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Physio-biochemical characterization in wal

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Abstract
The field experiment was carried out to study the physio-biochemical basis of yield variation in twenty different wal (*Lablab purpureus* L.) genotypes at education and research farm, Dept. of Agril. Botany, College of Agriculture, Dapoli during *rabi* 2016-17. The experiment laid out in randomized block design with three replications. T7, T8, T13, T14 and T19 were showed superior performance for all the physio-biochemical traits. Rate of photosynthesis varied from 12.97 to 23.47µmol CO_2 m^{-2} s^{-1}. Stomatal conductance observed between 0.174 to 0.337 µmol m^{-2} s^{-1}. Transpiration rate ranged from 6.08 to 9.11µmol H_2O m^{-2} s^{-1}. The range of chlorophyll content recorded during 60 days period is 0.854 mg/g to 1.300 mg/g. Physio-biochemical characters can be effectively used for identification and grouping of varieties which can be further used for breeding programme.

Keywords: Physio-biochemical characterization, wal, *Lablab purpureus* L.

Introduction

Wal (*Lablab purpureus* L.) Sweet belongs to the family of Fabaceae and is also known as Hyacinth bean and Egyptian kidney bean (Verdcourt, 1979) [9]. It is a native to India or South-East Asia. It is probably of an Asian origin and has been under cultivation since ancient times. It is adoptable to wide range of climatic conditions (Kimani *et al.* 2012) [6], such as arid, semi-arid, sub-tropical and humid region where temperature vary between 22 ^{0}C to 35 ^{0}C, pH range varying from 4.4 to 7.8. Being a legume, it can fix atmospheric nitrogen. It combines a great number of qualities that can be used successfully under various conditions. Its first advantage is its adaptability. Not only it is drought resistant, it is able to grow in a diverse range of environmental conditions worldwide. It is also nutritionally important. It provides 50 Calories energy. It has 6.7 per cent carbohydrates, 0.7 per cent fats, 3.8 per cent proteins with moisture 86 per cent and also vitamins and minerals. It also contains 1.8 per cent fibre and 0.9 per cent ash. The approximate composition of the dry pulse is 24.9 per cent protein with 9.6 per cent moisture, 60.1 per cent carbohydrates, 0.8 per cent fat, 1.8 per cent fibre and 3.2 per cent ash content (Kay 1975, Food legumes).

Total production of pulses in world is 70 million tonnes from an area of 70 million hectors, with average productivity of 908 kg/ha. India is the largest producer of pulses in the world with 25% share in global production. During 2012, in India, the total production of pulses was 64.4 million tonnes from an area of 72.3 million hectares, with average productivity of 890 kg/ha. Maharashtra contributes 12 per cent of total production of pulses in India (FAO, 2012).

Yield is a complex trait governed by many traits and there are ample evidences to show that selections directly for seed yield in plants are not easy. Thus, any physiological character that is associated with higher yield or which makes a significant contribution to yielding ability would be useful in the improvement of seed yield. The basic studies on the basis of physiological traits are needed to overcome the yield barriers within the genotypes. There are two physiological approaches to achieve the target of yield potential. One is physio-genetic, which consist the genotypic differences in physiological traits and another one is the physio-agronomic relates with the management practices. It is ultimately the morpho-physiological variations, which is important for realising higher productivity as evident from very high and positive association within traits. Because characterization and evaluation will provide a rapid, reliable and efficient means of information for proper utilization of germplasm. This is also helpful to select suitable parental line for further improvement programme.

Materials and methods

The present investigation was carried out at Education and Research Farm, Department of Agricultural Botany, College of Agriculture, Dapoli, during the year 2016-17. In this study, 20 kadwa wal genotypes (Table 1) having different growth and yield characters used for physiological characterization.

Table 1: Number of Treatments: 20 (Genotypes)

Treatments	Genotype Code	Treatments	Genotype Code
T1	No.45	T11	No.29
T2	No.37	T12	No.31
T3	No.15	T13	No.51
T4	No.40	T14	No.65
T5	No.19	T15	No.25
T6	No.61	T16	No.43
T7	Sangmeshwar wal	T17	No.63
T8	No.44	T18	No.68
T9	No.34	T19	No.47
T10	No.24	T20	Kw-2

The experiment was laid out in randomized block design with three replications, provided with twenty treatments (twenty different genotypes of wal). Application of FYM @10 tons/ha was incorporated at the time of preparation of land. Fertilizers were applied @ 25 kg N_2O, 50 kg P_2O_5 per hectare at the time of sowing. Rate of photosynthesis, rate of transpiration and stomatal conductance was measured by using Infra-Red Gas Analyser (IRGA) machine and total chlorophyll content of the leaves was calculated by using the formula given by Arnon (1949) [1].

Result and discussion

Rate of photosynthesis is major factor that affects crop growth. It determines amount of food generated per sq. meter per second. Rate of photosynthesis also considerably varied among genotypes. Maximum rate was recorded during 60 days after sowing and it decreased later (Table 2). At 60 DAS, rate of photosynthesis varied in the range of 23.47 to 12.97 µmol CO_2 m^{-2} s^{-1}. Maximum and minimum rate was recorded in treatments T_6 and T_{17} respectively. Similar findings were reported by Kripa Ram (2013) [7] in mustard (*B. juncea* (L.) Czern & Coss), Borkar (2011) [2] in groundnut genotypes.

Table 2: Mean performance of different lablab bean genotypes for photosynthesis rate (µmol CO_2 m^{-2} s^{-1})

Treatments	30 DAS	60 DAS	90 DAS	At harvest
T_1	17.60	21.27	19.00	15.70
T_2	10.91	19.50	17.57	12.50
T_3	15.50	18.67	16.63	11.70
T_4	14.23	22.63	19.63	16.33
T_5	14.33	18.30	15.70	12.40
T_6	18.77	23.47	20.93	16.20
T_7	19.33	16.20	14.27	11.20
T_8	19.83	19.60	16.70	13.70
T_9	17.27	20.43	16.87	12.57
T_{10}	14.93	15.67	12.27	9.67
T_{11}	10.27	19.17	16.10	11.63
T_{12}	16.70	18.43	15.03	11.63
T_{13}	19.51	19.47	15.83	11.05
T_{14}	19.43	21.37	15.33	12.67
T_{15}	15.93	19.13	15.27	9.60
T_{16}	16.93	21.30	17.70	14.30
T_{17}	11.33	12.97	12.00	11.47
T_{18}	13.83	16.43	13.70	13.00
T_{19}	19.50	20.50	17.83	14.83
T_{20}	12.57	16.00	13.33	11.30
S.Em ±	1.01	0.87	1.05	0.79
CD@5%	2.88	2.50	3.01	2.26

Very small amount of variation was observed between stomatal conductance (Table 3). Maximum stomatal conductance was observed in T_5 and T_{14} while minimum of it was observed in T15. At harvest, stomatal conductance varied in between 0.337 µmol m^{-2} s^{-1} and 0.174 µmol m^{-2} s^{-1}. Similar results reported by Borkar (2011) [2] and Zinlala (2014) [10].

Table 3: Mean performance of different lablab bean genotypes for stomatal conductance (µmol m^{-2} s^{-1}).

Treatments	30 DAS	60 DAS	90 DAS	At harvest
T_1	0.218	0.246	0.246	0.177
T_2	0.337	0.274	0.278	0.198
T_3	0.177	0.328	0.198	0.185
T_4	0.225	0.267	0.267	0.177
T_5	0.328	0.185	0.185	0.337
T_6	0.274	0.328	0.354	0.246
T_7	0.310	0.337	0.218	0.318
T_8	0.223	0.218	0.328	0.218
T_9	0.198	0.246	0.337	0.185
T_{10}	0.184	0.177	0.274	0.267
T_{11}	0.285	0.217	0.177	0.177
T_{12}	0.240	0.337	0.218	0.215
T_{13}	0.267	0.328	0.215	0.246
T_{14}	0.246	0.185	0.246	0.337
T_{15}	0.174	0.218	0.328	0.174
T_{16}	0.217	0.246	0.252	0.217
T_{17}	0.311	0.217	0.337	0.311
T_{18}	0.185	0.311	0.185	0.198
T_{19}	0.233	0.356	0.177	0.177
T_{20}	0.215	0.246	0.198	0.227
S.Em ±	0.0079	0.008	0.0057	0.0057
CD@5%	0.023	0.023	0.016	0.017

Transpiration rate was increased continuously up to 90 days due to rise in temperature and then it declined slightly (Table 4). It increased with advancing age of the crop due to increase in temperature. Genotypes ranged between 9.11 and 6.08 µmol m^{-2} s^{-1}. At 90 days after sowing, maximum and minimum rate of transpiration was found in T11 and T4 respectively. Similar findings were reported by Borkar (2011) [2] Borkar and Zinlala (2014) [10].

Table 4: Mean performance of different lablab bean genotypes for transpiration rate (µmol H_2O m^{-2} s^{-1}).

Treatments	30 DAS	60 DAS	90 DAS	At harvest
T_1	2.69	5.16	6.28	5.53
T_2	2.24	3.55	6.65	4.53
T_3	2.37	4.21	7.29	5.62
T_4	2.88	4.35	6.08	5.23
T_5	3.20	4.19	8.59	4.84
T_6	3.28	5.57	7.35	6.40
T_7	3.36	6.22	8.66	5.71
T_8	2.84	6.30	8.92	6.04
T_9	2.39	5.88	7.35	4.39
T_{10}	2.39	6.55	8.49	3.64
T_{11}	2.68	7.56	9.11	5.50
T_{12}	2.44	6.52	7.31	6.56
T_{13}	3.75	6.23	6.84	7.79
T_{14}	3.15	7.44	6.53	5.32
T_{15}	3.51	7.16	7.48	6.27
T_{16}	2.85	8.06	6.48	7.92
T_{17}	3.28	7.49	8.23	6.45
T_{18}	2.36	6.18	8.83	5.44
T_{19}	2.19	7.52	8.30	4.72
T_{20}	2.54	5.95	6.89	4.62
S.Em ±	0.10	0.21	0.28	0.33
CD@5%	0.30	0.61	0.80	0.93

Life is a photochemical phenomenon. The chemical compounds most important in this conversion of light energy to chemical energy are the pigments that exist within the chloroplast or chromatophores of the plant. Chlorophyll is the principal organelle which carries out process of photosynthesis. Ultimately food is generated in this apparatus. Thus it is important to know the amount of chlorophyll present in the leaf tissue to determine photosynthetic efficiency of the plant. The present investigation showed that chlorophyll content increased with advancing age of the crop and it was reduced during maturity phase.

Table 5: Mean performance of different lablab bean genotypes for chlorophyll content (mg/g)

Treatments	30 DAS	60 DAS	90 DAS	At harvest
T_1	0.964	1.202	0.971	0.964
T_2	1.064	1.042	0.987	1.064
T_3	1.046	1.173	0.958	1.046
T_4	1.118	1.174	1.013	1.118
T_5	1.135	1.175	1.127	1.135
T_6	1.408	1.246	1.075	1.408
T_7	0.910	1.284	1.012	0.910
T_8	0.948	1.097	0.752	0.948
T_9	1.176	1.177	0.944	1.176
T_{10}	0.937	1.239	0.960	0.937
T_{11}	0.902	1.300	1.010	0.902
T_{12}	0.980	1.082	0.862	0.980
T_{13}	0.270	1.062	0.715	0.270
T_{14}	1.087	0.854	1.042	1.087
T_{15}	1.336	1.043	1.189	1.336
T_{16}	1.114	1.131	1.122	1.114
T_{17}	1.379	0.942	1.130	1.379
T_{18}	1.162	1.065	1.193	1.162
T_{19}	1.523	1.104	1.180	1.523
T_{20}	1.279	0.987	0.892	1.279
S.Em ±	0.110	0.05	0.080	0.110
CD@5%	0.320	0.13	0.230	0.320

Total chlorophyll content increased with advancing age of the crop and it was maximum during 60 days of crop growth and it started declining thereafter (Table 5). Maximum chlorophyll content was recorded in T_{11} followed by T_7 and minimum of it was observed in T_{13}. The range of chlorophyll content recorded during 60 days period is 0.854 mg/g to 1.300 mg/g. Similar results reported by Sankar Ganesh (2015) [8] estimated chlorophyll content in cowpea at different zinc concentrations. Also, Francis (2006) [4] found similar results in cowpea and he stated that spectrophotometer could be used as yield prediction tool in screening and selection of cowpea genotypes.

Conclusion
It is concluded that, T7, T8, T13, T14 and T19 were showed speriur performance for all the physio-biochemical traits. Thus the physio-biochemical characters can be effectively used for identification and grouping of these varieties which can be further used for breeding programme.

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