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Evaluation of Parents and Crosses for Yield, Yield Attributes and Water Use Efficiency Traits in Mungbean

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ABSTRACT

Seven mungbean genotypes viz., ML-267, LGG-528, MGG-390, WGG-42, AKM-9904, LM-95, EC-362096 and their 21 F_1 crosses were evaluated for yield, yield attributes and water use efficiency related traits. The analysis of variance for ten yield attributing parameters, three water use efficiency related parameters and one thermo tolerance related parameter revealed highly significant differences which indicated the existence of sufficient variability in the material. The mean squares due to crosses was also found highly significant for all the characters studied indicating significant genetic differences among crosses. The crosses MGG-390 × LM-95, LM-95 × EC-362096 and ML-267 × LGG-528 would be effective for genetic enhancement of yield and its components along with drought tolerant traits.

Key words: *Mungbean, SLA, SCMR, Relative injury, WUE*

INTRODUCTION

Mungbean (*Vigna radiata* (L.) Wilczek) popularly known as green gram, is one of the important pulse crops of India. India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world[6]. Pulses play a vital role in providing a balanced protein component in the diet of the people and also play an important role in Indian agriculture constituting the major source of essential amino acids for predominantly vegetarian population of India[1].

Among the wide array of pulses cultivated in India, mungbean ranks third in position after bengalgram and redgram. It is an excellent source of high quality protein in the form of dry edible seeds and fresh sprouts. Being rich in quality proteins, minerals and vitamins, it is an inseparable ingredient in the diets of vast majority of population in the Indian subcontinent. Since mungbean matures in about 60 to 70 days, it is an excellent crop for rotation in different cropping systems. Mungbean may also be sown as an intercrop or as a green manure or cover crop.

The per capita consumption of pulses has increased from 14.2 g in 2006-07 to 22.08 g in 2016-17 but per capita availability of pulses declined steadily on account of sluggish growth in the production of pulses.

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In order to meet the 40 grams per day per capita requirement of pulses as per W.H.O, attention has to be paid to increase production. Our nation's production and productivity levels of mungbean are low, which indirectly affect the nutritional status of people resulting in malnutrition. Among several reasons for low productivity, various biotic and abiotic factors play major role. Among the abiotic stresses, drought is a wide spread problem that seriously influences the mungbean productivity. Although intensive research work has been done on genetic architecture of yield and yield attributes of mungbean but limited work was done on mungbean yield attributes along with WUE and thermo tolerance related traits. Realizing the significance of drought on yield components there is an immediate need to work in order to enhance the genetic potential of mungbean genotypes with high yield and drought and heat tolerance.

More rapid progress may be achieved by a prior knowledge of the physiological basis of surrogate traits related to WUE, such as specific leaf area (SLA) and soil plant analytical development chlorophyll meter reading (SCMR). SLA is negatively correlated with WUE whereas SCMR is positively associated with WUE[4]. Hence, these traits could be used for selecting higher water use efficient greengram genotypes.

High temperature stress during germination and flowering cause considerable yield losses in mungbean. Temperature is rising day by day, which highly affects the crop at different phenophases, ultimately yield. It causes cell death, burning, flower drop, pollen abortion, shortening the grain filling duration etc[3]. Heat tolerance is determined by measuring relative injury percentage.

MATERIAL AND METHODS

The present experiment was carried out at dry land farm of Sri Venkateswara Agricultural College, Tirupati, situated at an altitude of 182.9 m. above mean sea level, 32.27°N latitude and 79.36°E longitude, situated geographically in southern agro climatic zone of Andhra Pradesh, India. The soil is sandy loam with medium fertility. Seven parents *viz.*, ML-267, LGG-528, MGG-390, WGG-42, AKM-9904, LM-95 and EC-362096 were raised in paired row method for effecting crosses in a diallel fashion without reciprocals to generate seed of 21 F_1 crosses. The 21 F_1 crosses along with their seven parents constituted 28 treatments for this experiment. The seven parents and their 21 F_1 crosses were sown in randomized block design with two replications during the first fortnight of November, 2016 at dry land farm, S.V. Agricultural College, Tirupati. Each genotype was sown by dibbling the seeds in two rows of 3 m length, with a spacing of 30 cm between the rows and 10 cm between the plants. All the 28 treatments were allotted at random to the experimental plots in each replication. The crop was fertilized at the rate of 20 kg N and 40 kg P_2O_5 in the form of urea and single super phosphate at the time of sowing. Thinning was done to leave single seedling per hill after 15 days of sowing. Irrigation, weeding and plant protection measures were taken up as and when needed during the crop growth period, as per the standard recommended package of practices to raise a good and healthy crop. Observations were recorded on five randomly chosen competitive plants from each genotype in each replication for the characters viz., plant height, number of branches per plant, number of clusters per plant, pods per cluster, pods per plant, seed yield per plant, 100-seed weight, harvest index, SLA, SCMR, SLW and relative injury. Days to 50% flowering and days to maturity were recorded on plot basis. The analysis of variance of RBD and their significance for all the characters were carried out as suggested by Panse and Sukhatme[5]. The significance of treatment differences was tested at five and one per cent levels of probability as per the 'F' table values of Fisher and Yates[2].

RESULTS AND DISCUSSION

The analysis of variance for ten yield attributing parameters, three water use efficiency related parameters and one thermo tolerance related parameter in parents and crosses is presented in Table 1. The results revealed highly significant differences among the genotypes for all the characters. Thus, it indicated the existence of sufficient variability in the material. The mean squares due to crosses was also found highly significant for all the characters studied indicating significant genetic differences among crosses. The mean performance of the 7 parents and their 21 F_1 crosses was represented in the Table 2.

Among the parents, the genotype ML-267 (35.50 days) was found early bloomer and the genotype LM-95 (41.50 days) was found late bloomer. Three parents ML-267, LGG-528 and MGG-390 were early in flowering compared to the mean flowering of the lines (38.86 days). Among the crosses, ML-267 × LGG-528 was the earliest to flower with a flowering of 33.00 days followed by WGG-42 × LM-95 (33.50 days),WGG-42 × EC-362096 (34.50 days), WGG-42 ×AKM -9904 (35.00 days) and MGG-390 × LM-95(35.00 days) . The cross ML-267 × MGG - 390 was late to flower with a flowering of 42.00 days. The mean flowering of crosses (37.64 days) is lower compared to the mean flowering of parents (38.86 days) indicating early flowering of the crosses over the parents.

The mean range for days to maturity in parents varied from 66.50 days (ML-267) to 72.50 days (LM-95) with a parental mean of 69.71 days**.** Four genotypes *viz*., ML-267, EC-362096, LGG-528 and MGG-390 were found early in maturity compared to mean maturity of lines (69.71 days). Among the crosses, ML-267 × LGG-528 (65.50 days) was the earliest to mature and LGG-528 × WGG-42 (72.50 days) was found to be late in maturity. Days to maturity followed almost the same trend as that of days to 50 per cent flowering showing good correspondence between the traits days to 50 per cent flowering and days to maturity.

Among the parents, mean plant height ranged from 44.40 cm (WGG-42) to 55.10 cm (EC-362096) with a general mean height of 50.91 cm. Four genotypes *viz.*, ML-267, MGG-390, AKM-9904 and EC-362096 exceeded the general mean value (50.91 cm). Plant height in crosses ranged from 47.80 cm (LGG-528 × WGG-42) to 57.00 cm (LM-95 × EC-362096).

The variation for number of branches per plant in parents was from 1.05 branches (AKM-9904) to 2.50 branches (ML-267). Parental mean was recorded as 1.41 branches per plant. Two lines *viz.*, ML-267 and MGG-390 had recorded more number of branches per plant than the general mean. Number of branches per plant in crosses ranged from 1.05 (WGG-42 × LM-95 and WGG-42 × AKM-9904) to 2.35 (ML-267 × LGG-528) with a general mean of 1.55. Branches per plant of most of the crosses exceeded the mean number of branches of the parents involved in the respective cross combination indicating the superior performance of the crosses over both the parents.

Among the parents, the number of clusters per plant ranged from 5.90 to 7.20 with a mean of 6.47. The highest number of clusters per plant was recorded by the genotype MGG 390 (7.20), whereas the lowest value was registered by LGG-528 (5.90). Three genotypes showed more number of clusters per plant than the general mean of the genotypes (6.47). Mean performance of crosses ranged from 5.10 (WGG-42 × EC-362096) to 9.70 (ML-267 × LGG-528) with overall mean of crosses 8.11. Among the crosses, (ML- 267 × LGG-528 (9.70) recorded more number of clusters per plant followed by LM-95 × EC-362096 (9.45) and MGG-390 × LM-95 (9.40). All the crosses have shown more number of clusters per plant than their parents involved except WGG-42 × EC-362096 (5.10) and WGG-42 × LM-95 (6.55).

The mean number of pods per cluster among parents ranged from 2.74 (ML-267) to 3.70 (AKM-9904) with a general mean of 3.27. Four parents *viz.,* LGG-528, MGG-390, AKM-9904 and LM-95 recorded more number of pods per cluster than the general mean of parents. The cross ML -267 × LM-95 (4.48) registered more number of pods per cluster followed by MGG-390 × LM-95 (4.32) while the less number was observed in the crosses WGG 42 × LM-95 (2.69) and LGG-528 ×

AKM-9904 (2.70). General mean of F_1 was recorded as 3.57 for pods per cluster.

Number of pods per plant varied from 17.70 (ML-267) to 25.40 (MGG-390) among the parents. Four genotypes *viz.*, MGG-390, AKM-9904, LM-95 and LGG-528 recorded more number of pods per plant compared to the general mean of parents (21.06). Among crosses, more number of pods per plant was displayed by ML-267 × LM-95 (41.20 pods), while less was registered by WGG-42 × EC-362096 (16.00 pods). General mean of pods per plant for F_1 crosses was registered as 29.12. Most of the crosses were found superior over both the parents involved, which might be due to favorable combination of genes from both the parents with respect to number of pods per plant.

The test weight for parents ranged from 3.42 g (LM-95) to 4.94 g (EC-362096) with a general mean of 4.10 g. Three parents *viz;* EC-362096 and WGG-42 registered more 100 seed weight than the parental mean of 4.10 g. Among crosses, higher test weight was recorded by the cross WGG-42 × EC-362096 (6.08 g), while lesser test weight of 3.53 g was observed in the cross LGG-528 × LM-95.

Among the parents, the trait harvest index varied from 34.52 per cent to 42.37 per cent. The parent AKM-9904 has shown highest harvest index (42.37%), while lowest (34.52%) was observed in the parent WGG-42. Two parents *viz.*, AKM-9904 and MGG-390 surpassed the mean value for harvest index (37.28%). The mean value of this trait among the crosses varied from 35.91 per cent (WGG-42 × EC-362096) to 47.75 per cent (ML-267 × LGG-528) with a general mean value of 40.12 per cent.

Seed yield ranged from 7.52 g to 9.91 g among the parental lines. The parent MGG-390 (9.91 g) registered highest seed yield. On contrary, the lowest seed yield was registered by the parent ML-267 (7.52 g). Out of seven parents, three parents MGG-390, AKM-9904 and EC-362096 surpassed the mean seed yield (8.32 g) of parents. In crosses seed yield per plant ranged from 6.67 g (WGG-42 × EC-362096) to 13.34 g (MGG-390 × LM-95).

The mean value of parents for SLA ranged from 150.63 $cm^2\ g^{-1}$ to 199.24 $cm^2\ g^{-1}$ with parental mean value of 180.92 $cm^2\ g^{-1}$. Highest SLA was registered by the parent LM-95 (199.24 $cm^2\ g^{-1}$), where as the lowest was observed in the genotype EC-362096 (150.63 $cm^2\ g^{-1}$). Three genotypes out of seven have recorded less specific leaf area compared to the general mean of parents (180.92 $cm^2\ g^{-1}$). Among crosses, the minimum SLA was recorded in LM-95 × EC-362096 (150.55 $cm^2\ g^{-1}$) and the maximum value was registered by LGG-528 × LM-95 (208.69 $cm^2\ g^{-1}$).

A range of 44.30 to 46.35 SPAD Chlorophyll Meter Reading was observed with a general mean of 45.31. The maximum SPAD Chlorophyll Meter Reading was recorded by the genotype LGG-528 (46.35), whereas the minimum was observed in MGG-390 (44.30). Three genotypes showed more SCMR values when compared to the general mean of this character (45.31). In case of crosses, the mean SCMR value varied from 42.20 (AKM-9904 × LM-95) to 52.85 (WGG-42 × EC-362096).

SLW ranged from 0.0050 (LM-95) to 0.0066 (EC-362096) with a general parental mean of 0.0056. Two genotypes have registered more mean values than their respective general mean. Among the crosses, the cross LGG-528 × LM-95 (0.0048 $g\ cm^{-2}$) has registered lowest specific leaf weight. The cross LM-95 × EC-362096 has recorded highest value of 0.0066 $g\ cm^{-2}$.

Among the parents, ML-267 has registered lower relative injury (40.59%) while AKM-9904 has shown higher value (50.69%). The general parental mean observed was 44.69 per cent. Four parents have exhibited less mean values than their respective general mean. In cross combinations, the value varied from 28.32 per cent to 52.62 per cent with a general mean of 43.43 per cent. The cross LM-95 × EC-362096 has recorded lowest relative injury (28.32%) whereas the cross AKM-9904 × LM-95 has shown the highest value (52.62%).

The results indicated that significant differences are existing in the mean performance of parents and crosses for yield components and drought related traits. But none of the genotypes showed consistent high performance for all the characters studied. Among the parents, MGG - 390 was the best parent as it showed high *per se* values for six yield attributes *viz*., plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant and seed yield and three drought related traits *viz*., specific leaf area, specific leaf weight and relative injury. The next best genotype was AKM-9904 for five yield attributes *viz*., number of clusters per plant, number of pods per cluster, number of pods per plant, seed yield, harvest index and three drought related traits *viz*., SCMR, specific leaf area and specific leaf weight. Further LM-95 recorded high *per se* performance for five yield attributes *viz*., plant height, number of clusters per plant, number of pods per cluster, number of pods per plant, harvest index and drought related trait *viz*., relative injury.

Critical examination of the mean performance of cross combinations depicted that, none of the crosses showed consistent high performance for all the characters. Among cross combinations, MGG-390 × LM-95 was found to be best cross as it recorded the high *per se* performance for eight yield attributes *viz*., plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, 100 seed weight, harvest index, seed yield per plant and three drought related traits *viz*., specific leaf area, specific leaf weight and relative injury. The second best cross was ML-267 × LGG-528 for eight yield attributes *viz*., plant height, number of branches per plant, number of clusters per plant, number of pods per clusters, number of pods per plant, 100 seed weight, harvest index, seed yield per plant and three drought related traits SCMR, SLA and relative injury. The next best cross was LM-95 × EC-362096 for seven yield attributes *viz*., plant height, number of branches per plant, number of clusters per plant, number of pods per plant, 100 seed weight, harvest index and seed yield and three drought related traits *viz*., SCMR, specific leaf area and relative injury. Further, the crosses ML-267 × LM-95 and ML-267 × EC-362096 were found to be good for number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, 100 seed weight, seed yield per plant and SCMR.

Table 1. Analysis of variance for fourteen traits in mungbean during *Rabi*, 2016

S. No.	Character	Mean Sum of Squares		
		Replications (df = 1)	Treatments (df = 27)	Error (df = 27)
1	Days to 50% flowering	4.018	11.235**	1.240
2	Days to maturity	0.018	7.870**	0.981
3	Plant height (cm)	2.083	15.008**	1.784
4	No. of branches per plant	0.035	0.445**	0.099
5	No. of clusters per plant	0.258	3.282**	0.246
6	No. of pods per cluster	0.040	0.479*	0.196
7	No. of pods per plant	0.033	103.963**	6.243
8	Hundred seed weight (g)	0.000	0.840**	0.098
9	Harvest Index (%)	0.050	23.139**	8.766
10	Spad Chlorophyll Meter Reading	0.900	12.506**	3.555
11	Specific Leaf Area (cm^2g^{-1})	1.166	566.941**	25.266
12	Specific Leaf Weight (g cm^{-2})	0.000	0.000004**	0.000
13	Relative Injury (%)	0.080	95.736**	2.832
14	Seed Yield per plant (g)	0.074	6.221**	0.633

* : Significant at 5% level; ** : Significant at 1% level

Table 2. Mean performance of seven parents and 21 crosses for yield, yield attributes and water use efficiency traits in mungbean

S. No.	Parents / Crosses	DF (No.)	DM (No.)	PH (cm)	NBP (No.)	NCP (No.)	NPC (No.)	NPP (No.)	HSW (g)	HI (%)	SCMR	SLA (cm^2 g^{-1})	SLW (g cm^{-2})	RI (%)	SYP (g)
1	ML 267	35.50	66.50	53.70	2.50	6.45	2.74	17.70	4.10	36.44	46.00	196.08	0.0051	40.59	7.52
2	LGG 528	36.50	69.00	49.00	1.25	5.90	3.65	21.50	3.98	36.29	46.35	165.50	0.0060	43.77	8.02
3	MGG 390	37.50	69.50	51.40	1.45	7.20	3.54	25.40	3.94	39.42	44.30	185.58	0.0054	42.94	9.91
4	WGG 42	41.00	70.50	44.40	1.10	6.80	2.79	18.90	4.25	34.52	44.80	180.22	0.0056	43.68	7.70
5	AKM 9904	40.50	71.50	51.90	1.05	6.15	3.70	22.60	4.06	42.37	45.85	189.20	0.0053	50.69	8.42
6	LM 95	41.50	72.50	50.90	1.35	6.70	3.38	22.65	3.42	36.46	45.15	199.24	0.0050	46.10	8.05
7	EC 362096	39.50	68.50	55.10	1.15	6.10	3.10	18.70	4.94	35.48	44.75	150.63	0.0066	45.09	8.65
	Mean of parents	**38.86**	**69.71**	**50.91**	**1.41**	**6.47**	**3.27**	**21.06**	**4.10**	**37.28**	**45.31**	**180.92**	**0.0056**	**44.69**	**8.32**
1	ML 267 × LGG 528	33.00	65.50	55.50	2.35	9.70	4.04	39.20	4.33	47.75	49.30	160.00	0.0063	30.85	12.98
2	ML 267 × MGG 390	42.00	69.50	54.80	1.50	8.30	3.76	31.10	4.95	40.26	48.25	193.03	0.0052	42.15	9.09
3	ML 267 × WGG 42	38.50	66.00	48.10	1.90	7.80	3.93	30.40	3.88	42.45	44.50	205.65	0.0049	44.63	8.75
4	ML 267 × AKM 9904	38.50	68.50	53.10	1.10	9.30	3.71	34.50	4.23	38.49	45.85	203.10	0.0049	41.60	11.07
5	ML 267 × LM 95	38.00	70.00	54.20	1.70	9.20	4.48	41.20	4.25	40.61	44.65	205.33	0.0049	50.61	12.00
6	ML 267 × EC 362096	41.50	68.00	55.60	1.70	8.10	3.88	31.40	4.28	39.11	47.50	172.55	0.0058	39.72	9.45
7	LGG 528 × MGG 390	39.50	70.50	51.00	1.15	8.50	3.51	29.80	4.33	37.61	42.70	182.79	0.0055	49.07	9.07
8	LGG 528 × WGG 42	38.50	72.50	47.80	1.30	7.80	3.78	29.50	3.92	40.40	44.90	185.45	0.0054	51.64	9.18
9	LGG 528 × AKM 9904	41.50	69.00	52.50	1.30	8.50	2.70	23.00	4.34	39.31	43.15	200.65	0.0050	49.16	8.37
10	LGG 528 × LM 95	38.50	68.00	51.60	1.35	8.85	3.54	31.30	3.53	39.53	48.35	208.69	0.0048	48.33	9.61

Table 4.2. Contd…

S. No.	Parents / Crosses	DF (No.)	DM (No.)	PH (cm)	NBP (No.)	NCP (No.)	NPC (No.)	NPP (No.)	HSW (g)	HI (%)	SCMR	SLA (cm^2 g^{-1})	SLW (g cm^{-2})	RI (%)	SYP (g)
11	LGG 528 × EC 362096	38.50	68.50	54.10	1.40	9.10	3.39	30.70	4.70	37.02	47.65	178.47	0.0056	35.17	9.07
12	MGG 390 × WGG 42	38.00	66.00	50.90	1.95	8.35	3.14	26.07	4.13	36.00	44.60	181.34	0.0055	41.00	8.50
13	MGG 390 × AKM 9904	37.50	67.50	52.60	1.10	8.10	3.39	27.40	4.00	39.18	45.55	191.49	0.0052	43.69	8.88
14	MGG 390 × LM 95	35.00	66.50	53.60	2.30	9.40	4.32	40.60	4.52	45.99	49.00	180.00	0.0056	32.10	13.34
15	MGG 390 × EC 362096	37.00	68.00	54.80	1.25	8.30	4.17	34.60	3.80	39.61	42.80	154.14	0.0065	50.50	10.74
16	WGG 42 × AKM 9904	35.00	67.00	53.30	1.05	6.60	2.82	18.40	5.75	40.25	50.70	186.64	0.0054	50.59	8.33
17	WGG 42 × LM 95	33.50	66.00	49.90	1.05	6.55	2.69	17.60	5.35	39.46	47.65	196.42	0.0051	50.63	8.21
18	WGG 42 × EC 362096	34.50	68.00	51.50	1.20	5.10	3.14	16.00	6.08	35.91	52.85	191.90	0.0052	48.32	6.67
19	AKM 9904 × LM 95	37.50	71.50	53.70	1.90	6.35	3.25	20.40	3.85	36.03	42.20	194.04	0.0052	52.62	7.14
20	AKM 9904 × EC 362096	36.00	70.50	52.70	1.40	6.95	3.86	26.40	4.81	40.02	47.10	188.58	0.0053	31.35	9.39
21	LM 95 × EC 362096	37.00	69.50	57.00	2.00	9.45	3.38	31.90	5.46	47.50	48.00	150.55	0.0066	28.32	13.18
	Mean of crosses	**37.64**	**68.40**	**52.78**	**1.55**	**8.11**	**3.57**	**29.12**	**4.50**	**40.12**	**46.53**	**185.99**	**0.0054**	**43.43**	**9.67**
	S.E.	0.79	0.70	0.95	0.25	0.35	0.31	1.77	0.22	2.09	1.34	3.57	0.0001	1.19	0.56
	CD (5%)	2.28	2.03	2.77	0.72	1.02	0.91	5.12	0.64	6.07	3.89	10.37	0.0003	3.45	1.63
	CV (%)	2.91	1.44	2.58	23.58	6.4	12.67	9.21	7.13	7.51	4.12	2.69	2.7700	3.85	8.53

DF : Days to 50% flowering; DM : Days to maturity; PH : Plant height; NBP : No. of branches per plant; NCP : No. of clusters per plant; NPC : No. of pods per cluster; NPP : No. of pods per plant; HSW : Hundred seed weight; HI : Harvest Index; SCMR : SPAD Chlorophyll Meter Reading; SLA : Specific Leaf Area; SLW : Specific Leaf Weight; RI : Relative Injury; SYP : Seed Yield per plant

CONCLUSION

Considering *per se* performance of parents MGG 390, AKM-9904, LM 95, ML-267 and EC 362096 were adjudged as the best parents and crosses involving these parents may throw desirable segregants for both yield attributing and drought related characters. As seed yield is the important trait to be improved, selection of these crosses involving the above parents such as MGG-390 × LM-95, LM-95 × EC-362096 and ML-267 × LGG-528 would be effective for genetic enhancement of yield and its components along with drought tolerant traits.

REFERENCES

1. Arumugam Pillai, M., Anandhi, K. and Selvi, B., Stability analysis of yield in black gram. *Legume Research*. **33(1):** 70-71 (2010).
2. Fisher, R.A. and Yates, F., Statistical tables for biological agriculture and medical research, 6th edition, Oliver and Boyd Ltd., Edinburgh. (1967).
3. Khalil, S.I., El-Bassiouny, H.M.S., Hassanein, R.A., Mostafa, H.A., EI-Khawas, S.A. and Abd El-Monem, A.A., Antioxidant defence system in heat shocked wheat plants previously treated with arginine or putrescine. *Australian Journal of Basic Applied Sciences*. **3(3):** 1517-1526 (2009).
4. Nageswara Rao, R.C., Talwar, H.S. and Wright, G.C., Rapid assessment of specific leaf area and leaf nitrogen in peanut (Arachis hypogaea L.) using chlorophyll meter. *Journal of Agronomy and Crop Science*. 186(3): 175-182 (2001).
5. Panse, V.G. and Sukhatme, P.V., *Statistical methods for agricultural workers.* 4th Edition ICAR, New Delhi. (1985).
6. India stat. www.*Indiastat.com*, 2016-17