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Evaluation of Cowpea Genotypes for Quantitative, Yield, Chlorophyll and NDVI status at Eastern Dry Zone of Karnataka

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ABSTRACT: Cowpea is one of the important legume crop having higher amounts of proteins, calories, minerals and vitamins. Currently cultivating varieties are less productive in tropics and sub tropics. The development and use of potential cultivars offer a simple and cost effective method to produce higher yield with less inputs. Hence, field experiment on cowpea genotypes for growth, yield, chlorophyll and NDVI status was carried out at eastern dry zone of Karnataka, ZARS, University of Agricultural Sciences, GKVK, Bangalore, INDIA from July 2021 to November 2021. There were 55 cowpea genotypes including five checks were evaluated in randomized complete block design with three replications. The results of the field experiment showed that, significant differences among all the cowpea genotypes for all the quantitative traits, yield parameters, Chlorophyll and NDVI status. The grain yield was ranged from 737 to 2650 kgha^{-1}. Significantly higher grain yield was recorded by IC-219489 (2650 kg ha^{-1}) over other genotypes and which was on par with C-152, IC-402175, NBC-42, KBC-2, IC-402135, IC-462099 and IC-422174 (2544, 2507, 2458, 2409, 2286, 2208 and 2189 kg ha^{-1}, respectively) genotypes. Higher yield of IC-219489 genotype was mainly due to production of more trifoliate leaves (38), more SPAD chlorophyll content (50.9 and 79.67 at 30 and 60 days after sowing, respectively) and NDVI (0.69 and 0.74 at 30 and 60 days after sowing, respectively) which were helped in accumulating more solar energy in terms of higher seed weight (22.09 g plant^{-1}) and 100 seed weight (14.25 g).

Keywords: Cowpea genotypes, NDVI, quantitative traits, SPAD Chlorophyll.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp.), one of the most important food legumes grown and consumed in the arid and semi-arid regions of the world. Its grain contains higher amounts of essential nutrients *viz.*, calcium (826 mg/kg) and iron (53.2 mg/kg) than that of meat, fish and egg which are very useful in blood cholesterol reduction (Rangel *et al*., 2003, Achuba, 2006 and Boukar *et al*., 2019). Its grain also contains protein to the tune of 250 mg/g, zinc (38.1 mg/kg), and magnesium (1915 mg/kg) (Boukar *et al*., 2019). Young and succulent leaves and pods are used as cooked vegetable, while the grains are ground and processed into powder for making thick porridge, gravy or sometimes consumed as a boiled delicacy (Silva, 2018). It can be used as an important companion crop in mixed cropping systems to suppress weed infestation and to enhance soil fertility by fixing around 70 to 350kg/ha of atmospheric nitrogen through symbiosis with the root nodule bacteria *Rhizobium* (Meena *et al*., 2015). It is cultivating under low soil fertility and dry-land conditions as the most resilient legume crop in India. Cowpea growth pattern, seed maturity period is extremely diverse and more complex than other crops. Globally it is cultivated in 14.5 million hectares with the production of 6.5 million tons per annum (FAO 2018). In India, the mean grain yields of cowpea is between 249 to 980kg/ha which is far less than the potential yield 3t per hectare elsewhere (Molosiwa *et al*., 2016). A major constraint to achieve this production of cowpea grains in the tropics and sub tropics is lack of high yielding cultivars and poor cultivation practices. Therefore, development of best performing, locally adaptable potential cultivars offer a simple and cost

effective method to produce higher yield with less inputs for sustainable production. With this background, the present study was undertaken to evaluate the performance of 55 cowpea genotypes for their quantitative traits, yield, Chlorophyll content and NDVI status at eastern dry zone of Karnataka.

MATERIALS AND METHODS

A. Experimental Location and Source of Cowpea Genotypes

Field experiment was carried out at Zonal Agricultural Research Station, University of Agricultural Sciences, GKVK, Bangalore, Karnataka state, India. The field study was conducted at the "L" block of Krishimela demo unit from July 2021 to November 2021. The experimental site is situated in the Eastern Dry Zone (Zone-5) which is located between 12º 51' N Latitude and 77º 35' E Longitude at an altitude of 930 m above mean sea level (MSL). The experiment was done with the aim of identifying the cowpea genotypes for higher growth, yield parameters, Chlorophyll and NDVI content. Totally 55 genotypes mentioned in the results tables were collected from All India Coordinated Research Project on Arid Legumes, Bangalore centre and used for the study.

B. Soil and its characteristics

The experimental soil was red sandy clay loam. The methodology adopted for assessing soil physical and chemical properties are furnished in Table 1. The moisture content at field capacity was 24.63 per cent with a bulk density of 1.39 g cc^{-1}. The experimental site was slightly acidic in nature (pH 6.12) with medium electrical conductivity (0.23dS m^{-1}) and organic carbon content was low (0.42%). It had medium available nitrogen (283.0 kg ha^{-1}), phosphorus (55.5 kg ha^{-1}) and potassium (238.6 kg ha^{-1}) status.

Table 1: Methods adopted for assessing soil physical and chemical properties and values recorded.

Soil property	Value	Method followed
1. Coarse Sand (%)	33.30	International pipette method (Piper, 2002)
2. Fine sand (%)	36.30	
3. Silt (%)	07.40	
4. Clay (%)	23.00	
5. Soil textural class	**Red sandy clay loam**	
6. Field capacity (%)	24.63	Field method (Colmann, 1954)
7. Permanent wilting point (%)	7.05	Field method (Richards, 1954)
8. Bulk density (g cc^{-1})	1.39	Core sampler (Piper, 2002)
9. pH (1:2.5)	6.12	Potentiometry (Jackson, 1973)
10. EC (1:2.5) (dSm^{-1})	0.23	Conductometry (Jackson, 1973)
11. Organic carbon (%)	0.42	Wet oxidation method (Walkley and Black, 1934)
12. Available nitrogen (kg ha^{-1})	283.0	Microkjeldahl distillation (Subbiah and Asija,1956)
13. Available Phosphorous (kg ha^{-1})	55.5	Spectrophotometry (Jackson, 1973)
14. Available Potassium (kg ha^{-1})	238.6	Flame photometry (Jackson,1973)

Normal climatic conditions. The normal annual rainfall of the station was 920 mm and the major part of rain was received between May to October and maximum rainfall was received during September and October. The normal mean minimum air temperature ranged between 14.0°C to 20.5°C Whereas, normal mean maximum air temperature ranged from 26.3°C to 33.8°C. The normal mean sunshine hours varied from 4.4 to 9.6 hours and normal mean monthly maximum relative humidity ranged from 76 to 90.0 per cent.

C. Experimental Design and Procedure

During June 2021, the land was ploughed with tractor drawn cultivator followed by passing rotovator to bring the soil to fine tilth. Totally 165 plots each plot measured 1.5 m × 1.8 m. An alley of 1 m was left between plots. The experiment was laid out in a randomized complete block design (RCBD) and replicated three times. Farmyard manure @ 10 t ha^{-1} was applied and mixed into the soil 15 days prior to sowing. Shallow furrows spaced at 45 cm apart were opened using marker. Recommended dose of 25kg N, 50 kg P_2O_5 and 20 kg K_2O were applied using DAP, urea and MoP as fertilizer source. Two cowpea seeds per spot were dibbled at 15 cm interval in the furrows on 27th July 2021. The seeds were covered with soil and gently compacted. Gap filling was done 10 days after sowing to ensure required population. Pendimethalin @ 1kg a.i ha^{-1} was sprayed as pre-emergence application on second day after sowing and hand weeding once at 25 DAS followed by earthing up at 40 DAS was done for effective control of weeds and to provide favourable environment.

The plant height was measured from ground level to the tip of the main stem of randomly selected plants at harvest; the average height was computed and expressed in centimeters. Number of branches, trifoliate leaves and nodes were counted from randomly selected plants at harvest and their average was worked out as numbers per plant. The yield parameters *viz.*, days

taken for 50 per cent flowering, petiole length, peduncle length, number of pods per plant, pod length, seed weight per plant, 100 seed weight, seed yield and haulm yield were recorded at harvest. Days to 50 per cent flowering was judged when 50 per cent of plants in net plot area flowered based on visual assessment and recorded in days. The pods were separated from the haulm when they turn brownish and dried in sun till they attain 10-12 % moisture.

Leaf chlorophyll content and NDVI status. Leaf chlorophyll content was measured at 30 and 60 DAS by using 'SPAD 502 plus' designed at LICOR, Ins. The SPAD 502 values recorded from randomly selected plants represent the chlorophyll content of the leaf. The GreenSeeker handheld optical sensor was used to measure NDVI from the crop canopy. The sensor angle was adjusted in such a way that it was parallel to sensing area at a height of about 60 cm above the canopy. The relative strength of the detected light is a direct indicator of the density of the foliate in the sensor's view. The higher the density and more vigorous the plant, the greater is the difference between the reflected light signals. The sensor displayed the measured value on its LCD.

D. Statistical analysis

The experimental data recorded were subjected to statistical analysis adopting Fisher's method of analysis of variance as outlined by Gomez and Gomez (1984). Critical difference (CD) values are given in the table at 5 per cent level of significance.

RESULTS AND DISCUSSION

A. Growth and Yield Performance of Cowpea Genotypes

The data pertaining to plant height, number of branches, trifoliate leaves and nodes per plant of cowpea genotypes are presented in Tables 2. Mean plant height ranged from 45.0 to 75.0 cm and there were significant differences in plant height. Among the various cowpea genotypes, IC-402164 recorded the significantly taller plants (75.0 cm) at physiological maturity over other genotypes and which was on par with EC-170584-1-1, EC-394708, IC-422174, IC-402175 and IC-219489 (74.0, 72.0, 72.0, 71.9 and 70.7 cm, respectively). Similarly, number of branches, trifoliate leaves and nodes per plant were ranged from 4.0 to 10.0, 18 to 49 and 4.4 to 7.9, respectively. Significantly higher number of branches (10.0) and trifoliate leaves (49) were noticed in NBC-16 genotype. Whereas, nodes per plant were found non-significant.

There was a positive relation between the leaves number and photosynthetic capability of plants. More number of leaves, greater in turn produces more leaf area and thus contributes to the additional photosynthetic ability of the plant. A higher rate and quantity of photosynthesis in turn decide the dry matter synthesis and its accumulation in different parts and finally result in higher yield.

The data pertaining to yield parameters and yield of cowpea genotypes are presented in Tables 3 and 4. The number of days taken to 50% flowering varied significantly from 48.3 to 58.3 days. IC-462099 genotype took significantly more days for 50% of the plants to flower compared to the other cowpea genotypes. The least number of days taken for 50% flowering was 48.3 days by IC-402162 and CIG-3 genotypes. Lengthy petiole (19.8 cm) was found in IC-603187 over other genotypes and least length of 8.9 cm was recorded in EC-438480 genotype. Similarly, larger peduncles (47.0 cm) was observed in IC-202781 and lesser peduncle length was noticed in IC-249593 (26.7 cm). There were significant differences in the number of pods produced per plant for the cowpea genotypes. IC-402175 produced significantly more pods per plant (67.8 pods) than the other genotypes, with the exception of IC-402162, IC-402164, C-331 and IC-219489 which were recorded 67.0, 67.07, 65.67 and 65.0 pods, respectively. In general, higher the number of pods/ plants more pod yield is obtained but some of the scientists reported that, fruit size (length and diameter) and weight of individual pod is also determining factor for yield estimation. Pandey and Singh (2011) also reported the significant variation in number of pods per plant among the different varieties of cowpea, which is similar in the present experiment.

Pod length was ranged from 8.4 cm (IC-462099) to 18.9 (IC-219489). NBC-44 produced significantly the heaviest 100-seed weight (15.64 g). The least 100-seed weight was produced by IC-402162 (4.47 g). Magashi *et al.* (2014) reported that pod length varied from 13.77 cm to 16.50 cm under Nigerian condition.

Significantly higher grain yield was recorded by IC-219489 (2650 kg ha^{-1}) over other genotypes and which was on par with C-152, IC-402175, NBC-42, KBC-2, IC-402135, IC-462099 and IC-422174 (2544, 2507, 2458, 2409, 2286, 2208 and 2189 kg ha^{-1}, respectively) genotypes.

Chlorophyll and NDVI content in Cowpea Genotypes

Chlorophyll content and Normalized Difference Vegetation Index are a measure of greenness of leaves and total biomass which could be used for mid-season prediction of final grain yield. Tables 5 present the results of Chlorophyll content (SPAD readings) and green seeker readings of cowpea genotypes. Higher yield of IC-219489 genotype was due to more SPAD chlorophyll content (50.9 and 79.67 at 30 and 60 days after sowing, respectively) and NDVI values (0.69 and 0.74 at 30 and 60 days after sowing, respectively) which intern resulted in accumulating more solar energy in terms of higher seed weight (22.09 g $plant^{-1}$) and 100 seed weight (14.25 g).

Table 2: Growth parameters of cowpea as influenced by genotypes.

Sr. No.	Genotypes	Plant height (cm)	Branches per plant	Trifoliate leaves per plant	Nodes per plant
1	C-24-1	60.00	7.70	48.00	6.90
2	C-331	60.00	8.00	36.00	5.30
3	EC-170584	55.00	7.00	28.00	6.90
4	EC-170584-1-1	74.00	6.70	32.00	7.60
5	EC-2591054	59.00	7.70	42.00	6.90
6	EC-394708	72.00	7.00	36.00	7.00
7	EC-394779	68.00	8.00	36.00	6.40
8	EC-394839	60.00	8.30	32.00	6.60
9	EC-458402	52.00	6.00	23.00	6.60
10	EC-458418	65.00	6.70	18.00	7.20
11	EC-458438	56.00	6.30	38.00	7.90
12	EC-458440	50.00	7.00	42.00	4.80
13	EC-458469	55.00	6.70	26.00	6.40
14	EC-438480	57.00	7.70	27.00	4.40
15	EC-458473	50.00	6.70	25.00	5.30
16	EC-458480	45.00	7.00	42.00	5.40
17	EC-458490	58.00	5.70	22.00	7.20
18	EC-472250	57.40	7.00	32.00	6.90
19	EC-472252	45.90	6.30	48.00	4.60
20	EC-472257	70.00	8.70	38.00	6.40
21	IC-4506	60.00	5.70	34.00	7.80
22	IC-101171	62.00	6.30	36.00	6.70
23	IC-202104	55.00	6.70	28.00	5.90
24	IC-202781	65.90	6.30	32.00	7.40
25	IC-219489	70.70	7.70	48.00	7.00
26	IC-249588	54.00	7.30	28.00	5.70
27	IC-249593	48.00	6.30	26.00	7.20
28	IC-2591054	52.00	6.00	18.00	6.30
29	IC-330996	65.00	5.30	24.00	7.20
30	IC-402048	70.00	9.00	38.00	7.70
31	IC-402090	58.00	7.70	36.00	5.90
32	IC-402135	65.90	8.30	32.00	7.10
33	IC-402154	46.00	6.30	36.00	5.60
34	IC-402162	67.00	7.00	42.00	5.60
35	IC-402164	75.00	8.00	42.00	6.20
36	IC-402175	71.90	6.70	26.00	7.30
37	IC-402182	50.00	7.00	21.00	3.00
38	IC-422174	72.00	8.00	38.00	7.40
39	IC-462099	55.00	6.30	22.00	5.00
40	IC-603187	70.00	7.70	48.00	6.90
41	NBC - 8	55.00	5.30	22.00	5.40
42	NBC - 16	60.00	9.00	49.00	7.00
43	NBC - 39	62.00	8.00	25.00	6.40
44	NBC - 41	60.00	6.70	48.00	6.10
45	NBC - 42	62.00	6.00	30.00	6.30
46	NBC - 44	45.00	5.30	18.00	5.20
47	V - 16	66.00	7.00	38.00	6.30
48	V - 578©	54.00	7.30	42.00	7.60
49	V - 585	57.00	5.70	28.00	5.90
50	VC - 458492	67.90	4.00	35.00	6.00
51	VC - 604-7-29-3	59.70	5.00	23.00	5.80
52	Check KBC - 2	68.00	8.00	36.00	6.90
53	Check KBC - 9	66.00	7.70	28.00	6.80
54	Check C - 152	70.00	8.70	35.00	6.80
55	Check CIG - 3	53.90	8.00	34.00	7.90
	S. Em ±	**1.55**	**0.41**	**0.88**	**0.83**
	CD (*p*=0.05)	**4.33**	**1.14**	**2.47**	**NS**

Table 3: Yield parameters as influenced by cowpea genotypes.

Sr. No.	Genotypes	Days to 50% flowering	Petiole length (cm)	peduncle length (cm)	Number of pods per plant	pod length (cm)
1	C-24-1	50.7	12.4	29.3	15.67	12.00
2	C-331	50.0	16.9	29.0	65.67	14.30
3	EC-170584	48.7	12.5	29.0	21.33	17.10
4	EC-170584-1-1	51.0	16.5	37.7	31.67	14.40
5	EC-2591054	50.7	16.6	37.7	51.00	16.40
6	EC-394708	49.3	16.8	40.3	45.00	15.30
7	EC-394779	48.7	13.4	33.3	36.67	17.20
8	EC-394839	49.7	13.8	38.3	54.67	17.60
9	EC-458402	52.0	16.8	41.3	56.33	18.80
10	EC-458418	50.3	16.8	32.0	24.33	13.90
11	EC-458438	49.7	13.8	29.7	19.00	12.10
12	EC-458440	49.3	13.8	38.0	50.33	15.10
13	EC-458469	49.7	15.8	39.0	42.67	15.00
14	EC-438480	51.3	8.9	44.3	36.00	11.80
15	EC-458473	50.3	12.8	31.3	22.00	14.80
16	EC-458480	49.7	11.4	32.3	31.67	13.10
17	EC-458490	50.0	12.7	33.3	36.00	14.80
18	EC-472250	54.7	11.9	42.3	36.00	15.20
19	EC-472252	53.0	12.9	41.7	41.00	15.70
20	EC-472257	51.0	15.8	41.0	49.67	14.80
21	IC-4506	49.7	15.2	40.0	43.33	13.40
22	IC-101171	50.3	16	37.7	53.33	16.10
23	IC-202104	50.0	15.7	35.7	45.00	18.50
24	IC-202781	51.3	14.8	47.0	53.00	16.80
25	IC-219489	50.9	18.6	45.0	65.00	18.90
26	IC-249588	49.7	16.8	37.7	16.00	16.00
27	IC-249593	54.0	15.1	26.7	19.33	14.10
28	IC-2591054	50.7	12.1	39.7	19.00	21.70
29	IC-330996	53.3	17.4	26.0	50.67	18.00
30	IC-402048	51.3	14.8	39.7	55.33	19.20
31	IC-402090	50.3	16.4	38.7	63.00	17.70
32	IC-402135	51.3	14.2	30.0	48.33	15.60
33	IC-402154	51.0	12.4	34.3	39.87	13.90
34	IC-402162	48.3	10.2	35.3	67.07	15.40
35	IC-402164	53.3	18.7	43.0	67.00	19.10
36	IC-402175	48.0	15.7	36.3	67.80	16.10
37	IC-402182	54.3	13	34.7	15.67	12.20
38	IC-422174	51.0	14.9	44.0	67.47	15.30
39	IC-462099	58.3	11	42.3	9.07	8.40
40	IC-603187	50.3	19.8	40.0	59.47	14.80
41	NBC - 8	53.0	12.4	44.0	15.20	13.60
42	NBC - 16	51.3	17.2	34.0	26.40	14.30
43	NBC - 39	50.3	12.8	40.3	23.67	17.50
44	NBC - 41	51.3	12.9	28.0	45.00	14.40
45	NBC - 42	51.0	14.9	32.0	63.07	15.50
46	NBC - 44	55.0	11.4	39.0	18.60	15.70
47	V - 16	52.0	17.8	41.0	63.27	17.00
48	V - 578©	50.7	15.1	41.0	53.47	14.20
49	V - 585	55.0	15.7	36.7	25.53	16.20
50	VC - 458492	53.0	18.6	45.0	60.73	15.40
51	VC - 604-7-29-3	50.0	11.5	33.3	51.67	13.30
52	KBC – 2©	51.3	16.6	32.3	65.07	18.00
53	KBC – 9©	50.3	16.8	35.3	26.07	16.70
54	C – 152©	49.3	17.7	37.0	20.27	14.20
55	CIG – 3©	48.3	11.9	32.3	33.33	14.20
	S. Em ±	**0.93**	**0.24**	**0.90**	**1.22**	**0.77**
	CD (*p*=0.05)	**2.61**	**0.66**	**2.52**	**3.42**	**2.16**

Table 4: Yield of cowpea genotypes.

Sr. No.	Genotypes	Seed weight (g plant^{-1})	100 seed weight (g)	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest Index (H.I)
1	C-24-1	12.53	8.44	1503	2559	0.37
2	C-331	12.62	10.29	1514	2495	0.38
3	EC-170584	10.79	9.96	1294	2353	0.35
4	EC-170584-1-1	16.29	7.55	1954	3120	0.39
5	EC-2591054	16.62	8.89	1995	3095	0.39
6	EC-394708	12.49	8.44	1498	2411	0.38
7	EC-394779	16.06	9.67	1927	3172	0.38
8	EC-394839	14.28	12.83	1713	2773	0.38
9	EC-458402	12.46	10.18	1495	2280	0.40
10	EC-458418	12.96	7.97	1556	2456	0.39
11	EC-458438	13.39	7.73	1607	2450	0.40
12	EC-458440	16.04	6.96	1924	2939	0.40
13	EC-458469	8.67	10.25	1040	1586	0.40
14	EC-438480	13.93	7.09	1672	2777	0.38
15	EC-458473	6.14	7.17	737	1421	0.34
16	EC-458480	9.03	7.09	1084	1922	0.36
17	EC-458490	11.17	7.97	1340	2397	0.36
18	EC-472250	10.88	10.90	1306	2156	0.38
19	EC-472252	12.82	12.10	1538	2541	0.38
20	EC-472257	18.23	9.42	2188	3619	0.38
21	IC-4506	11.56	7.77	1388	2269	0.38
22	IC-101171	20.87	7.33	2504	4071	0.38
23	IC-202104	18.05	8.69	2166	3610	0.37
24	IC-202781	15.63	9.17	1876	3151	0.37
25	IC-219489	22.99	14.25	2650	4365	0.38
26	IC-249588	12.35	9.56	1482	2463	0.38
27	IC-249593	14.78	8.02	1774	2917	0.38
28	IC-2591054	12.07	6.43	1448	2372	0.38
29	IC-330996	16.49	8.40	1979	3257	0.38
30	IC-402048	16.46	9.38	1975	3269	0.38
31	IC-402090	11.64	9.60	1396	2284	0.38
32	IC-402135	19.05	8.77	2286	3489	0.40
33	IC-402154	7.31	7.67	878	1339	0.40
34	IC-402162	13.91	4.47	1669	2549	0.40
35	IC-402164	12.53	8.82	1504	2369	0.39
36	IC-402175	20.89	6.76	2507	4002	0.39
37	IC-402182	12.03	7.20	1444	2370	0.38
38	IC-422174	18.16	7.49	2180	3558	0.38
39	IC-462099	18.4	10.45	2208	3762	0.37
40	IC-603187	12.51	8.23	1501	2459	0.38
41	NBC - 8	13.48	16.14	1618	2647	0.38
42	NBC - 16	9.59	8.66	1150	1839	0.38
43	NBC - 39	18.04	9.26	2165	3444	0.39
44	NBC - 41	14.09	6.84	1691	2730	0.38
45	NBC - 42	20.49	8.39	2458	3840	0.39
46	NBC - 44	15.08	15.61	1810	2954	0.38
47	V - 16	12.92	8.01	1550	2491	0.38
48	V - 578©	10.88	6.92	1306	2198	0.37
49	V - 585	11.67	7.99	1400	2412	0.37
50	VC - 458492	10.92	11.18	1310	2235	0.37
51	VC - 604-7-29-3	13.03	10.53	1564	2593	0.38
52	KBC – 2©	20.08	8.79	2409	3677	0.40
53	KBC – 9©	17.67	9.40	2121	3378	0.39
54	C – 152©	21.2	7.91	2544	3957	0.39
55	CIG – 3©	17.68	9.43	2121	3320	0.39
	S. Em ±	**1.41**	**0.02**	**164.1**	**227.2**	-
	CD (*p*=0.05)	**3.95**	**0.06**	**460.7**	**638.0**	-

Table 5: SPAD Chlorophyll content and NDVI values of cowpea genotypes at 30 and 60 days after sowing.

Sr. No.	Genotypes	SPAD meter readings		NDVI values	
		30 DAS	60 DAS	30 DAS	60 DAS
1	C-24-1	52.93	77.13	0.52	0.56
2	C-331	52.97	63.00	0.61	0.66
3	EC-170584	57.83	58.13	0.59	0.63
4	EC-170584-1-1	55.73	65.63	0.59	0.63
5	EC-2591054	48.70	54.97	0.69	0.74
6	EC-394708	53.97	71.37	0.52	0.56
7	EC-394779	51.80	62.30	0.54	0.57
8	EC-394839	43.03	54.07	0.61	0.65
9	EC-458402	48.77	52.67	0.60	0.64
10	EC-458418	56.07	67.43	0.58	0.62
11	EC-458438	50.00	56.10	0.61	0.65
12	EC-458440	48.30	73.37	0.34	0.36
13	EC-458469	54.77	62.80	0.45	0.48
14	EC-438480	42.87	56.47	0.27	0.29
15	EC-458473	50.43	55.90	0.43	0.46
16	EC-458480	56.93	62.20	0.62	0.67
17	EC-458490	57.77	66.13	0.59	0.63
18	EC-472250	49.77	57.20	0.30	0.33
19	EC-472252	50.83	61.80	0.35	0.38
20	EC-472257	49.33	59.60	0.64	0.69
21	IC-4506	48.00	61.33	0.64	0.69
22	IC-10171	54.20	72.23	0.69	0.74
23	IC-202104	54.23	65.43	0.56	0.59
24	IC-202781	49.70	74.03	0.71	0.77
25	IC-219489	50.90	79.67	0.64	0.68
26	IC-249588	60.33	59.60	0.58	0.62
27	IC-249593	55.40	60.70	0.57	0.61
28	IC-2591054	52.70	60.90	0.52	0.56
29	IC-330996	48.97	61.83	0.57	0.61
30	IC-402048	48.57	77.07	0.70	0.75
31	IC-402090	48.77	64.30	0.58	0.63
32	IC-402135	57.30	63.43	0.68	0.73
33	IC-402154	53.30	72.63	0.16	0.16
34	IC-402162	52.97	71.73	0.46	0.50
35	IC-402164	48.20	66.03	0.54	0.57
36	IC-402175	54.83	67.10	0.65	0.70
37	IC-402182	46.73	50.97	0.21	0.22
38	IC-422174	47.80	64.60	0.64	0.69
39	IC-462099	41.67	52.87	0.00	0.00
40	IC-603187	51.50	66.70	0.66	0.71
41	NBC - 8	40.97	59.40	0.35	0.37
42	NBC - 16	65.70	73.67	0.58	0.63
43	NBC - 39	45.80	65.53	0.55	0.58
44	NBC - 41	46.70	51.87	0.58	0.62
45	NBC - 42	53.40	57.30	0.64	0.69
46	NBC - 44	48.07	66.90	0.40	0.43
47	V - 16	49.53	61.43	0.68	0.73
48	V - 578 @	43.30	51.77	0.63	0.68
49	V - 585	46.33	58.50	0.53	0.57
50	VC - 458492	55.63	75.03	0.50	0.54
51	VC - 604-7-29-3	49.43	75.27	0.46	0.48
52	KBC – 2©	55.17	67.63	0.67	0.72
53	KBC – 9©	56.10	55.40	0.65	0.70
54	C – 152©	52.50	59.80	0.65	0.70
55	CIG – 3©	54.47	62.80	0.63	0.67
	S. Em ±	**4.02**	**1.63**	**0.09**	**0.09**
	CD (*p*=0.05)	**NS**	**4.57**	**0.24**	**0.26**

CONCLUSION

It could be concluded that IC-219489 genotype found to be the better to get higher grain yield (2650 kg ha^{-1}) with higher SPAD chlorophyll values and NDVI values and next best genotypes for higher yield are C-152, IC-402175, NBC-42, KBC-2, IC-402135, IC-462099.

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