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BIOPHYSICAL AND BIOCHEMICAL PARAMETERS ASSOCIATED WITH PRODUCTIVITY IN BLACK SEEDED SOYBEAN

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Abstract

A field experiment was conducted during *kharif* 2014 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to study the difference on growth, physiology and productivity inblack seeded soybean (*Glycine max*(L.) Merrill.) mutants and parents,The mutants and their parents and local checks used are KHSb2 Parent, KHSb2 Tall mutant, KHSb2 Dwarf mutant, Kalitur and DSb-21. The biophysical parameters such as rate of photosynthesis, stomatal conductance and rate of respiration were higher with DSb21, Kalitur and KHSb2 dwarf mutant. Further, data on SPAD values and the seed phenol content revealed that KHSb2 parent had maximum chlorophyll content and KHSb2 dwarf mutant had higherphenol contentamong all the genotypes under investigation.

Key words: Biophysical, Biochemical and Phenol.

Introduction

Soybean (*Glycine max* (L.)Merril) is one of the legume species, native to EastAsia. It is known as the "Golden Bean" of the 20th century. It is widely grown for its oil and protein. The plant is classified as an oilseed - rather than a pulse by the Food and Agricultural Organization (FAO) as the seed oil and oil cake are economically useful in various ways *viz.*, used as cooking medium and for manufacturing several industrial products such as vanaspati ghee, paints, linoleum oilcloth, printing inks, soaps, insecticides, disinfectants *etc.* Soybean seed contains about 20 per cent oil and 40 per cent protein, 30 per cent carbohydrates, 4 per cent saponins and 5 per cent fiber. Due to high protein content, soybean is known as 'poor man's meat.Black soybeansare merely a variety of soybean. Nutritionally, they are very similar to regular yellow soybeans.

They are low in net carbohydrates and high in hytonutrients, antioxidants, fiber, protein, vitamin K, iron, magnesium, copper, manganese and riboflavin. With more antioxidants and protein and fewer carbohydrates than other beans, black soybeans are 'Power house food for weight loss'. The extract from black soybean had a longer LDL (Low density lipoprotein) oxidation lag time than that from yellow soybean. Regarding polyphenol contents,the seed coat of black soybeans have a higher polyphenol content than that of yellow soybean.The present investigation was carried out to know the biophysical and biochemical parameters associated with productivity in black seeded soybean

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Materials and Methods

The experiment was laid out in randomized block design (RBD) consisting of five treatments including two yellow soybean varieties (DSb-21 and KHSb2 parent), Kalitur (black soybean), and black seeded mutants of KHSb2 parent (KHSb2 dwarf and KHSb2 tall) and were replicated four times.The crop was harvested when plants started drying to pale color, leaflets started shedding and pods turned to pale color. The border row plants were first uprooted manually from all sides of each plot and then the net plots were harvested excluding five plants randomly selected and tagged for recording the observations. The harvested plants were dried in shade for seven days. The seeds were separated manually by gently beating the dried plants with a wooden stick. The seeds were cleaned and dried in the shade, the seed yield (g $plot^{-1}$) was recorded for each treatment and then seed

yield per hectare was computed and expressed as kg ha^{-1}. Observations on biophysical and biochemical characters were recorded at regular intervals of 30, 60 days after sowing (DAS) and at harvest. Measurement of rate of photosynthesis, stomatal conductance and rate of transpiration were made on the top third fully expanded leaf at different growth stages by using portable photosynthesis system (LI-6400 LICOR, Nebraska, Lincoln USA,). These measurements were made between 10.00 am to 12.00 noon on all the sampling dates. Chlorophyll content was estimated and expressed in terms of SCMR (SPAD chlorophyll meter reading) at 30 and 60 DAS. Required amount of seeds were ground thoroughly in a mortar with a pestle in a little hot distilled ethanol(80%) and seed extracts were prepared. Estimation of seed phenol content was by Folin-Ciocalteau method. The pods from each net plot were threshed; cleaned and seed yield was calculated and expressed as q ha^{-1}.

Results and Discussion

The cause and effect of relationship of various biophysical functions like photosynthesis, stomatal conductance, transpiration and leaf temperature are difficult to understand mainly because of the complexity in understanding interplay of several processes. Photosynthesis is a process which converts solar energy into chemical energy in the presence of water and carbon dioxide which occurs in chloroplast of cells. A close relationship between chlorophyll content and photosynthetic rate was observed by Watanabe and Yoshida (1970) who stated that higher chlorophyll content is one of the important factors responsible for higher photosynthetic rate. In the present study, rate of photosynthesis was higher with black soybean Kalitur during early phase of the crop growth at later phases

Table 1: Biophysical parameters (Photosynthesis, stomatal Conductance, Transpiration) at different growth stages in black seeded soybean genotypes and mutants.

Treatments	Photosynthesis (µmol $CO_2 m^{-2} s^{-1}$)		Stomatal Conductance (µ mol $m^{-2} s^{-1}$)		Transpiration (m mol $H_2O m^{-2} s^{-1}$)	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
KHSb-2 Parent	22.60	28.12	0.83	0.32	5.14	2.93
KHSb-2 Tall	18.22	21.11	0.69	0.24	5.36	3.01
KHSb-2 Dwarf	19.85	33.33	0.84	0.39	4.64	2.27
Kalitur	24.44	22.85	0.59	0.34	4.81	2.88
DSb-21	20.89	33.18	0.86	0.34	4.70	2.14
S.Em±	0.33	2.22	0.03	0.04	0.05	0.09
CD (0.05)	1.03	6.83	0.08	0.11	0.17	0.28

Table 2: SPAD values and seed phenol content (µg/g) in black seeded soybean genotypes and mutants.

Treatments	SPAD values		Seed phenol content (µg/g)
	30 DAS	60 DAS	
KHSb2 Parent	40.86	46.28	11.27
KHSb2 tall mutant	32.48	42.61	14.56
KHSb2 dwarf mutant	38.10	45.45	18.08
Kalitur	37.18	44.66	17.92
DSb-21	39.18	46.22	12.61
Mean	37.56	45.04	14.88
S. Em±	0.10	0.19	1.15
CD (P=0.05)	0.32	0.60	3.56

KHSb2 dwarf and DSb21 recorded significantly higher photosynthetic rate (table 1). These differences could be attributed to variation inchlorophyll content. Significantly higher stomatal conductance was also observed with DSb-21, KHSb2 dwarf and Kalitur. Transpiration is another biophysical parameter which is having direct relationship with the stomatal conductance. Higher transpiration rates were noticed with the KHSb2 tall mutant. Stomata are minute pores present on the epidermal leaf surface. They are important since the metabolism of crop plants depends on to a larger extent on the diffusion of gasses and water vapours through these pores. The arrangement and the frequency of the stomata vary widely among the species and among the genotype within the species. Hsiao (1973) reported that photosynthesis is largely dependent on stomatal regulation and stomatal regulation further connected to the transpiration rate. It was found that stomatal conductance was higher with those genotypes where photosynthetic rate was higher and it was with genotypes DSb-21, Kalitur and KHSb-2 dwarf. Similar reports were also given by Zhu *et al.* (2002) who suggested that soybean verities with high yield potential had higher photosynthetic rate as well as stomatal conductance than those with lower yield potential. Chlorophyll has been rightly designated as "pigment of life" because of their central role in living system responsible for harvesting sunlight and transforming its energy into biochemical energy essential for life on earth. SPAD values quantify relative chlorophyll content in crop plants and are mainly used to indicate current leaf nitrogen status. In general, higher the

Table 3: Yield and yield components in black seeded soybean genotypes and mutants.

Treatment	No. Pods per plant	No. seeds per pod	Seed weight (g plant^{-1})	Seed yield (q ha^{-1})	Test weight (g)	Harvest index (%)
KHSb2 Parent	62.85	2.35	10.84	30.13	11.63	34.00
KHSb2 Tall mutant	55.26	2.25	10.71	27.66	11.10	30.00
KHSb2 dwarf mutant	87.82	2.40	11.37	33.15	13.40	36.00
Kalitur	77.65	2.30	11.15	32.10	12.06	35.00
DSb-21	90.23	3.00	12.49	38.87	13.71	38.00
S. Em±	2.03	0.19	1.50	2.19	0.09	3.00
CD (P=0.05)	6.26	0.60	4.61	6.75	0.28	8.00

SPAD value greater is the chlorophyll and thus in the present study, these values have been taken to depict chlorophyll content of leaves. The chlorophyll content differed significantly among the genotypes and mutants under study at 30 and 60 DAS (table 2). The KHSb-2 parentrecorded significantly higher SPAD values during 30 and 60 DAS and was on par with DSb-21, Kalitur and KHSb-2 dwarf. The seed coat of black soybean has a higher polyphenol content than that of yellow soybean.In the present study, higher phenol content was noticed in KHSb2 dwarf mutant (black soybean) followed by Kalitur and KHSb2 parent. In the present investigation, yield attributing characters like number of pods per plant, number of seeds per pod, seed weight per plant, seed yield per plot, test weight were significantly differed among the soybean genotypes and mutants. In general, DSb21, KHSb2 dwarf and Kalitur found superior over (table 3) rest ofgenotypes with respect to seed yield. It could be due to higher values of yield attributing characters recorded with these genotypes.

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