International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(5): 1522-1525

Received: 16-07-2017
Accepted: 17-08-2017

**Devendra Vasht**
Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

**Ompal Singh**
Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

**SK Dwivedi**
Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

**Anubha Upadhayay**
Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

**SK Pandey**
Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

**Correspondence**
**Devendra Vasht**
Department of Plant Physiology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

# Physiological and biochemical assessment of genotypic variation in soybean (*Glycine max* (L.) Merrill] genotypes

**Devendra Vasht, Ompal Singh, SK Dwivedi, Anubha Upadhayay and SK Pandey**

**Abstract**
A field investigation was conducted to access genotypic variation in relation morphological, structural attributes of yield, biochemical estimation and seed yield of soybean. The result shows that a wide variability was exist among soybean genotypes in relation to their seed quality parameters and structural components of productivity and seed yield. Maximum seed protein and oil (%) was estimated in JS 21-03 while seed proximate parameters were higher in JS 21-02, JS 21-04 and JS 21-01. Among genotypes JS 21-05 registered maximum seed yield (7.86 g/plant and 4140.62 kg/ha) due to significantly improved structural yield attributing parameters.

**Keywords:** Biochemical estimation and Yield attributes

## Introduction
Soybean (*Glycine max* (L.) Merrill] one of nature's most versatile crops, is increasingly becoming an important food and cash crop in the tropics due to its high nutrient quality and adaptability to various growing environments (Smith *et al*., 1995; Tukamuhabwa *et al*., 2001; FAO, 2004; McKevith, 2005) [17, 18, 12]. It is a native to East Asia, widely grown for its oilseeds bean which has numerous uses. Soybean ranks first among the oilseeds in the world and has now found a prominent place in India (Mahna, 2005) [11]. It has emerged as one of the important commercial crops in many countries. Soybean is also known as the "Golden bean" or "Miracle crop" because of its multiple uses and qualities as it is both a pulse and oilseed crop.

It is the most important *kharif* oilseed crop of Madhya Pradesh with an area, production and productivity. The current area is 11.037 mhac and production 8.736 tonsbesides yield of 790 kg/hac in India while the current area is 5.546 mhac and production 4.967 tons besides yield of 860 kg/hac in M.P SOPA (2014-15). Soybean ranks first among the oil seed crops in the world and in India both. India is the fourth ranking country in the world after United States of America, Brazil, and Argentina regarding area and fifth ranking after China regarding production. Soybean has unprecedented expansion in India by recording 15-20% annual growth rate. Madhya Pradesh is the soybean bowl of India, contributing 65-70 per cent of country's soybean production, followed by Maharashtra, Rajasthan and Karnataka which is much below the average national and world productivity. Being a leguminous crop, it is capable of fixing atmospheric nitrogen at the rate of 85-115 kg/ha with symbiosis of *Rhizobium japonicum* micro-organism after fulfillment of its requirement (Alexander, 1977) [1].

The crop has a variety of uses including for human food, livestock feed, vegetable oil, and many industrial products and is a major crop in several developing and developed countries (McKevith, 2005) [12]. Soybean seed content 35-40% protein, 19% oil, 35% carbohydrate (17% of which is a dietary fiber), 5% minerals and several other components including vitamins (Liu, 1997) [10]. The oil contains about 0.5-1.0 per cent lecithin which is essential for building up of human nerve tissues. Due to high protein content, soybean is known as 'poor man's meat'. Its oil is also used as raw material in manufacturing antibiotics, paints, varnishes, adhesives, lubricants *etc.* The bulk of the crop is solvent extracted for vegetable oil and then defatted soya meal which is used for animal feed. A very small proportion of the crop is consumed directly as food by humans. Soybean products, however, appear in large variety of processed foods. Several countries like Japan, China, Indonesia, Philippines and European countries are importing soybean to supplement their domestic requirement for human consumption and cattle feed.

The soybean cultivars have variability for physiological and morphological attributes of growth and productivity. The latter is determined by the photosynthesis and its net accumulation in the economic sink. The genotypic response of a cultivar is related to its physiological functional components, adaptation to the environmental extremes and partitioning of photo-assimilates. In spite of the best efforts to improve the soybean varieties, the yield of this crop remains low. Several studies have been made to understand their performances which mainly include the contribution of various yield components towards yield (Das *et al*., 1992; Mehta *et al*., 2000; Chettri, 2003; Jian *et al*., 2007) [5, 13, 4, 8]. The yield components depend on some physiological traits. To understand the physiological basis of yield difference among the genotypes of soybean, it is essential to quantify the components of growth, and the relevant variables, which is useful in crop improvement. Variation in dry matter accumulation and pod production in different genotypes may be related to some factors such as leaf area (LA), crop growth rate (CGR), net assimilation rate (NAR) and relative growth rate (RGR). Pandey *et al*. (1978) [15] analyzed growth parameters of five varieties of blackgram in order to study the physiological causes of yield differences and observed the differences in CGR, NAR, RGR and LA among the varieties. The dry matter accumulation may be the highest if LAI reaches its maximum value within the shortest possible time (Khan and Khalil, 2010) [9]. Not only TDM production, but also the capacity of efficient partitioning between the vegetative and reproductive parts may produce high economic yield (Shiraiwa *et al*., 2004; Oh *et al*., 2007) [16, 14]. Higher seed yield of any crop can be achieved only through proper combinations of a cultivar, environment and agronomic practices. A deep understanding of the physiological processes involved in the seed production such as vegetative growth formation of storage organs and seed filling is essential to determine the best combination of aforesaid factors and also provide specific guidelines for future breeding programme.

New genotypes are a main source in the development of commercial varieties on the basis of desirable plant traits as well as to help to meet our national food/oil demand (Dong *et al*., 2001) [6] Soybean possess a wide diversity in terms of plant genotypes, physiological response to light, temperature and cultural treatments and therefore in functional response and productivity via highly variable morpho-physiological parameters which soybean genotypes possess.

## Materials and methods

Jabalpur has a semiarid subtropical climate. It is situated on 23' 90" N latitude and 79' 58"E longitude at an altitude of 411.78 meter above the mean sea level. It falls under subtropical climatic conditions, which is characterized by the features of hot dry summers and cool dry winters. The 10-years mean annual rainfall of the area is 1284 mm with intermittent dry spells. The maximum and minimum temperature ranged between 37.6 and 17.9 $^0$C respectively with relative humidity of 80-90%. This investigation of assessment of physiological and biochemical variation among soybean (*Glycine max* (L.) Merrill) genotypes was conducted during *Kharif* season of the year 2015 at Research Farm Adhartal, Department of Plant Breeding and Genetics, JNKVV, Jabalpur (M.P.) using Randomized complete Block Design with ten genotypes in four replication. The nitrogen content was estimated by micro kjeldhal method (A.O.A.C., 1965) as per method suggested by Gopalan *et al*. (1985) [7] and protein percent in the sample was estimated multiplying nitrogen percent of sample by factor 6.25.Total carbohydrates in the sample were estimated by the hydrolysis method as described in AOAC (1984) [3] and the fat content by Soxhlet's extraction method as described in AOAC (1980) [2]. Yield and yield attributing traits were also recorded. The statistical analysis was done by using standard procedure.

## Results and discussion

The soybean cultivars have variability for physiological and morphological attributes of growth and productivity. The latter is determined by the photosynthesis and its net accumulation in the economic sink. The genotypic response of a cultivar is related to its physiological functional components, adaptation to the environmental extremes and partitioning of photo-assimilates. In spite of the best efforts to improve the soybean varieties, the yield of this crop remains low. To understand the physiological basis of yield difference among the genotypes of soybean, it is essential to quantify the components of growth, and the relevant variables, which is useful in crop improvement. Variation in dry matter accumulation and pod production in different genotypes may be related to mopho-physiological yield attributing traits and biochemical estimations. Seed quality parameters were also significantly varied among soybean genotypes at maturity. Maximum seed protein content (Table-1) was estimated in JS 21-03 (43.26%), JS 21-07 (41.29%) and JS 21-01(40.38%) and moderately in JS 21-05 (39.41%). While maximum seed oil was extracted by JS 21-03(22.35%), JS 20-29 (19.51%) and JS 21-05(21.39%) and carbohydrate content was higher in JS 21-02 (21.13%), JS 21-04 (20.8%) and JS 21-08 (20.01%). The crude fiber and ash content were noted maximum in JS 21-04 (4.56%, 4.63%), JS 21-06 (4.28%, 5.41%) and minimum seed fiber were obtained in JS 21-01(3.49%) and JS 21-05 (3.85). Improvement in structural yield attributing components resulted in maximum realisation of productivity potential of soybean genotypes. The significant variation was noted (Table-2) among soybean genotypes with respect to their components of yield with biological and seed yield. Maximum plant height was noted in JS 21-02 (54.90 cm) and JS 21-01(54.59) and number of branches in JS 21-05 (4.66), JS 21-06 (4.58) and JS 21-01(4.37). Number of pod per plant and seed per pod were counted maximum in JS 21-05 (94.75, 3.19), JS 21-07(84.75, 2.94) and JS 21-06 (79.75, 2.88). While pod length, pod width and pod girth were more in JS 21-03 (44.91, 8.06, 4.58) and JS 21-05 (40.25, 7.62, 4.30). The pod weight was higher in JS 21-03 (7.45 gm/plant), JS 21-06 (7.39 gm/plant) and JS 21-08 (7.16 gm/plant).The biological yield was maximum in JS 21-05(58.61 gm/plant, 10182.20kg/hac), JS 21-06 (51.02 gm / plant, 7864.80 kg/hac) and JS 21-07(56.85gm/plant, 8461.33 kg/hac) on per plant as well as per hectare bases showed their highest production efficiency. While JS 21-05, JS 21-4 and JS 21-07 showed maximum partitioning efficiency of photo assimilates from source to the economic sink. The higher seed yield per plant and per hectare were registered in JS 21-05 (23.75gm/plant, 4140.62kg/hac), JS 21-06 (17.84gm/plant, 2109.37kg/hac), JS 21-07(17.56gm/plant, 2968.75kg/hac) and JS 21-04(12.89gm/plant, 2226.56kg/hac). From the result of present study, it can be concluded that the high yielding genotype JS 21-05 possesses higher photo assimilate production with efficient partitioning efficiency as well as moderate seed quality parameters.

**Table 1:** Variation in biochemical estimations in seeds of different soybean genotypes.

| Genotypes | | Protein % | Fat % | Fibre % | Carbohydrate % | Ash % |
|---|---|---|---|---|---|---|
| G1 | JS 21-01 | 40.38 | 20.08 | 3.49 | 18.33 | 4.25 |
| G2 | JS 21-02 | 38.39 | 18.51 | 4.07 | 21.13 | 5.23 |
| G3 | JS 21-03 | 43.26 | 22.35 | 3.73 | 19.19 | 3.68 |
| G4 | JS 21-04 | 38.31 | 19.47 | 4.56 | 20.8 | 4.63 |
| G5 | JS 21-05 | 39.41 | 21.39 | 3.85 | 18.24 | 5.16 |
| G6 | JS 21-06 | 38.8 | 18.53 | 4.28 | 19.68 | 5.41 |
| G7 | JS 21-07 | 41.29 | 20.37 | 3.71 | 17.53 | 3.91 |
| G8 | JS 21-08 | 39.43 | 19.61 | 3.87 | 20.01 | 4.23 |
| G9 | JS 21-09 | 39.47 | 19.51 | 4.05 | 19.64 | 4.83 |
| G10 | JS 20-29 | 40.32 | 21.57 | 3.7 | 18.72 | 4.17 |
| Mean | | 39.91 | 20.14 | 3.93 | 19.33 | 4.55 |
| SEm± | | 0.10 | 0.08 | 0.08 | 0.06 | 0.06 |
| CD at 5% | | 0.29 | 0.24 | 0.22 | 0.19 | 0.18 |

**Table 2:** variation in morpho-physiological, structural yield attributes and yields in soybean genotypes.

| Genotypes | | Plant height (cm) | No of Branches/ plant | No of pod/ plant | No. of seeds/ pod | Pod weight gm/ plant | Pods/ length (mm) | Pod girth (mm) | Pod width (mm) | Seed index (gm) | Biological yield | | Harvest index (%) | Seed Yield | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | g/plant | Kg/ha | | g/plant | Kg/hac |
| G1 | JS 21-01 | 54.59 | 4.37 | 67.25 | 2.16 | 6.70 | 37.59 | 4.19 | 6.41 | 4.70 | 23.42 | 3494.25 | 29.24 | 6.82 | 996.09 |
| G2 | JS 21-02 | 54.90 | 4.33 | 66.50 | 2.24 | 6.44 | 30.20 | 3.15 | 6.08 | 9.93 | 45.68 | 4098.53 | 32.34 | 14.78 | 1347.66 |
| G3 | JS 21-03 | 50.95 | 4.39 | 70.75 | 2.41 | 7.45 | 44.91 | 4.58 | 8.06 | 6.86 | 35.80 | 4225.00 | 32.88 | 11.71 | 1347.65 |
| G4 | JS 21-04 | 53.00 | 4.08 | 78.25 | 2.78 | 6.14 | 38.14 | 3.55 | 7.20 | 5.94 | 33.45 | 5805.88 | 38.61 | 12.89 | 2226.56 |
| G5 | JS 21-05 | 52.40 | 4.66 | 94.75 | 3.19 | 6.27 | 40.25 | 4.30 | 7.62 | 7.87 | 58.61 | 10182.20 | 41.94 | 23.75 | 4140.62 |
| G6 | JS 21-06 | 49.09 | 4.58 | 79.75 | 2.88 | 7.39 | 36.64 | 3.39 | 6.71 | 7.78 | 51.02 | 7864.80 | 29.95 | 17.84 | 2109.37 |
| G7 | JS 21-07 | 51.13 | 4.41 | 84.75 | 2.94 | 6.33 | 34.47 | 3.70 | 7.32 | 7.05 | 56.85 | 8461.33 | 34.45 | 17.56 | 2968.75 |
| G8 | JS 21-08 | 48.84 | 4.08 | 76.00 | 2.66 | 7.16 | 29.64 | 4.02 | 6.52 | 7.44 | 43.25 | 5969.63 | 34.70 | 15.10 | 2089.84 |
| G9 | JS 21-09 | 49.98 | 3.92 | 74.25 | 2.30 | 6.13 | 32.73 | 3.51 | 6.96 | 6.43 | 32.96 | 5370.75 | 33.23 | 10.96 | 1738.28 |
| G10 | JS 20-29 | 44.78 | 3.87 | 74.75 | 2.13 | 5.46 | 37.84 | 4.28 | 7.13 | 7.55 | 31.16 | 4905.38 | 38.32 | 11.98 | 1835.94 |
| Mean | | 50.97 | 4.27 | 76.70 | 2.57 | 6.55 | 36.24 | 3.87 | 7.00 | 7.16 | 41.32 | 6037.78 | 34.57 | 14.34 | 2080.08 |
| SEm± | | 0.43 | 0.18 | 0.68 | 0.13 | 0.01 | 0.0278 | 0.0678 | 0.0180 | 0.24 | 1.50 | 483.54 | 0.28 | 0.45 | 206.74 |
| CD at 5% | | 1.26 | 0.51 | 1.97 | 0.38 | 0.02 | 0.0805 | 0.1968 | 0.0523 | 0.68 | 5.86 | 1403.11 | 1.09 | 1.31 | 599.89 |

**Acknowledgments**
The author is thankful to his teachers and parents for providing most valuable and inspiring guidance, close supervision and support.

**References**

1. Alexander M. Ecology of Nitrogen-fixing organisms, In: A.A. Ayanaba and P.J. Dart (eds.) Biological nitrogen Fixation in Farming Systems. Wiley, New York, 1977, 100-119.
2. AOAC. Official Methods of Analysis, 13th edition. Association of Official Analytical Chenists. Washington D.C. 1980, 376-384.
3. AOAC. Official Methods of Analysis, 14th edition. Association of Official. Agricultural Chemists. Washington DC, 1984.
4. Chettri SS. Study of variation for yield and yield contributing characters in soybean. Soybean Science. 2003; 23:6-9.
5. Das ML, Rahman A, Azam MA, Khan MHR, Miah AJ. Comparative performance of some soybean cultivars and the influence of seasons on seed yield. SABRAO J. 1992; 24:137-142.
6. Dong YS, Zhuang BC, Zhao LM, Sun H, He MY. The genetic diversity of annual wild soybeans grown in China. Theoretical and Applied Genetics. 2001; 103:98-103.
7. Gopalan C, Rama Sastri BV, Balasubramanian SC. Nutritive value of Indian foods (revised and updated by B.S. Narasinga Rao, Y.G. Deosthale, & K.C. Pant). Hyderabad, India, National Institute of Nutrition, 1985.
8. Jian J, Guang Hua W, Xiao Bing L, Yan Xia X, Liang M, Herbert SJ. Yield and quality changes from 50 years of genetic improvement of soybean cultivars in Heilongjiang Province. Res. Agric. Modern. 2007; 28(6):757-761.
9. Khan A, Khalil A. Effect of leaf area on dry matter production in aerated mungbean seed. International Journal Plant Physiol. Biochem. 2010; 2:52-61.
10. Liu KS. Chemistry and Nutritional Value of Soybean Components. In: Soybeans: Chemistry, Technology and Utilization, Liu, K.S. (Ed.). Chapman and Hall, New York, USA. 1997, 25-113.
11. Mahna SK. Production, regional distribution of cultivars, and agricultural aspects of soybean in India. 2005, Chapter 4. D., Werner and W. E. Newton (eds.), Nitrogen Fixation in Agriculture, Forestry, Ecology, and the Environment, Springer. Printed in the Netherlands, 2005, 43-6.
12. McKevith B. Nutritional aspects of oil seeds. Nutr. Bull. 2005; 30:1326.
13. Mehta N, Bohar ABL, Raneat GS, Mishra Y. Variability and character association in soybean. Bangladesh Journal of Agricultural Research, 2000; 25:1-7.
14. Oh EI, Uwagoh R, Jyo S, Saitoh K, Kuroda T. Effect of risisngtemperature on flowering, pod set, dry matter production and seed yield in soybean. Japanese Journal of Crop Science. 2007; 76(3):433-444.
15. Pandey RK, Saxena MC, Singh VB. Growth analysis of blackgram genotypes. Indian Journal of Agricultural Science. 1978; 48:466-473.
16. Shiraiwa T, Ueno N, Shimada S, Horie T. Correlation between yielding ability and dry matter productivity during initial seed filling stage in various soybean genotypes. Plant Production Science. 2004; 7:138-142.
17. Smith J, Woodworth JB, Dashiell KE. Government policy and farm-level technologies: the expansion of soybean in Nigeria. IITA Res. 1995; 11:14-18.
18. Tukamuhabwa P, Dashiell KE, Assafo-Adjei B. Determination of yield loss caused by soybean rust (*Phakopsora pachyrhizi* Syd.) in four genotypes of soybeans. African Crop Science Conf. Proc. 2001; 5:423-426.