

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

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## SUMMARY

An experiment was consisting of six genotypes viz., JS-71-05, Kuber, Chaturbhuj, Indira Soya -9, JS-335 and MACS-124 was to study the difference in growth and yield of soybean. The genotype MACS-124 showed maximum plant height among all other genotypes and recorded more number of leaves as well as leaf area index. Genotype, Kuber recorded highest total dry weight, absolute growth rate, relative growth rate and net assimilation rate. In yield attributing characters genotype Kuber recorded highest number of seed per pod and 100 seed weight while genotype JS-335 showed highest harvest index.

**Key words :** AGR, RGR, NAR, Genotype, Yield.

Soybean [*Glycine max* (L.) Merrill.] is recognised as one of the premier agricultural crop, which has revolutionized the agricultural economy with its immense potential for food, fuel and numerous industrial products. Its yield is very complex character, its depends upon a number of genetic and physiological factors interacting with environment. Due to uncertain constraints of productivity like lower sink demand is inviting the wide gap in critical yield status, resulting in stagnant genetic yield potential. In view of fast shrinkage of agricultural - resources, it is urgently needed to identify the possible key and physiological variables which are the physiological determinant and associated with the seed yield of crop. This could only the ray of hope in order to select the most suitable genotype for Chhattisgarh region and to understand the dynamic of yield variation associated with phenology of the crop. The present investigation was undertaken to study “physiological basis of seed yield variation in soybean” with following objectives to study the physiological efficiency and growth pattern of soybean genotypes and to evaluate the physiological traits associated with higher yield.

## MATERIALS AND METHODS

The present investigation was carried out during kharif 2001 at the Instructional Farm, Indira Gandhi

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Agricultural University, Raipur Chhattisgarh. The experiment was laid out in Randomized Block Design (RBD) with three replications and six genotypes viz. JS-71-05, Kuber, Chaturbhuj, Indira Soya -9, JS-335 and MACS-124. Absolute growth rate (AGR) is the total gain in weight by a plant within specific time interval and measured and calculated by following formula:

$$AGR \propto \frac{w_2 - w_1}{t_2 - t_1}$$

where,

$w_1$  = total dry weight of plant at time  $t_1$   
 $w_2$  = total dry weight of plant at time  $t_2$   
 $t_1$  = initial time of observation  
 $t_2$  = final time of observation

Relative growth rate (RGR) is the increase in plant material unit per time was calculated by formula given by Fisher (1921)

$$RGR \propto \frac{\ln w_2 - \ln w_1}{t_2 - t_1}$$

where,

$w_1$  = total dry weight of plant at time  $t_1$   
 $w_2$  = total dry weight of plant at time  $t_2$   
 $t_1$  = initial time of observation.  
 $t_2$  = final time of observation.

Net assimilation rate (NAR) is expressed as increased in dry matter unit per leaf area per unit time; it was calculated by formula given by Gregory (1917) as following:

$$NAR \propto \frac{w_2 - w_1}{t_2 - t_1} \times \frac{\ln w_2 - \ln w_1}{A_2 - A_1}$$

where,

$A_1$  = leaf area per plant at time  $t_1$   
 $A_2$  = leaf area per plant at time  $t_2$

Leaf area index is the leaf area existing on unit ground was proposed by Watson (1952) and was

calculated by following formula:

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

Crop growth rate (CGR) is the absolute growth rate as per unit ground and this was worked out as formula given by Watson (1952)

$$\text{CGR} = \text{NAR} \times \text{LAI}$$

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

$$\text{Harvest index} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

$$\text{Total chlorophyll content of N} = \frac{\text{OD } 652 \times 1000}{34.5} \times \frac{V}{1000 \times W}$$

OD = Optical density

V = final volume of DSMO (Dimethyl sulphoxide) solution (10 ml)

W = fresh weight of sample taken (g)

## RESULTS AND DISCUSSION

The results clearly highlighted the increased trends in plant height, which is statistically significant at all the growth stages of crop (Table 1). MACS -124 recorded significant maximum plant height at 60 DAS and to 90 DAS (Days After Sowing) and Kuber 90 DAS. Genotypic differences in plant height in soybean were also reported by Abbas *et al.* (1992), Koti and Chetti (1998).

The differences in mean number of primary branches were significant at 90 DAS (Table 1). Genotype Indira Soya-9 produced maximum number of primary branches with respects to all other genotype and these result are in conformity with Deshmukh *et al.* (1991) and Kotti and Chetti (1998) in soybean. Genotype MACS-I24 recorded highest number leaves per plant. (Table 1). The differences in mean leaf area were statistically significant at 60 and 90 DAS (Table 1). The genotype MACS-I24 maintained highest value of leaf area from 60 DAS onward. Similar result was observed by Gontia and Awasthi (1998) in soybean. The mean leaf, stem and total dry weight per plant varied significantly at various growth stages (Table 1 and 2). The genotype Kuber accumulated

**Table 1 : Mean plant height, number of leaves, leaf area (dm<sup>2</sup>), leaf dry weight (g) and stem dry weight (g) per plant at various growth stages**

Genotypes	Plant height			No. of leaves			Leaf area (dm <sup>2</sup> )			Leaf dry weight(g)			Stem dry weight (g)		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
JS-71-05	19.11	34.46	38.61	27.00	77.27	75.30	10.67	29.54	28.60	1.05	6.19	3.22	2.13	8.81	17.98
Kuber	19.80	39.56	45.38	23.66	79.21	76.59	10.91	20.29	19.68	1.02	6.04	4.13	2.07	8.92	18.01
Chaturbhuj	19.85	39.87	44.74	27.33	77.92	75.77	10.22	20.59	20.00	1.12	6.91	4.88	2.12	7.71	16.54
JS-335	16.57	34.09	39.81	26.00	76.77	74.38	10.40	25.49	24.71	1.03	6.09	4.18	2.09	7.78	16.65
Indira Soya-9	18.68	35.51	41.47	20.33	70.94	69.33	10.24	20.67	20.06	1.01	6.03	4.11	2.14	8.01	17.96
MACS -124	19.29	42.10	51.62	27.33	82.88	79.83	10.97	30.46	28.80	1.07	6.34	4.48	2.10	7.98	16.82
S.E.±	0.49	0.46	0.39	1.53	0.61	0.39	0.22	0.91	0.82	0.003	0.003	0.40	0.009	0.02	0.01
C.D. (P=0.05)	1.55	1.45	1.25	NS	1.93	1.24	NS	2.86	2.60	0.012	0.009	NS	0.028	0.06	0.03

**Table 2 : Mean total dry weight (g), AGR (Absolute growth rate), RGR (Relative growth rate), NAR (Net assimilation rate) and LAI (Leaf area index) per plant at various growth stages**

Genotypes	Total dry weight (g)			AGR (g / plant / day)		RGR (g / plant / day)		NAR (g / plant / day)		LAI		
	30 DAS	60 DAS	90 DAS	Days interval		Days interval		Days interval		30 DAS	60 DAS	90 DAS
				30-60	60-90	30-60	60-90	30-60	60-90			
JS-71-05	3.18	16.46	31.42	0.443	0.499	0.054	0.021	0.023	0.017	2.66	7.38	7.15
Kuber	3.10	17.91	42.96	0.470	0.859	0.057	0.032	0.031	0.043	2.72	5.07	4.92
Cbaturbhuj	3.23	16.80	41.85	0.452	0.839	0.055	0.030	0.030	0.041	2.55	5.14	5.00
JS-335	3.12	16.32	30.03	0.440	0.457	0.055	0.020	0.026	0.018	2.60	6.37	6.17
Indira Soya-9	3.16	14.65	38.38	0.383	0.791	0.051	0.030	0.025	0.038	2.56	5.16	5.01
MACS -124	3.17	14.86	40.03	0.390	0.835	0.050	0.031	0.020	0.028	2.74	7.61	7.20
S.E. ±	0.0092	0.62	2.30	0.0018	0.0024	0.003	0.0003	0.0011	0.001	0.055	0.227	0.206
C.D. (P=0.05)	0.028	1.95	7.25	0.00056	0.0075	0.0095	0.0095	0.0034	0.0031	NS	0.715	0.648

**Table 3: Yield attributing characters of soybean genotype**

Genotype	No. of pods/ plant	No. of seeds/ plant	No. of Seeds/ pod	100 seeds weight (Test weight) (g)	Seed yield plant (g)	Seed yield / ha (q)	Straw yield / ha (g)	Biological yield / ha (q)	Harvest index (%)
JS-71-05	68.33	163.93	2.40	13.17	21.68	12.00	25.07	37.07	32.27
Kuber	85.33	216.20	2.53	13.62	29.45	13.27	25.59	38.86	34.11
Chaturbhuj	65.33	187.43	2.86	14.87	27.87	10.02	20.67	30.69	32.63
JS-335	69.33	191.96	2.76	13.20	25.34	10.78	18.51	29.29	36.63
Indira Soya-9	76.33	178.03	2.33	11.08	19.73	8.60	24.47	33.08	25.86
MACS -124	61.66	146.00	2.36	13.62	19.89	7.44	21.06	28.21	26.29
S.E. ±	2.55	7.85	0.036	0.0025	1.058	0.875	0.236	0.944	1.82
C.D. (P=0.05)	8.05	24.76	0.110	0.0078	3.330	2.756	0.740	2.980	5.73

maximum mean stem dry weight followed by JS-71-05. The total dry weight was maximum in Kuber, followed Chaturbhuj at 60 and 90 DAS.

The genotype Chaturbhuj accumulated maximum leaf dry weight followed by MACS 124 at 60DAS and 90 DAS. The genotypic differences with respect to leaf dry weight, stem dry weight and total dry weight were also reported by Deshmukh *et al.* (1991) in soybean.

The growth analytical parameter studies like AGR, RGR, NAR and LAI exhibited significant trends (Table 2). Genotype Kuber recorded highest AGR, RGR and NAR as compared to all other genotypes. The genotypic difference with respect to AGR, RGR, NAR and LAI was reported by Rajput and Shrivastava (1991) in soybean.

All the genotypes were different in yield attributing character (Table 3). As regards to yield attributing

characters, the genotype Kuber produced maximum number of pods per plant as well as the number of seeds per plant. Similar result was obtained by Singh *et al.* (1983). The genotype Chaturbhuj recorded highest number of seed per pods and 100 seed weight. Genetics variability in soybean was also obtained by Singh *et al.* (1983). The genotype Kuber recorded highest seed yield per plant, seed yield per hectare and straw and biological yield per hectare as well. The highest seed yield produced by Kuber 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 JS-335 showed highest value of harvest index and this is conformity with results of Nirmal Kumari and Balasubramanian (1991) in soybean.

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