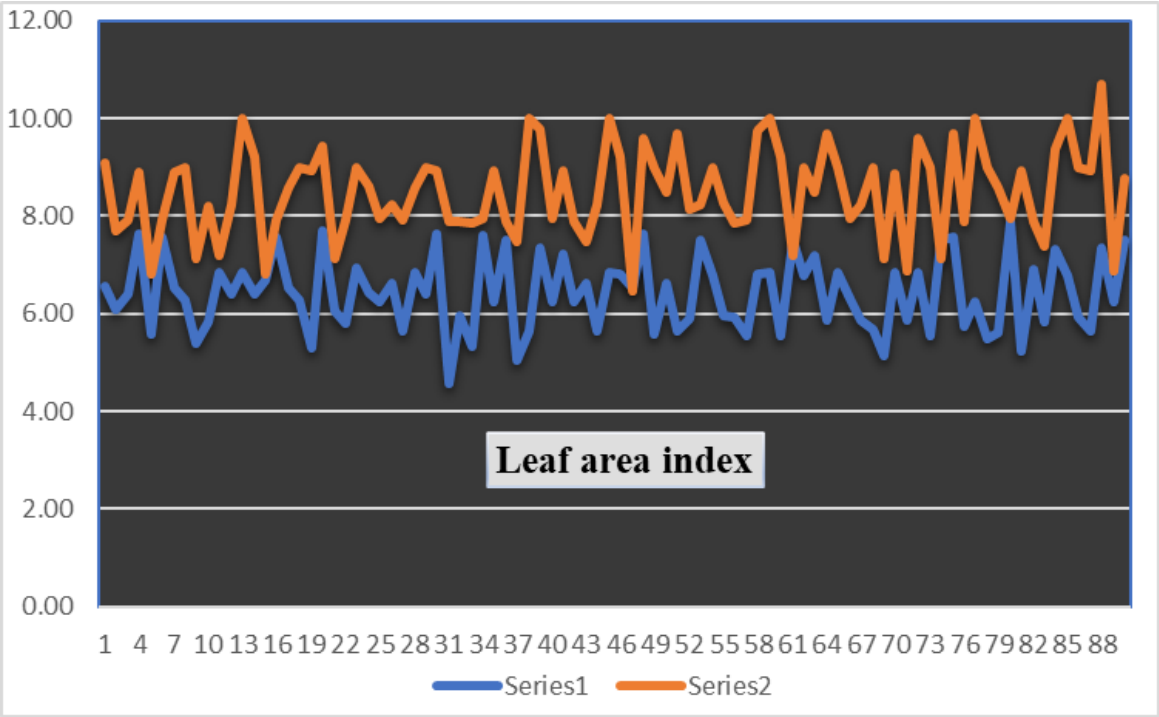

Figure 1: Graphical representation of Leaf Area Index in different series ofLAI at 60DAS and 90DAS respectively.

maximum plant height at 60 DAS(Days After Sowing)whereas AGS-48 followed by JS 22-04 and JS 22-52recorded the maximum height at 90 DAS. In the current investigation, it was evident that the genotype with short stature showed more tolerance against drought as compared to the taller onceMishra *et al.*, (2020)Genotypic differences in plant height in soybean were also reported by Abbas et al. (1992). Genotype JS 21-72 followed by DS 31-09,JS 22-16 produced the maximum number of pods per plantwith respect to all other genotypes and these results are in conformity with Deshmukh et al. (1991) in soybean. Genotype JS 21-72 followed by JS 22-18 and PS-1613 recorded the highest number of leaves per plant. (Table 1). The differences in mean leaf area were statistically significant at 60 and 90 DAS (Table 1). The genotype JS 24-37 followed by JS 22-26 and JS 22-33 maintained the highest value of leaf area from 60 DAS onward. Similar result was observed by Gontia and Awasthi (1998) in soybean. LAI and biomass are the two key indicators of plant healthand development Barela *et al.*, (2022). The growth analytical parameter studies like Canopy temperature, LAI and LAD exhibited significant trends (Table 1). According to recent studies infrared thermometers have been a useful instrument for measuring canopy temperatures in semi-arid and dry settings. The optimal canopy temperatures for peak photosynthetic enzyme activity, which were discovered to be 27 °C, served as the basis for the soybean temperature thresholds (Fig 2).Early work with infrared thermometers proved successful in monitoring plant Evaporative rate,the canopy temperature in the current study ranged from 32.13 in JS 23-03 to 36.15 in JS 22-49. The genotypic difference with respect to Canopy temperature, LAI and LAD werereported by Rahangdale *et al.*, (2023), Rajput and Shrivastava (1991) in soybean. All the genotypes were different in yield attributing character (Table 1). As regards to yield attributing Table 1: Morpho-physiological characters of soybean genotype included Plant height at 30,60 and 90 DAS(Days after sowing), leaf number at 30,60 and 90 DAS, LAI(Leaf area index) at 60 and 90 DAS, LAD(Leaf area duration at 60 and

90 DAS), CT(Canopy temperature), S/POD(Seed per pod), P/P(Pods per plant), NS/P(Number of seeds per plant), 100SW(Hundred seeds weight), BY/P(Biological yield per plant),HI(Harvest index),SY/P(Seed yield per plant). Similar result was obtainedby Singh et al. (1983). The genotype JS 24-35 followed by JS 24-37 recorded the highest number of seeds per pods and 100 seed weight. Genetic variability in soybean was also obtained by Singh et al. (1983). The genotype JS 21-72 followed by JS 22-16 recorded highest seed yield per plantand biological yield per plant as well. Seed per pod were highest in JS 22-52 followed by JS 22-32 and JS 22-33, whereas the highest seed yield produced by JS 21-72 might be due to highest number of pods per plant and number of seed per plant. Similar variations in soybean were also obtained by Deshmukh et al. (1991). The genotype NRC-137 followed by JSM 259 showed highest value of harvest index and this in conformity with the resultsof Nirmal Kumari and

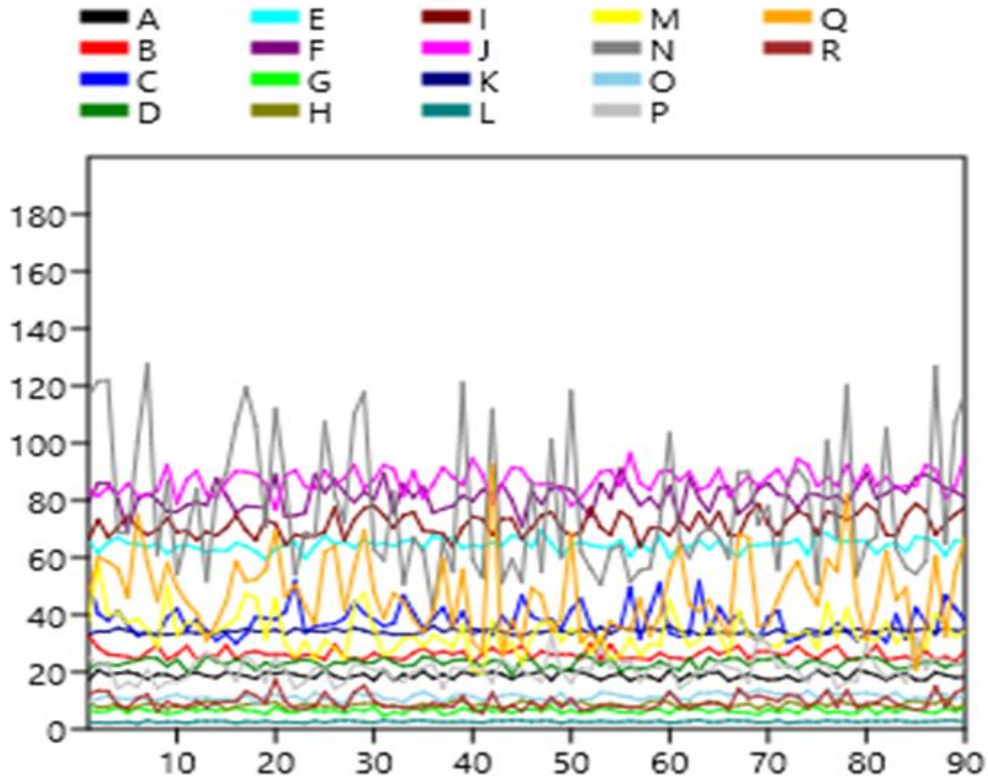

Figure 2. Graphical representation of different physiological along with quantitative traits

Balasubramanian (1991) in soybean.

Conclusion

The observed results imply that physiological features restrict soybean genotypes' ability to develop and function metabolically. These features demonstrated the existence of significant diversity throughout several growth periods. The results of this work may help to identify various adaptive mechanisms developed by soybean genotypes and contribute to the identification of useful.

Conference disclaimer:

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Environment (SCALFE-2023) on April 28-30, 2023 in Himachal Pradesh University, Summer Hill, Shimla, HP, India. Web Link of the proceeding: https://www.shobhituniversity.ac.in/pdf/Souvenir-Abstract%20Book-Shimla-HPU-SCALFE-2023.pdf

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		Plant height			Leaf number			Leaf area index		Leaf area duration									
	Germplasm	**30DAS**	**60DAS**	**90DAS**	**30DAS**	**60DAS**	**90DAS**	**60DAS**	**90DAS**	**LAD1**	**LAD2**	**CT**	**S/POD**	**P/P**	**NS/P**	**100SW**	**BY/P**	**HI**	**SY/P**
1	**AGS 48**	17.10	32.92	52.17	21.33	66.33	79.33	6.56	9.08	66.06	83.68	33.18	2.17	38.00	116.50	9.32	25.29	47.57	12.09
2	**AGS 163**	20.67	28.45	40.33	22.67	61.67	86.00	6.07	7.70	73.28	81.48	34.17	2.33	46.03	121.67	10.73	22.43	60.18	13.49
3	**AVKS 199**	19.00	26.19	38.00	22.67	65.33	86.00	6.41	7.92	67.14	84.67	34.10	2.17	39.50	121.83	11.58	22.84	58.52	13.32
4	**AVKS 206**	19.53	25.77	41.33	22.33	67.00	80.33	7.63	8.89	70.49	82.19	35.35	2.33	41.00	68.83	10.90	14.23	56.17	8.09
5	**Cat 87**	20.02	25.30	36.50	23.33	65.00	69.67	5.59	6.82	74.50	85.87	34.47	2.50	37.00	68.50	10.53	16.34	45.99	7.46
6	**Cat 783**	19.19	24.27	32.67	24.00	64.67	80.33	7.56	7.92	70.49	81.47	33.40	2.00	38.50	100.50	11.07	14.78	74.70	10.72
7	**JS 24-35**	17.53	26.97	33.33	25.00	63.67	82.33	6.53	8.89	67.93	82.11	33.90	3.00	34.67	133.67	10.35	20.74	58.37	12.10
8	**DS 3106**	19.20	29.21	32.83	24.67	65.00	80.00	6.26	8.98	69.71	83.15	33.03	2.33	28.50	61.00	10.10	14.17	44.75	6.32
9	**DS 3109**	19.03	24.33	39.00	22.00	61.33	76.00	5.38	7.13	73.70	92.39	33.10	2.50	51.00	86.67	11.35	16.57	57.97	9.62
10	**JS 24-36**	17.70	26.19	42.17	24.33	63.67	76.00	5.82	8.19	68.85	79.00	33.19	2.50	32.50	54.17	12.10	16.47	49.45	8.12
11	**EC350664**	19.17	29.01	35.00	20.33	64.33	78.33	6.85	7.20	69.45	87.22	33.93	2.17	37.67	68.17	10.78	18.17	44.35	7.99
12	**EC481571**	19.77	24.33	38.17	21.33	63.33	79.33	6.41	8.24	66.13	90.26	33.57	2.67	36.17	84.00	10.83	24.28	40.47	9.84
13	**JS 335**	18.60	26.19	34.50	25.67	62.00	78.33	6.85	10.00	69.03	82.07	33.55	2.67	32.50	51.83	11.10	26.06	30.90	7.75
14	**JS 2069**	18.06	25.33	31.00	23.67	62.67	87.67	6.41	9.22	67.71	80.70	33.64	2.67	34.17	82.83	10.20	24.59	37.02	9.14
15	**JS 20-73**	19.87	29.21	33.33	22.67	62.33	81.67	6.68	6.82	70.35	86.55	34.34	2.67	36.00	89.50	10.70	21.52	44.54	9.57
16	**JS 20-98**	19.37	24.33	30.00	24.33	65.00	75.67	7.56	7.92	74.71	90.18	34.08	2.17	38.67	106.50	9.40	16.74	58.75	9.81
17	**JS 20-105**	18.58	26.72	33.50	23.00	64.00	78.00	6.53	8.57	69.58	89.91	35.08	2.67	47.44	119.50	12.05	26.12	51.77	13.28
18	**JS 20-116**	17.71	27.22	39.17	20.67	62.00	77.67	6.26	8.98	66.06	89.09	34.17	2.44	45.81	106.17	9.10	22.30	52.28	11.62
19	**JS 21-05**	19.82	26.19	38.83	23.33	59.33	77.33	5.30	8.94	73.28	85.73	34.10	2.83	31.67	70.67	11.61	16.32	55.73	9.28
20	**JS 21-72**	19.35	26.19	38.33	25.67	68.00	89.00	7.71	9.44	71.75	76.73	34.73	2.33	52.57	132.00	12.63	25.00	69.38	17.35
21	**JS 22-03**	20.15	26.19	41.17	23.00	64.33	74.33	6.05	7.12	64.53	88.72	33.24	2.50	29.62	86.17	10.80	20.74	46.29	9.59
22	**JS 22-04**	19.08	24.67	51.83	23.67	65.33	74.67	5.80	7.92	67.97	90.53	35.18	2.33	25.40	54.00	11.55	14.17	50.59	7.17
23	**JS 22-10**	18.38	26.05	33.67	24.33	59.67	75.67	6.94	8.98	67.21	84.77	34.27	2.17	30.67	68.83	9.85	16.57	42.98	7.15
24	**JS 22-11**	17.91	25.70	36.00	23.67	64.00	89.00	6.42	8.61	67.46	84.22	34.28	2.83	24.34	67.67	12.80	21.52	36.77	7.91
25	**JS 22-12**	20.67	24.33	36.33	21.33	67.67	82.67	6.24	7.94	69.03	90.53	34.00	2.33	31.26	107.33	10.86	20.74	61.90	12.87
26	**JS 22-13**	18.53	29.61	36.83	23.33	64.67	87.33	6.62	8.25	77.38	85.33	35.08	2.83	28.28	82.00	10.17	14.17	63.93	9.05
27	**JS 22-14**	17.53	24.67	38.67	23.00	65.67	82.67	5.66	7.92	66.06	87.78	34.10	3.00	24.45	72.50	8.85	16.06	41.54	6.73

28	**JS 22-15**	18.57	24.74	44.33	24.67	63.33	79.33	6.85	8.57	73.28	92.39	35.35	2.83	43.70	110.17	13.10	22.90	56.42	12.91
29	**JS 22-16**	19.30	24.30	40.50	23.00	66.33	83.00	6.41	8.98	77.19	84.06	34.47	2.50	50.47	127.89	11.73	24.90	63.48	15.22
30	**JS 22-17**	17.10	26.60	38.33	23.33	64.33	80.33	7.63	8.94	78.13	87.15	33.40	2.33	34.67	62.83	12.44	20.74	47.64	9.85
31	**JS 22-18**	20.67	25.03	36.00	25.33	66.70	88.33	4.58	7.88	74.70	92.39	33.90	3.00	25.83	59.00	10.61	20.74	38.81	8.04
32	**JS 22-19**	17.00	24.74	37.00	26.33	64.00	75.67	5.96	7.88	70.35	90.86	33.03	2.67	27.45	83.00	10.48	17.24	47.49	8.14
33	**JS 22-20**	19.20	24.30	46.67	22.00	65.67	85.67	5.32	7.85	74.71	81.48	33.10	2.50	31.84	50.67	9.50	16.57	44.81	7.41
34	**JS 22-22**	18.03	26.60	40.67	22.33	66.33	81.00	7.61	7.95	75.84	90.18	33.19	3.00	32.50	67.00	11.80	20.09	38.36	7.45
35	**JS 22-23**	20.20	28.38	35.17	25.33	63.00	84.67	6.24	8.94	69.30	80.70	33.93	3.00	28.67	62.17	13.00	21.52	34.05	7.32
36	**JS 22-24**	17.70	26.19	38.67	24.67	67.67	75.67	7.51	7.88	69.03	85.61	36.15	2.67	32.83	41.17	11.45	22.84	40.48	9.22
37	**JS 22-25**	19.17	27.16	42.50	22.67	66.33	77.00	5.03	7.47	68.24	91.45	34.10	2.50	31.00	65.50	9.40	14.17	59.52	8.44
38	**JS 22-26**	17.53	26.19	35.50	24.00	67.00	78.00	7.63	10.10	63.74	88.04	35.08	2.50	28.50	55.22	11.60	21.52	35.63	7.67
39	**JS 22-27**	20.20	27.16	41.00	24.33	63.33	81.67	7.36	9.78	70.49	85.33	34.00	2.67	36.45	121.00	12.30	20.74	55.77	11.52
40	**JS 22-28**	19.00	23.37	33.50	23.67	64.33	79.67	6.24	7.95	74.31	94.57	35.08	2.50	20.67	59.33	11.45	22.43	30.51	6.84
41	**JS 22-29**	19.53	26.19	34.33	22.00	63.67	83.67	7.22	8.94	73.45	88.97	34.55	2.33	19.50	53.00	10.10	20.74	26.73	5.55
42	**JS 22-30**	20.02	28.35	37.00	24.00	65.33	82.00	6.24	7.88	67.97	78.58	35.17	2.83	38.00	111.67	11.33	16.37	92.14	12.71
43	**JS 22-31**	19.19	26.19	39.67	23.67	64.33	85.67	6.62	7.47	73.56	85.61	33.98	2.83	26.67	51.17	11.70	24.59	25.88	6.34
44	**JS 22-32**	17.53	27.35	35.17	19.00	67.67	80.00	5.66	8.23	73.60	91.45	33.03	3.10	30.33	59.33	12.15	21.52	38.64	8.32
45	**JS 22-33**	19.20	29.01	46.67	24.33	66.67	71.00	7.95	10.08	66.59	90.86	32.67	3.07	22.83	51.33	11.69	20.74	30.29	6.28
46	**JS 22-34**	19.50	24.67	39.50	24.33	63.67	83.33	6.82	9.22	70.35	85.63	33.86	2.67	32.83	87.00	10.63	18.74	49.39	9.70
47	**JS 22-35**	20.20	27.22	37.83	20.67	69.33	78.67	6.53	6.46	74.71	85.61	33.77	2.83	37.33	55.00	10.55	16.57	46.71	7.71
48	**JS 22-36**	17.10	26.19	38.50	22.33	65.00	84.33	7.63	9.58	75.84	85.93	34.60	2.83	37.84	101.17	9.65	32.65	33.88	11.06
49	**JS 22-38**	20.67	26.19	35.00	20.33	60.33	84.67	5.59	8.98	70.20	83.67	34.16	2.17	30.50	60.00	12.65	20.18	38.70	7.52
50	**JS 22-39**	20.33	26.19	41.67	21.33	64.33	83.67	6.62	8.50	67.46	78.18	33.42	2.83	35.00	118.17	8.60	16.32	68.54	10.70
51	**JS 22-40**	19.91	24.67	45.50	26.00	65.33	78.67	5.63	9.68	69.03	80.70	34.85	2.50	32.50	62.00	10.60	21.52	30.41	6.55
52	**JS 22-41**	18.80	29.87	35.83	25.00	64.33	74.33	5.90	8.15	77.38	84.97	33.42	2.50	26.50	56.00	10.40	20.74	33.76	6.99
53	**JS 22-42**	17.23	24.33	29.33	22.33	63.67	86.00	7.51	8.24	70.49	89.91	35.67	2.83	32.67	50.50	12.80	29.65	29.58	8.37
54	**JS 22-43**	18.70	29.61	36.00	25.00	63.67	80.67	6.79	8.98	67.93	90.53	33.42	2.50	24.67	62.67	12.50	21.52	37.72	8.12
55	**JS 22-44**	19.40	24.67	35.67	20.33	66.00	91.00	5.96	8.26	76.12	84.97	35.17	2.50	25.67	64.33	11.65	22.43	35.31	7.92
56	**JS 22-45**	17.00	24.74	49.67	21.67	60.33	83.67	5.92	7.85	73.60	96.38	35.08	2.83	32.00	51.50	11.20	23.89	34.23	7.46
57	**JS 22-46**	18.40	24.74	31.67	21.00	65.67	78.33	5.54	7.92	63.74	85.93	34.10	2.50	25.50	55.50	10.10	16.57	45.64	7.59

58	**JS 22-47**	18.37	24.30	41.50	21.67	62.00	81.00	6.80	9.74	70.21	83.67	35.35	2.50	29.83	56.33	11.25	21.52	32.59	7.02
59	**JS 22-48**	16.90	26.60	51.00	23.67	67.33	77.00	6.85	10.00	70.43	89.91	34.47	2.83	29.17	72.33	11.00	21.52	39.57	8.50
60	**JS 22-49**	20.67	25.03	33.67	22.00	60.00	85.00	5.54	9.22	67.71	90.53	36.15	2.17	45.00	103.50	12.80	23.67	54.56	13.03
61	**JS 22-50**	17.00	24.74	32.33	20.67	64.00	72.67	7.51	7.21	73.28	86.79	34.10	2.50	35.50	66.33	10.60	14.17	64.60	9.14
62	**JS 22-51**	19.20	24.30	33.00	24.67	63.67	88.00	6.79	8.98	69.35	89.97	34.34	2.83	29.00	60.00	10.34	16.57	43.61	7.19
63	**JS 22-52**	18.20	26.60	51.67	20.33	66.00	80.67	7.19	8.50	75.84	83.63	33.10	3.17	31.17	67.83	12.70	20.74	41.07	8.52
64	**JS 22-53**	19.67	28.38	33.33	25.00	63.00	76.00	5.88	9.68	70.20	84.97	33.19	2.50	37.33	70.67	12.60	20.18	45.23	9.13
65	**JS 22-54**	19.87	26.19	42.67	23.33	66.00	84.33	6.85	8.98	75.93	90.86	33.93	2.50	33.83	67.00	13.10	23.40	38.53	9.03
66	**JS 22-55**	16.90	27.35	37.17	24.67	62.33	84.67	6.29	7.95	67.97	81.57	33.57	3.00	26.00	59.67	11.85	21.52	32.37	6.96
67	**JSM 259**	18.20	29.01	40.50	24.67	60.33	75.33	5.88	8.24	67.55	84.97	33.40	2.83	41.50	89.83	12.65	21.74	67.21	14.14
68	**JSM 232**	19.20	24.67	33.00	22.33	64.33	78.33	5.69	8.98	75.10	88.31	33.97	2.83	32.67	90.00	12.55	16.16	67.03	10.75
69	**JS 23-03**	18.03	27.22	31.17	24.33	64.33	84.00	5.15	7.13	78.79	84.97	32.13	2.33	32.50	71.33	13.81	32.65	35.87	11.71
70	**JS 23-05**	17.23	27.16	39.17	24.33	64.67	86.00	6.85	8.88	71.67	88.04	33.40	2.33	29.67	78.00	13.02	29.65	36.59	10.74
71	**JS 23-08**	17.43	26.19	41.33	25.33	64.67	82.00	5.88	6.89	67.80	90.79	34.88	3.00	28.71	55.67	12.20	21.52	45.48	9.80
72	**JS 23-09**	18.53	26.19	30.33	22.00	65.00	81.67	6.85	9.58	73.21	84.97	33.26	2.17	33.00	87.00	12.40	22.43	53.27	11.95
73	**JS 23-10**	16.90	29.01	31.67	21.33	66.33	77.00	5.54	8.98	76.12	94.45	32.66	2.50	33.00	90.83	10.90	20.18	58.72	11.73
74	**MAUS 71**	17.70	26.19	33.33	23.67	61.00	82.00	7.51	7.13	74.82	92.39	34.83	2.67	34.33	86.33	13.47	16.57	49.52	8.25
75	**MACS 450**	20.67	24.67	32.67	24.00	68.67	82.00	7.57	9.68	67.93	84.97	34.27	2.50	28.17	50.83	10.90	21.52	43.40	9.34
76	**NRC 125**	18.70	27.42	33.67	22.67	68.33	80.67	5.73	7.88	76.12	88.04	33.42	3.00	44.17	100.83	13.25	22.67	59.46	13.56
77	**NRC 128**	19.67	29.01	37.00	21.33	65.67	81.67	6.24	10.00	74.82	84.97	34.22	2.67	32.00	67.00	11.95	14.17	55.10	7.79
78	**NRC 137**	17.10	24.67	34.50	24.00	65.67	78.67	5.48	8.98	73.21	92.39	34.00	2.83	42.00	120.00	12.52	18.57	68.03	13.56
79	**PS 1092**	20.67	24.40	31.00	24.67	65.67	84.33	5.61	8.58	75.10	84.97	35.08	2.50	31.50	53.67	12.45	16.72	44.00	7.36
80	**PS 1225**	19.91	25.70	33.50	25.00	65.67	89.33	7.88	7.95	78.79	92.39	34.27	2.67	31.67	64.83	12.73	29.65	31.05	8.98
81	**PS 1613**	18.80	29.21	33.50	26.30	68.33	86.67	5.22	8.94	76.12	84.97	34.00	2.67	31.00	67.33	12.05	21.52	43.07	9.27
82	**PS 1641**	17.23	24.33	30.33	23.33	64.33	82.33	6.91	7.88	67.97	88.04	35.08	2.67	37.56	105.17	11.44	18.00	62.29	11.24
83	**RVS 2012-19**	18.70	24.74	40.00	21.00	65.00	85.00	5.83	7.37	67.55	84.09	34.83	3.00	30.00	63.00	12.70	20.18	44.98	8.85
84	**SL 96**	19.50	25.42	31.50	21.33	62.00	82.67	7.30	9.37	75.10	84.97	34.27	2.67	33.50	56.50	10.34	16.32	49.46	7.70
85	**SL 710**	17.23	23.62	42.50	22.33	67.33	88.00	6.78	9.00	78.79	84.97	34.57	2.50	28.33	54.33	11.05	32.65	20.74	6.77
86	**SL 744**	17.20	27.30	37.17	23.67	66.67	89.00	5.92	8.98	76.12	92.39	35.08	2.67	28.33	58.67	10.73	20.74	35.40	7.34
87	**JS 24-37**	19.87	24.33	33.00	23.33	65.33	87.00	8.3.63	10.94	67.97	90.78	34.10	2.72	40.50	129.83	12.60	24.91	60.47	15.03

88	**NRC 86**	18.90	25.42	46.83	21.67	60.67	84.33	7.36	10.69	72.00	80.70	35.35	2.97	37.00	64.83	12.20	24.22	32.38	7.85
89	**NRC 130**	18.07	23.62	42.17	23.00	66.00	83.00	6.24	6.88	75.10	84.97	34.47	2.92	32.17	107.33	10.68	23.00	54.80	12.61
90	**PS 1569**	18.31	27.30	38.00	22.33	65.33	81.00	7.51	8.78	77.66	95.65	34.55	2.60	34.33	118.00	11.97	21.67	66.98	14.50
	Mean	18.76	26.23	37.60	22.93	64.43	80.35	6.41	8.47	71.47	86.76	34.15	2.61	33.48	77.93	11.38	20.73	47.44	9.51
	SE	0.83	1.76	1.90	1.58	2.00	4.16	0.96	0.88	3.71	5.18	0.61	0.15	2.08	6.86	0.31	1.33	5.51	0.85
	C.D.5%	2.32		5.30						8.59		1.71	0.41	5.80	19.14	0.86	3.71	15.37	2.39

Table1: General Mean Values of each genotype for Physiological and quantitative traits

Note: Plant height at 30,60 and 90 DAS(Days after sowing), leaf number at 30,60 and 90 DAS, LAI(Leaf area index) at 60 and 90 DAS, LAD(Leaf area duration at 60 and 90 DAS), CT(Canopy temperature), S/POD(Seed per pod), P/P(Pods per plant), NS/P(Number of seeds per plant), 100SW(Hundred seeds weight),BY/P(Biological yield per plant), HI(Harvest index),SY/P(Seed yield per plant).