

Full Length Research Paper

Stability analysis of components characters in cowpea (*Vigna unguiculata* (L.) Walp)

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Stability of yield and its attributes were assessed for nineteen genotypes over twelve environments (two seasons 2009 and 2010 × six planting dates), to determine the quantitative responses of cowpea genotypes. The interaction between genotypes and environments (G×E) were significant for all the characters studied characters except pod length, hundred seed weight and weight of pods per plant. The longest pods and heaviest hundred seeds weight were produced by genotype TVU 21, IT82C-116, providing the highest number of seeds per plant. Whereas, Sudany genotypes gave the highest number of pods per plant and heaviest seeds per plant, Blackeye Crowder genotypes had the heaviest pods per plant and total dry seed yield. The best season and planting date are fall season, third planting date (August, 15th) for most studied traits. The stable genotypes were Chinese Red, IT81D1064, IT85F2205 and Sudany for total dry seed yield.

Key words: Sowing dates, stability parameters, genotype × environment, selection, grain yield.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp) is one of the most ancient crops known to man. In Egypt, cowpea is a popular vegetable crop. The total area under cultivation of this crop was estimated at 9155 feddans (feddan= 4200 m²) for dry seed in 2008 with a mean production of 980 kg/fed. Also, the area that produced green pods was 10064 feddans with a mean of 5.19 ton/fed (Department, Agriculture, Statistics, Ministry of Agriculture, Giza, Egypt). Stable performance of cowpea genotypes across contrasting environments is essential for the successful selection of stable and high yielding varieties (Dashiell et al., 1994; Ariyo, 2000; Ahmed et al., 2005; Yousaf and Sarwar, 2008). Combination of genotypes stability with high yield is an important criteria for selecting high yielding and stable genotypes. Therefore, a number of

techniques that simultaneously coupled with high yield and stability of performance have been proposed. The regression technique (Eberhart and Russell, 1966) has been used. In this technique, the response of genotypes to a given environment is considered. G × E cannot be avoided, in fact, it is an important limiting factor for testing the efficiency of any breeding programme. The occurrence of large genotype × environment (G × E) interaction affects the recommendations of the breeders in selecting genotypes for specific environment. Genotype × environment analysis is used to provide unbiased estimates of yield and other agronomic characteristics and to determine yield stability or the ability to withstand both predictable and unpredictable environmental variation (Kamdi, 2001).

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Table 1. Source, seed color and growth habit of the tested cowpea genotypes.

Genotype	Seed color	Growth habit
1. Dokii 331	White with black eye	Determinate
2. Kaha 1	Yellowish-white	Determinate
3. Cream 7	Yellowish-white	Determinate
4. IT91K-118-20	Light Brown	Determinate
5. IT93K2045-20	Light Brown	Determinate
6. TVU-21	White with red eye	Indeterminate
7. IT82D-889	Light Brown	Determinate
8. Chinese Reds	Dark Brown	Indeterminate
9. IT81D1064	Dark Brown	Determinate
10. IT85F-2205	Light Brown	Determinate
11. IT90K-1020-6	Light brown	Determinate
12. Blackeye Crowder	White with black eye	Determinate
13. IT82C-16	Dark Brown	Determinate
14. IT82-812	Light Brown	Indeterminate
15. Sudany	Black	Indeterminate
16. Cream 12	Yellowish-white	Determinate
17. Monarch Blackeye	White with black eye	Determinate
18. Azmerly	White with black eye	Determinate
19. Black Crowder	Black	Indeterminate

The regression coefficient (b_i) and genotype mean yield were used together as measure of adaptation (Bilbro and Ray, 2000). Genotype with $b = 1.0$ was considered as adapted to all environments, genotype with $b < 1.0$ was considered adapted for low yielding environments and genotype with $b > 1.0$ was considered as better adapted for high yielding environments, depending upon the genotype mean yield. De Rocha et al. (2007a) found that TE97-321G-4, EVX-92-49E and EVX-63-10E cowpea lines were highly adaptable, but only the last one was highly predictable. The BRS Guariba cultivar as well as EVX-92-49E and TE97-321G-4 lines best expressed their genetic potential in environments of high yield. Taiwo (2007) reported that IT 98K-1111-1, IT 86D-1010, IT 86D-719, IT 93K-452 and IT 97K-503-1 were identified to be of a high fodder yield and stable genotypes performance across performance environment. Ajeigbe et al. (2008) found that IT98K-506-1, IT97K-1113-7, IT97K-1069-6, IT97K-1092-2, IT97K-1069-5, IT98K-131-2 and IT97K-568-18 produced higher grain and fodder yielders than the other varieties. The objective of this investigation were to assess the magnitude of G×E interaction as well as the relative performance and stability of 19 cowpea genotypes under abiotic (heat) stress of Upper Egypt environmental conditions, to identifying the most stable genotypes for this stress.

MATERIALS AND METHODS

Study sites and experimental design

The field experiments were conducted at Faculty of Agriculture Farm, South Valley University, Qena Governorate, Egypt, during

the growing seasons of 2009 and 2010. The material used in this study and sources of the investigated genotypes are shown in Table 1. These nineteen genotypes were evaluated in summer and fall seasons of 2009 and 2010. In each season, the genotypes were arranged in a Randomized Complete Block Design (RCBD) with three sowing dates viz, March, 15th, 30th and April, 15th in the summer seasons of 2009 and 2010, and July, 15th, 30th and August, 15th in the fall seasons of 2009 and 2010. Each genotype was represented by single row and was repeated three times, the length of the row was 3 m, 60 cm apart and plants spaced 20 cm from each other. Then, different agricultural production practices that is, fertilization and pest management were applied as per the commercial cowpea production in Egypt.

Data collection

The measured traits included

- (1) Pod length (cm): Ten normal and fully dry pods for each genotype from each plot were taken to determine dry pod length and the average were recorded.
- (2) Number of pods/plant: Average pod number of ten plants for each genotype from each plot was estimated.
- (3) Number of seed per pod: Recorded from 10 pods per plant at harvesting time and the average was estimated.
- (4) Hundred seed weight (gram): Average weight of the ten samples for each genotype in each plot was determined.
- (5) Average seed weight/plant (gram): Ten plants from each genotype were taken from each plot to determine the weight of seeds/plant (gram) and the average was recorded.
- (6) Average pod weight (gram): Ten normal and fully dry pods for each genotype from each plot were taken to determine dry pod weight and the average were recorded.
- (7) Total dry seed yield (ton/fed.): Estimated as the weight of the dry seed per plot.

Data from all plots were subjected to analysis of variance (Steel and Torrie, 1980). Stability parameters were worked out according to (Eberhart and Russell, 1966).

Table 2. Means of pod length of the nineteen genotypes under twelve environments.

Genotype	Pod length (cm)												
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	Mean
Dokii 331	13.73	12.50	14.8	13.33	12.43	14.40	14.10	14.70	14.80	13.43	14.97	15.47	14.06
Kaha 1	12.73	12.63	14.00	12.33	11.77	12.40	13.10	13.70	13.47	13.94	14.05	14.05	13.18
Cream 7	15.4	15.17	16.47	15.00	15.10	14.73	15.77	16.37	16.13	16.00	17.00	17.00	15.85
IT91K118-20	10.97	11.73	12.57	12.17	12.33	11.57	12.70	12.20	13.97	11.90	12.00	12.23	12.20
IT93K2045-20	14.00	13.86	15.00	14.14	14.07	14.80	14.80	15.00	15.77	15.20	15.90	15.57	14.84
TVU 21	18.40	17.90	19.40	18.00	17.97	18.20	17.10	17.50	18.47	18.83	19.00	19.80	18.38
IT81D-889	15.20	14.63	16.27	14.80	14.57	15.87	15.70	15.50	15.60	16.23	17.00	16.63	15.67
Chinese Red	12.13	11.60	13.20	11.73	11.53	12.80	13.47	13.10	13.87	13.13	13.33	13.87	12.81
IT81D1064	12.80	12.67	13.87	12.40	12.60	13.47	14.27	13.77	15.87	14.37	15.50	14.50	13.84
IT85F2205	13.63	13.13	14.70	13.23	13.07	14.30	14.85	14.98	15.30	14.50	15.80	15.37	14.41
IT90K1020-6	11.07	11.50	12.13	10.67	11.10	11.73	11.93	12.03	13.80	11.93	12.67	12.80	11.95
Blackeye Crowder	12.73	11.50	13.80	12.33	12.43	13.40	13.77	13.70	14.80	13.10	14.40	14.47	13.37
IT82C-16	17.73	16.50	18.80	17.33	16.77	18.40	18.00	17.10	18.17	18.10	19.60	19.47	18.00
IT82- 812	12.20	11.60	13.27	11.80	12.20	12.87	14.53	13.37	13.93	13.73	13.37	13.93	13.07
Sudany	11.00	9.53	10.00	9.67	9.93	9.17	10.43	10.73	10.80	11.43	12.23	12.00	10.58
Cream 12	15.73	14.50	16.8	15.33	14.43	16.40	15.63	16.00	16.30	16.03	16.63	17.17	15.91
Monarch Blackeye	10.90	10.17	11.97	10.50	10.10	11.57	11.93	11.87	12.63	12.27	12.60	12.63	11.60
Azmerly	15.73	15.50	16.8	15.33	15.43	16.40	14.90	15.70	16.07	16.13	16.57	17.17	15.98
Black Crowder	15.07	14.17	16.13	14.67	14.10	15.73	15.00	15.37	16.00	15.40	16.00	16.40	15.34
Environmental mean	13.74	13.20	14.74	13.41	13.26	14.12	14.31	14.35	15.04	14.51	15.19	15.29	14.26

E1 = Summer season 2009, First date E5 = Fall season 2009, Second date E9 = Summer season 2010, Third date, E2 = Summer season 2009, Second date, E6 = Fall season 2009, Third date, E10 = Fall season 2010, First date, E3 = Summer season 2009, Third date E7 = Summer season 2010, First date E11 = Fall Third 2010, Second date E4 = Fall season 2009, First date E8 = Summer season 2010, Second date E12 = Fall Third 2010, Third date.

RESULTS AND DISCUSSION

The combined analysis variance (Table 9) revealed that highly significant differences among genotypes (G), environments (E) as well as interaction between genotypes and environments (G×E) for most of the studied traits. These results indicated that cowpea genotypes responded differently to the diverse environmental conditions, differences were due to the genetic variations among genotypes and environmental factors and

climatic conditions, among others. Similar results were obtained by Teixeira et al. (2007) and Akande and Balogun (2009). The mean response of each trait is outlined below.

Pod length (cm)

The mean performance of genotypes is presented in Table 2. The average pod length of the 19 genotypes over all environments ranged from

18.38 cm (TVU 21) to 10.58 cm (Sudany). The delay in planting date increased the fresh pod length in all seasons. These results agree with those reported by Ali et al. (2004) and Rashwan (2010) who found that the delay in plating date until Dec. 15 increased the fresh pod length. Partitioning the genotype × environment interaction mean square (Table 10) that (G×E) mean squares were estimated with insignificant value. The stability parameters (\bar{x} , b_i and s^2_d) of the individual genotypes are illustrated in Table 11.

Table 3. Means of number of seeds per pods of the nineteen genotypes under twelve environment.

Genotype	Number of seeds per pods												Mean
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	
Dokii 331	9.33	10.00	10.00	9.33	10.33	10.00	10.67	11.00	10.33	10.33	11.00	10.67	10.25
Kaha 1	7.67	8.67	8.33	7.67	8.67	8.33	9.67	9.33	8.33	8.33	10.33	8.33	8.64
Cream 7	11.00	12.00	12.33	11.00	12.00	12.33	12.67	10.00	11.00	11.33	10.67	11.00	11.44
IT91K118-20	8.00	10.33	11.00	10.33	11.00	11.33	12.00	11.33	11.33	11.33	10.33	11.33	10.81
IT93K2045-20	10.33	11.33	12.00	11.67	11.33	12.00	10.67	9.00	10.00	10.67	10.67	10.67	10.86
TVU 21	10.67	11.67	10.67	10.67	11.33	10.67	12.67	11.33	12.00	12.00	10.67	12.00	11.36
IT81D-889	9.33	10.33	9.00	9.33	10.67	9.00	11.00	11.00	11.00	11.00	10.00	11.00	10.22
Chinese Red	8.33	9.33	8.00	8.33	10.00	8.00	11.00	10.00	10.00	10.33	10.00	10.33	9.47
IT81D1064	8.33	9.33	8.67	8.33	9.33	8.67	9.33	8.33	9.00	9.67	9.00	9.33	8.94
IT85F2205	8.33	9.33	8.67	8.33	9.33	8.67	10.33	8.00	9.33	9.67	10.00	10.33	9.19
IT90K1020-6	7.67	8.33	9.00	7.67	9.33	9.00	11.00	10.33	11.00	9.33	9.33	8.67	9.22
Blackeye Crowder	10.33	9.33	10.67	10.33	10.67	10.67	12.67	12.67	13.33	11.00	9.67	11.33	11.06
IT82C-16	12.67	13.67	13.67	12.67	13.67	13.67	9.33	9.00	9.33	13.00	12.00	13.00	12.14
IT82- 812	8.33	9.33	9.00	8.33	9.33	9.00	10.33	9.33	10.00	10.33	9.00	9.67	9.33
Sudany	9.33	7.67	7.67	9.00	8.00	8.33	9.33	10.00	10.67	9.67	8.67	9.67	9.00
Cream 12	11.00	11.33	12.00	7.33	12.00	12.00	11.67	12.33	8.00	11.33	11.33	11.33	10.97
Monarch Blackeye	7.67	8.67	7.67	7.67	8.67	7.67	11.33	10.00	10.67	9.67	11.33	9.67	9.22
Azmerly	9.33	10.33	10.33	9.33	10.33	10.33	11.33	11.00	11.33	10.33	11.00	10.67	10.47
Black Crowder	10.33	11.33	11.00	10.33	11.33	11.33	11.33	11.00	11.33	11.33	12.00	11.67	11.19
Environmental mean	9.37	10.12	9.98	9.35	10.39	10.05	10.96	10.26	10.42	10.56	10.37	10.56	10.20

11. All genotypes except IT85F2205 and Monarch Blackeye exhibited non significant stability parameters from unity and zero for regression coefficient (b_i) and deviation from regression (s^2_d), respectively. The genotypes IT91K118-20, Sudany and Kaha 1 appeared to be stable and exhibited below average response to different environments, ($b_i < 1$) their genotypes were considered to perform relatively better in less favorable environments. The genotypes Cream 7, TVU 21, IT81D-889 and Azmerly could be considered good inserted gave a pod length more than the overall of average genotypes besides their stability. The genotypes IT93K2045-20,

Black Crowder, Azmerly and IT81D-889 might be considered superior, because they should be the tallest pod length when compared with the average overall genotypes besides their stability. Similar results were reported by Akande and Balogun (2009), Teixeira et al. (2007) and Sarutayophat et al. (2007).

Number of seeds per pod

Results in Table 3 showed that average number of seeds per plant of genotypes overall environments ranged from 12.14 (IT82D-16) to

8.64 seeds per pods for genotype (Kaha 1), with an average of (10.20) seeds per pods for all genotypes. These are in accordance with the finding of Rajput (1994) who observed that sowing on 10th March recorded significantly more number of pods per plant (16.0), seeds per pod (13.2), seed yield (12.1 q ha⁻¹), stover yield (24.7 q ha⁻¹) and harvest index (34.5%) compared to sowing in 18th February and 30th March. The highest number of seeds per pod was that of genotype IT82D-16, in the third planting date (August 15th and April 15th) at two seasons (summer and fall), while, the lowest was for genotypes Kaha 1, in the first planting date in fall season (July, 15th).

Table 4. Means of number of pods per plant traits of the nineteen genotypes under twelve environments.

Genotype	Number of pods per plant												Mean
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	
Dokii 331	54.33	54.67	56.33	55.67	57.33	56.00	53.33	53.67	54.67	57.00	58.67	57.67	55.78
Kaha 1	34.00	34.67	36.33	34.67	37.00	35.67	31.67	32.00	33.00	35.33	38.67	38.67	35.14
Cream 7	53.67	55.00	55.33	54.67	56.67	55.00	52.00	52.33	53.33	55.67	58.00	57.67	54.94
IT91K118-20	48.33	49.33	50.33	49.33	51.33	50.00	46.33	46.67	47.67	50.00	53.00	52.67	49.58
IT93K2045-20	41.33	42.33	43.33	42.67	44.33	43.00	40.33	40.67	41.67	44.00	45.67	45.67	42.92
TVU 21	43.00	44.33	44.67	44.00	46.00	44.00	41.67	42.00	43.00	45.33	47.00	46.67	44.31
IT81D-889	37.00	37.33	39.33	38.00	40.33	38.33	36.33	36.67	37.67	40.00	41.33	41.00	38.61
Chinese Red	49.00	50.33	50.67	51.00	52.00	51.00	47.67	48.00	49.00	51.33	54.00	53.33	50.61
IT81D1064	35.67	35.67	38.00	37.67	38.67	38.33	35.00	35.33	36.33	38.67	40.67	39.33	37.44
IT85F2205	44.67	45.33	47.00	45.67	47.67	46.33	44.00	44.33	45.33	47.67	49.33	48.67	46.33
IT90K1020-6	34.67	35.00	38.00	37.00	38.67	38.00	36.33	37.33	37.00	35.33	40.00	39.00	37.19
Blackeye Crowder	62.67	63.33	64.67	64.00	65.33	65.00	61.00	61.67	62.00	63.67	68.00	65.00	63.86
IT82C-16	34.33	35.00	37.67	35.67	38.00	36.67	36.00	36.67	36.67	34.00	38.67	37.67	36.42
IT82- 812	38.33	38.67	41.00	40.33	41.00	41.00	39.00	39.33	40.00	37.67	43.33	41.00	40.06
Sudany	66.33	67.33	67.67	66.67	68.67	67.33	65.67	66.33	66.67	66.67	70.33	67.33	67.25
Cream 12	51.00	51.67	52.67	51.67	53.33	51.67	51.00	51.67	51.67	51.00	54.67	52.67	52.06
Monarch Blackeye	33.67	34.67	35.00	34.67	36.00	35.00	33.33	34.00	34.00	34.00	38.00	35.00	34.78
Azmerly	57.00	57.67	58.67	58.33	59.33	58.33	57.00	57.67	57.67	57.33	61.33	58.67	58.25
Black Crowder	55.67	56.00	57.33	57.00	57.67	57.33	55.67	56.33	56.33	55.33	60.00	57.33	56.83
Environmental mean	46.04	46.75	48.11	47.30	48.91	47.79	45.44	45.93	46.51	47.37	50.56	49.21	47.49

The differences among the tested genotypes (G) were highly significant; also, environmental (E) effect and the interactions between genotypes and environments (G×E) were highly significant as shown in Table 9. Most of this interaction was in a linear function with the environmental values as indicated by greater magnitude of the G×E (linear) mean squares (5.51) in comparison with the estimated value for E+ (G×E) mean squares (3.04), which appeared also highly significant. These results were presented in Table 10. These results appeared to be in harmony with those obtained by Torres et al. (2008) and Akande and Balogun (2009).

The stability parameters (\bar{x} , b_i and s^2d) of the individual genotypes are illustrated in Table 11. The results indicated that all genotypes values were non-significant except IT93K2045-20, Chinese Red and Monarch Blackeye were significant, genotypes Dokii 331, IT93K2045-20 and Black Crowder were considered specially adapted to unfavorable environments because the regression coefficient of these genotypes less than one ($b_i < 1$) while, genotypes IT91K118-20, IT82C-16 and Blackeye Crowder could consistently performed better under favorable environments because their regression coefficient (b_i) were more than one. The genotypes

IT93K2045-20, Dokii 331, Cram 7, and Black Crowder might be consider superior because they gave high mean values for number of seeds per pods above the grand mean, besides their stability. These results is in agreement with those obtained by Damarany (1994b), Ushakumari et al. (2002), Dahiya et al. (2007a, b, c) and Singh et al. (2007).

Number of pods/plant

Average number of pods per plant of genotypes overall environments ranged from (67.25) for

genotype Sudany to (34.78) pods per plant for genotype Monarch Blackeye, with an average of (47.49) pods per plant for all genotypes, data are presented in Table 4. The highest number of pods per plant was for genotype Sudany at fall season at second planting date (July, 30th), in both seasons, while, the lowest was for genotype Monarch Blackeye at summer season at first planting date (March, 15th), in both seasons. The significance of genotype by environment interaction in regional variety trials or in selection for wide adaptation has been reviewed by other workers (Becker and Leon, 1988; Crossa et al., 1990; Cooper and DeLacy, 1994). Other studies (Allen and Allen, 1981; Singh and Rachie, 1985; Damarany, 1994a; Ishiyaku et al., 2005) pointed out the existence of significant genotypic differences in cowpea for yield and agronomic traits. However, most of the studies were conducted under single location or controlled environments that might underestimate the environmental as well as genotype by environment interaction.

Results illustrated in Tables 9 and 10 showed that the differences among all genotypes (G) and environments (E) were highly significant. Also, the interactions between genotypes and environments (G×E) were highly significant. Also, highly significant effect of E (linear) was reported, indicating that the studied trait was highly influenced by the combination of environment. G×E (linear) item was highly significant, suggesting that cowpea genotypes were different in their response to environments. Similar results were reported by Teixeira et al. (2007) and Torres et al. (2008).

The estimated stability parameters (\bar{x} , b_i and s^2d) of the studied genotypes for number of pods per plant indicated that Sudany, Cream 12, Azmerly and Monarch Blackeye genotypes were stable ($b_i < 1$) with high mean values, while, IT90K1020-6, IT82C-16 and IT82-812 genotypes were stable with the mean values lower than the grand mean. On the other hand, Dokii 331, Cream 7, IT91K118-20 and Chinese Red were unstable ($b_i > 1$) and could consistently do better in favorable environments. These results are presented in Table 11. Similar results were obtained by Ushakumari et al. (2002) and Dahiya et al. (2007b).

Hundred seed weight (gram)

Average hundred seed weight (gram) of genotypes overall environments ranged from 22.16 (gram) for genotype TVU 21 to 11.63 (gram) hundred seed weight (gram) for genotype Chinese Red, with an average of 14.89 (g) hundred seed weight (gram) for all genotypes. The data were presented in Table 5. These results are in agreement with that obtained by Damarany (1994b), Dahiya et al. (2007b, c), Peksen (2007) and De Rocha et al. (2007b). The highest hundred seed weight was that of genotype TVU 21, in the third planting date at fall season,

while, the lowest was for genotypes Chinese Red, in the third planting date (April, 115th), in summer season. The stability parameters (\bar{x} , b_i and s^2d) of the individual genotypes are illustrated in Table 11. The results indicated that all genotypes values were non-significant except IT81D-889 and IT82C-16 were highly significant, genotypes Azmerly, IT81D-889, Blackeye Crowder and Black Crowder were considered specially adapted to unfavorable environments because the regression coefficient of these genotypes less than one ($b_i < 1$) while, genotypes Dokii 331, IT91K118-20, IT82C-16 and IT85F2205, Blackeye Crowder could consistently performed better under favorable environments because their regression coefficient (b_i) were more than one. The genotypes IT82D-889 and Azmerly might be consider superior because they gave high mean values for hundred seeds weight above the grand mean, besides their stability. These results are in agreement with those obtained by De Rocha et al. (2007b) and Akande and Balogun (2009).

Average seed weight/plant (gram)

The performance of tested genotypes is presented in Table 6. The results indicated that average weight of seeds per plant of the various genotypes ranged from 67.81 g for (Sudany) to 37.03 g for (Kaha 1), with an average of 48.05 g for all genotypes. The heaviest weight of seeds per plant 69.23 and 68.80 g was found for (Sudany) in summer season, at third plating date, in both seasons, respectively. While, the lightest of 35.80 g was found for (Kaha 1) genotype in fall season at first planting date. These results are in agreement with that obtained by Ushakumari et al. (2002), and Dahiya et al. (2007b, c).

The joint regression analysis of variance is presented in Table 9. The differences among the tested genotypes (G) were highly significant; also, environmental (E) effect and the interactions between genotypes and environments (G×E) were highly significant as shown in Table 10. Most of this interaction was in a linear function with the environmental values as indicated by greater magnitude of the G×E (linear) mean squares in comparison with the estimated value for E+ (G×E) mean squares, which appeared also highly significant. These results appeared to be in harmony with those obtained by Dahiya et al. (2007a, b).

The estimated stability parameters (\bar{x} , b_i and s^2d) of the studied genotypes for average seed weight indicated that Cream 7, Azmerly, Blackeye Crowder, Dokii 331 and Black Crowder genotypes were stable ($b_i < 1$) with high mean values, while, Kaha 1, and IT85F2205 genotypes were stable with the mean values lower than the grand mean. On the other hand, Sudany, Monarch Blackeye, IT82-812 and IT82C-16 genotypes were unstable ($b_i > 1$) and could consistently do better in favorable environments (Table 11). Similar results were obtained by

Table 5. Means of hundred seeds weight per plant traits of the nineteen genotypes under twelve environments.

Genotype	Hundred seed weight(g)												Mean
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	
Dokii 331	18.40	18.40	18.40	20.60	19.82	20.09	19.10	18.73	18.47	19.70	20.37	20.00	19.34
Kaha 1	11.93	11.70	11.93	13.90	13.12	13.63	12.13	12.87	12.00	12.90	13.47	13.30	12.74
Cream 7	12.87	12.80	12.87	15.00	14.22	14.56	13.47	13.93	12.93	14.00	14.60	14.40	13.80
IT91K118-20	12.43	12.53	12.43	14.73	13.96	14.13	12.90	13.33	12.50	13.73	14.03	14.13	13.40
IT93K2045-20	16.03	15.70	16.03	17.90	17.12	17.73	15.73	15.53	16.10	17.07	16.87	17.30	16.59
TVU 21	21.70	21.33	21.70	23.53	22.76	23.39	21.27	20.67	21.77	22.53	22.30	22.93	22.16
IT81D-889	13.50	13.10	13.50	15.30	14.52	15.19	13.67	14.23	13.57	14.30	14.63	14.70	14.18
Chinese Red	10.80	10.60	10.80	12.80	12.02	12.49	11.00	11.77	10.87	12.10	12.13	12.20	11.63
IT81D1064	10.93	10.93	10.93	13.13	12.36	12.63	10.70	10.67	11.00	12.13	11.83	12.53	11.65
IT85F2205	15.77	15.43	15.77	17.63	16.86	17.46	15.13	14.47	15.83	16.63	16.27	17.03	16.19
IT90K1020-6	12.60	12.50	12.60	14.70	13.92	14.29	12.90	13.97	12.67	13.70	14.03	14.10	13.50
Blackeye Crowder	12.80	12.90	12.80	15.10	14.32	14.49	13.20	13.73	12.87	14.10	14.33	14.50	13.76
IT82C-16	15.47	15.67	15.47	17.87	17.09	17.16	15.90	15.60	15.53	16.87	17.03	17.27	16.41
IT82- 812	12.70	12.37	12.70	14.57	13.79	14.39	12.73	14.27	12.77	13.57	13.87	13.97	13.47
Sudany	11.73	11.40	11.73	13.60	12.80	13.43	11.23	11.10	11.80	12.60	12.37	13.00	12.23
Cream 12	11.37	11.30	11.37	13.50	12.70	13.06	11.47	11.67	11.43	12.50	12.60	12.90	12.16
Monarch Blackeye	16.43	16.37	16.43	18.57	17.77	18.13	17.17	16.97	16.50	17.57	18.30	17.97	17.35
Azmerly	17.90	17.43	17.90	19.63	18.83	19.59	17.27	17.50	17.97	18.63	18.40	19.03	18.34
Black Crowder	13.10	13.00	13.10	15.20	14.40	14.79	13.80	13.63	13.17	14.20	14.93	14.60	13.99
Environmental mean	14.13	13.97	14.13	16.17	15.39	15.82	14.25	14.45	14.20	15.20	15.39	15.57	14.89

Ushakumari et al. (2002) and Dahiya et al. (2007b).

Average pods weight/plant (gram)

The performance of tested genotypes is presented in Table 7. The results indicated that average weight of seeds per plant of the various genotypes ranged from 82.00 (g) for Blackeye Crowder to 50.36 (g) for Chinese Red, with an average of 64.45 (g) for all genotypes. The heaviest weight of pods per plant 85.67 (g) was found for Blackeye Crowder in fall season, at

second plating date, while, the lightest of 45.33 (g) was found for Chinese Red in summer season at third planting date. These results are in agreement with that obtained by Hazra et al. (1999), and De Rocha et al. (2007b).

The joint regression analysis of variance is presented in Table 10. The differences among the tested genotypes (G) were highly significant, also, environmental (E) effect, while, the interactions between genotypes and environments (G×E) were insignificant, as shown in Table 9. Indicating the presence of genetic variability among these genotypes and the suitability of stability analysis. These results appeared to be in harmony with

those obtained by Chattopadhyay et al. (2001) evaluated twenty cowpea genotypes for stability in yield and its components such as number of pods per plant, pod length, and pod weight and revealed that the significant genotype and environment interaction was observed for all characters except pod length.

The estimated stability parameters (\bar{x} , b_i and s^2_d) of the studied genotypes for average pods weight are presented in Table 11. All genotypes exhibited insignificant stability parameters from unity and zero for regression coefficient (b_i) and deviation from regression (s^2_d), the results indicated that Dokii 331, TVU 21, Blackeye Crowder, Black

Table 6. Means of weight of seeds per plant traits of the nineteen genotypes under twelve environments.

Genotype	Average weight of seeds per plant (cm)												
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	Mean
Dokii 331	52.53	56.57	56.17	54.73	56.23	56.20	54.73	56.23	55.87	55.27	56.77	56.03	55.61
Kaha 1	38.03	37.73	36.90	35.80	37.47	37.10	35.82	37.47	36.77	36.33	38.00	36.93	37.03
Cream 7	51.70	56.23	56.10	54.77	55.97	56.27	54.77	55.97	55.93	55.30	56.50	56.10	55.47
IT91K118-20	44.70	50.37	51.10	49.37	50.13	50.87	49.37	50.13	50.53	49.90	50.67	50.70	49.82
IT93K2045-20	46.40	44.43	43.13	41.47	44.00	43.13	41.47	44.00	42.80	42.00	44.53	42.97	43.36
TVU 21	52.67	47.10	44.80	43.53	46.77	45.17	43.53	46.77	44.83	44.07	47.30	45.00	45.96
IT81D-889	44.77	40.60	39.17	37.83	40.27	39.03	37.83	40.27	38.70	38.37	40.80	38.87	39.71
Chinese Red	46.03	51.13	50.97	50.07	50.63	51.20	50.07	50.63	50.87	50.60	51.17	51.03	50.37
IT81D1064	43.43	38.80	36.93	35.77	38.17	36.60	36.00	38.40	36.50	36.30	38.70	36.43	37.67
IT85F2205	47.50	47.17	45.77	44.57	46.30	45.70	44.90	46.63	45.70	45.17	46.90	45.57	45.99
IT90K1020-6	48.10	38.30	36.17	34.57	37.50	35.87	34.90	37.83	35.87	34.97	37.90	35.73	37.31
Blackeye Crowder	62.67	66.17	66.20	64.63	65.47	65.83	64.97	65.80	65.83	65.03	65.87	65.70	65.35
IT82C-16	47.73	38.03	36.00	34.27	37.37	35.73	34.60	37.70	35.73	34.67	37.77	35.60	37.10
IT82- 812	51.40	42.00	40.10	38.10	41.37	39.87	38.43	41.70	39.87	38.50	41.77	39.73	41.07
Sudany	68.30	67.20	69.23	67.20	66.53	68.80	67.53	66.87	68.80	67.60	66.93	68.67	67.81
Cream 12	50.27	53.20	53.20	51.37	52.60	52.97	51.70	52.93	52.97	51.77	53.00	52.83	52.40
Monarch Blackeye	54.10	38.53	35.93	34.47	37.97	35.73	34.80	38.30	35.73	34.87	38.37	35.60	37.87
Azmerly	56.93	59.07	59.00	57.40	58.50	58.63	57.73	58.83	58.63	57.80	58.90	58.50	58.33
Black Crowder	55.77	57.60	57.30	55.13	56.60	56.87	55.47	56.93	56.87	55.53	57.00	56.73	56.48
Environmental mean	49.63	48.96	48.11	46.58	48.41	47.98	46.77	48.60	47.83	47.05	48.89	47.83	48.05

Crowder and Azmerly genotypes were stable ($b_i < 1$) with high mean values, while, Kaha 1, Cream 7 and IT81D1064 genotypes were stable with the mean values lower than the grand mean. On the other hand, IT82C-16 and IT82-812 genotypes were unstable ($b_i > 1$) and could consistently do better in favorable environments. Similar results were obtained by Hazra et al. (1999) and De Rocha et al. (2007b).

Total dry seed yield (ton/fed.)

Results in Table 8 showed that total dry seed yield of genotypes overall environments ranged from

0.989 (ton/fed.) for (Blackeye Crowder) to 0.328 (ton/fed.) dry seed yield for (IT81D1064), with an average of 0.706 (ton/fed.) dry seed yield for all genotypes. These are in accordance with the finding of Kurubetta (2006), he found that time of sowing influenced significantly the seed yield per plant. June second fortnight sowing recorded significantly higher seed weight (14.40 g plant⁻¹) compared to July first fortnight (8.51 g plant⁻¹) and July second fortnight (6.12 g plant⁻¹) sowing. However, July first fortnight was significantly superior to July second fortnight sowing, Damarany (1994c), Torres et al. (2008), Yousaf and Sarwar (2008) and Akande and Balogun

(2009). The highest dry seed yield 1.200 (ton/fed) was that for (Azmerly), in fall season at third planting date (August, 15th), while, the lowest 0.270 (ton/fed.) was for IT81D1064 in the summer season at third planting date (April, 15th).

The joint regression analysis of variance is presented in Table 10. The differences among the tested genotypes (G) were highly significant, also, environmental (E) effect, while, the interactions between genotypes and environments (G×E) were non-significant, as shown in Table 9. These results indicated that cowpea genotypes responded differently to different environmental conditions, suggestion the importance of assessment of

Table 7. Means of weight of pods per plant traits of the nineteen genotypes under twelve environments.

Genotype	Average weight of pods per plant (gram)												
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	Mean
Dokii 331	70.33	70.00	69.33	75.33	75.67	76.00	70.00	68.67	69.67	72.33	76.33	76.00	72.47
Kaha 1	59.00	59.00	58.00	64.00	64.33	64.67	59.00	57.67	58.00	61.33	65.33	64.67	61.25
Cream 7	59.33	59.00	58.33	64.33	64.67	65.00	59.00	57.67	58.67	61.33	65.33	65.33	61.50
IT91K118-20	57.67	57.67	56.67	62.67	63.00	63.33	57.67	56.33	56.67	60.00	64.00	65.33	60.08
IT93K2045-20	63.67	62.00	62.67	68.67	69.00	69.33	62.00	60.67	64.33	64.33	68.33	69.00	65.33
TVU 21	77.33	78.00	76.33	82.33	82.67	83.00	78.00	76.67	75.67	80.33	84.33	84.67	79.94
IT81D-889	61.33	61.00	60.33	66.33	66.67	67.00	61.00	59.67	60.67	63.33	67.33	69.33	63.67
Chinese Red	47.33	48.33	46.33	52.33	52.67	53.00	48.33	47.00	45.33	50.67	54.67	58.33	50.36
IT81D1064	56.00	54.00	55.00	61.00	61.33	61.67	54.00	52.67	57.00	56.33	60.33	60.67	57.50
IT85F2205	56.67	56.33	55.67	62.00	62.00	62.00	56.33	54.33	56.00	58.67	63.00	61.00	58.67
IT90K1020-6	69.00	68.33	68.00	74.33	74.33	74.33	68.33	66.33	68.67	70.67	75.00	74.33	70.97
Blackeye Crowder	80.33	78.67	79.33	85.67	85.67	85.67	78.67	77.67	81.00	81.00	85.33	85.00	82.00
IT82C-16	69.00	68.33	68.00	73.67	74.33	75.00	68.33	67.33	68.67	70.67	74.67	77.67	71.31
IT82- 812	68.33	66.00	67.33	73.00	73.67	74.33	66.00	65.00	69.67	68.33	72.33	74.00	69.83
Sudany	52.00	51.67	51.00	56.67	57.33	58.00	51.67	50.67	51.33	54.00	58.00	59.33	54.31
Cream 12	56.00	54.67	55.00	60.67	61.33	62.00	54.67	53.67	56.33	57.00	61.00	61.67	57.83
Monarch Blackeye	61.67	60.67	60.67	66.33	67.00	67.67	60.67	59.67	61.67	63.00	67.00	69.67	63.81
Azmerly	67.67	66.33	66.67	72.33	73.00	73.67	66.33	65.33	68.00	68.67	72.67	73.33	69.50
Black Crowder	71.00	69.67	70.00	75.67	76.33	77.00	69.67	68.67	71.33	72.00	76.00	75.67	72.75
Environmental mean	63.35	62.61	62.35	68.28	68.68	69.09	62.61	61.35	63.09	64.95	69.00	69.74	65.43

genotypes under different environments in order to identify the best genetic make up for particular environment. These results appeared to be in harmony with those obtained by Nwofia et al. (2007), Padi (2007), Peksen (2007), De Rocha et al. (2007 a,b), Sarutayophat et al. (2007) and Taiwo (2007).

The stability parameters (\bar{x} , b_i and s^2d) of the individual genotypes are illustrated in Table 11. All genotypes except IT93K2045-20, Dokii 331, Chinese Red and Cream 12 exhibited highly significant stability parameters from unity and zero for regression coefficient (b_i) and deviation from regression (s^2d), respectively. The genotypes Dokii 331, Cream 12, IT81D-889, Chinese Red,

IT81D1064, IT85F2205 and Sudany appeared to be stable and exhibited below average response to different environments, ($b_i < 1$), their genotypes were considered to perform relatively better in less favorable environments. Genotypes Cream 7, IT91k118-20, TVU 21 and Blackeye Crowder were unstable because regression coefficient (b_i) more than one. The genotypes Dokii 331 and Cream 12, could be considered good inserted gave dry seed yield more than the overall of average genotypes besides their stability. Similar results were reported by Patel et al. (2005), conducted the experiment in loamy sandy soil with cowpea which revealed that sowing in 2nd March

recorded significantly higher seed and haulm yield compared to sowing in 15th February, 17th March and 2nd April, (Gurushara and Sharma, 2004; Jena, 2003; Singh and Singh, 2000; Obiadalla-Ali et al., 2007; Rashwan, 2010).

Conclusion

The study identified considerable degree of genotypic differences and average stability for yield in cowpea when tested under various environments. The best genotypes were Dokii 331 and Cream 12. These genotypes were most stable that would be suitable for growth parameters under the test

Table 8. Means of total dry seed yield traits of the nineteen genotypes under twelve environments.

Genotype	Total dry seed yield (ton/fed.)												
	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	Mean
Dokii 331	0.950	0.920	0.920	0.950	1.000	1.100	0.968	0.929	0.890	0.960	0.988	1.101	0.973
Kaha 1	0.610	0.598	0.592	0.750	0.800	0.852	0.628	0.599	0.569	0.735	0.787	0.858	0.698
Cream 7	0.730	0.660	0.610	0.800	0.850	0.900	0.720	0.680	0.594	0.796	0.836	0.886	0.755
IT91K118-20	0.600	0.600	0.550	0.800	0.820	0.902	0.680	0.550	0.520	0.744	0.793	0.950	0.709
IT93K2045-20	0.610	0.570	0.549	0.680	0.700	0.740	0.601	0.575	0.550	0.657	0.708	0.757	0.642
TVU 21	0.700	0.670	0.660	0.850	0.900	0.950	0.711	0.680	0.640	0.836	0.895	0.955	0.787
IT81D-889	0.340	0.330	0.300	0.322	0.380	0.400	0.358	0.310	0.300	0.328	0.380	0.400	0.346
Chinese Red	0.400	0.380	0.360	0.480	0.500	0.552	0.400	0.380	0.360	0.477	0.490	0.549	0.444
IT81D1064	0.320	0.300	0.280	0.330	0.350	0.390	0.328	0.299	0.270	0.326	0.343	0.401	0.328
IT85F2205	0.650	0.600	0.550	0.730	0.750	0.792	0.640	0.589	0.569	0.698	0.760	0.799	0.677
IT90K1020-6	0.360	0.300	0.300	0.345	0.375	0.402	0.342	0.300	0.331	0.328	0.385	0.400	0.347
Blackeye Crowder	0.910	0.880	0.860	1.050	1.100	1.150	0.930	0.887	0.830	1.040	1.080	1.161	0.990
IT82C-16	0.850	0.800	0.750	0.950	0.980	1.003	0.853	0.790	0.755	0.946	0.985	1.000	0.889
IT82- 812	0.810	0.780	0.760	0.260	0.270	0.290	0.850	0.810	0.689	0.245	0.277	0.298	0.528
Sudany	0.590	0.550	0.510	0.623	0.650	0.680	0.583	0.539	0.519	0.597	0.655	0.697	0.599
Cream 12	0.850	0.810	0.790	0.890	0.900	0.943	0.901	0.800	0.750	0.847	0.890	0.978	0.862
Monarch Blackeye	0.870	0.830	0.800	1.000	1.040	1.100	0.881	0.820	0.799	0.987	1.073	1.097	0.941
Azmerly	0.800	0.700	0.700	1.000	1.100	1.200	0.773	0.732	0.699	1.000	1.072	1.190	0.914
Black Crowder	0.880	0.860	0.810	1.070	1.100	1.152	0.910	0.851	0.810	1.064	1.112	1.147	0.980
Environmental mean	0.675	0.639	0.613	0.731	0.767	0.816	0.687	0.638	0.602	0.716	0.764	0.822	0.706

Table 9. Combined analysis of variance for studied traits of 19 genotypes under various environments.

SOV	d.f	pod length (cm)	No. of seeds per pods	No. of pods per plant	hundred seeds weight (g)	weight of seeds per plant (g)	weight of pods per plant (g)	total dry seed yield Kg/fed.
Environments (E)	11	36.41**	12.69**	130.58**	34.46**	48.53**	598.04**	738283.36 **
Replication/ E	24	24.65	2.13	10.56	20.82	34.68	47.56	1416.64
Genotypes (G)	18	157.15**	39.02**	3661.90**	295.29**	3319.79**	2548.05**	1820938.13 **
G × E	198	0.79NS	2.50**	1.74**	0.23NS	18.63**	1.57NS	30879.28 **
Error	432	1.14	0.78	1.48	0.45	2.25	2.87	1249.18

* Significant at P < 0.05; ** highly significant at P < 0.01.

Table 10. The joint regression analysis of variance for the studied traits.

SOV	d.f	pod length (cm)	No. of seeds per pods	No. of pods per plant	Hundred seeds weight (g)	weight of seeds per plant (g)	weight of pods per plant (g)	total dry seed yield Ton/fed.
Genotypes (G)	18	157.24**	39.02**	3661.90**	295.29**	3319.78**	2548.05**	1820898.68**
E + (G×E)	209	2.28**	3.04**	8.52**	2.03**	20.20**	32.96**	41725.26**
E (linear)	1	340.45**	139.64**	1436.38**	379.09**	533.83**	6578.29**	3591930.96**
G×E (linear)	18	1.03 ^{NS}	5.51**	4.56**	0.08 ^{NS}	90.06**	0.73 ^{NS}	222547.50**
Pooled deviation	190	0.62 ^{NS}	2.09**	1.38 ^{NS}	0.23 ^{NS}	10.88**	1.57 ^{NS}	5909.44**
Pooled error	432	1.14	0.78	1.48	0.45	2.25	2.87	1249.18

*Significant at P < 0.05; ** highly significant at P < 0.01.

Table 11. Genotype average performance over 12 environments, and stability parameters of 19 cowpea genotypes.

Genotype	Pod length (cm)			No. of seeds per pods			No. of pods per plant			hundred seeds weight (g)			weight of seeds per plant (g)			weight of pods per plant (g)			total dry seed yield Kg/fed.		
	\bar{x}	Bi	s ² d	\bar{x}	Bi	s ² d	\bar{x}	Bi	s ² d	\bar{x}	Bi	s ² d	\bar{x}	Bi	s ² d	\bar{x}	Bi	s ² d	\bar{x}	Bi	s ² d
Dokii 331	14.06	1.20 ^{NS}	0.59	10.25	0.96 ^{NS}	0.33	55.78	1.07 ^{NS}	0.72	19.34	1.05 ^{NS}	0.18	55.61	0.01*	4.52	72.47	0.96 ^{NS}	0.35	0.973	0.82 ^{NS}	2127.16
Kaha 1	13.18	0.94 ^{NS}	0.50	8.64	1.05 ^{NS}	1.22	35.14	1.45**	1.52	12.74	0.95 ^{NS}	0.13	37.03	0.81**	0.09	61.25	0.95 ^{NS}	0.87	0.698	1.41**	1786.88
Cream 7	15.85	0.91 ^{NS}	0.50	11.44	0.37 ^{NS}	2.06	54.94	1.20 ^{NS}	1.16	13.80	0.97 ^{NS}	0.20	55.47	-0.23*	5.56	61.50	0.97 ^{NS}	0.25	0.755	1.37**	975.67
IT91K118-20	12.20	0.41 ^{NS}	1.43	10.81	1.65 ^{NS}	1.42	49.58	1.35*	1.13	13.40	1.03 ^{NS}	0.11	49.82	-0.62*	8.48	60.08	1.02 ^{NS}	0.98	0.709	1.90**	2313.73
IT93K2045-20	14.84	0.92 ^{NS}	0.13	10.86	-0.51*	2.31	42.92	1.12 ^{NS}	0.97	16.59	1.02 ^{NS}	0.20	43.36	1.51**	0.26	65.33	1.00 ^{NS}	1.36	0.642	0.98 ^{NS}	322.70
TVU 21	18.38	0.64 ^{NS}	1.26	11.36	1.17 ^{NS}	0.62	44.31	1.07 ^{NS}	1.16	22.16	1.03 ^{NS}	0.51	45.96	2.40**	4.43	79.94	0.98 ^{NS}	2.67	0.787	1.57**	2099.50
IT81D-889	15.67	0.96 ^{NS}	0.36	10.22	1.37 ^{NS}	0.98	38.61	1.08 ^{NS}	1.15	14.18	0.89**	0.10	39.71	1.83*	2.42	63.67	1.05 ^{NS}	0.74	0.346	0.44**	791.74
Chinese red	12.81	1.10 ^{NS}	0.24	9.47	1.87*	0.98	50.61	1.24 ^{NS}	1.06	11.63	0.96 ^{NS}	0.12	50.37	-0.53**	5.86	50.36	1.11 ^{NS}	8.01	0.444	0.93 ^{NS}	573.68
IT81D1064	13.84	1.38 ^{NS}	0.76	8.94	0.76 ^{NS}	0.30	37.44	1.14 ^{NS}	1.09	11.65	1.09 ^{NS}	0.19	37.67	1.97*	3.85	57.50	0.98 ^{NS}	2.66	0.328	0.51**	272.77
IT85F2205	14.41	1.23*	0.21	9.19	1.31 ^{NS}	0.84	46.33	1.09 ^{NS}	0.90	16.19	1.07 ^{NS}	0.77	45.99	0.98**	0.10	58.67	0.94 ^{NS}	1.59	0.677	1.16*	657.26
IT90K1020-6	11.95	1.00 ^{NS}	0.63	9.22	1.82 ^{NS}	1.65	37.19	0.87 ^{NS}	3.35	13.50	0.94 ^{NS}	0.27	37.31	3.10*	16.55	70.97	0.99 ^{NS}	0.57	0.347	0.44**	940.41
Black eye Crowder	13.37	1.26 ^{NS}	0.37	11.06	1.27 ^{NS}	3.88	63.86	1.22 ^{NS}	0.90	13.76	1.03 ^{NS}	0.10	65.35	-0.12**	3.09	82.00	0.97 ^{NS}	1.64	0.990	1.55**	1296.05
IT82D-16	18.00	1.16 ^{NS}	0.78	12.14	-1.49 ^{NS}	9.47	36.42	0.67 ^{NS}	3.75	16.41	1.11**	0.11	37.10	3.11*	15.50	71.31	1.07 ^{NS}	1.26	0.889	1.27**	1890.71
IT82- 812	13.07	1.04 ^{NS}	0.95	9.33	1.28 ^{NS}	0.26	40.06	0.83 ^{NS}	2.73	13.47	0.87 ^{NS}	0.48	41.07	3.11*	13.79	69.83	1.02 ^{NS}	3.40	0.528	-2.88**	82418.73
Sudany	10.58	0.94 ^{NS}	1.53	9.00	0.47 ^{NS}	2.84	67.25	0.74*	0.95	12.23	1.02 ^{NS}	0.31	67.81	-3.42*	73.98	54.31	1.01 ^{NS}	0.48	0.599	0.82**	238.80
Cream 12	15.91	1.04 ^{NS}	0.44	10.97	1.28 ^{NS}	7.23	52.06	0.65**	0.82	12.16	1.03 ^{NS}	0.01	52.40	0.11*	2.76	57.83	0.99 ^{NS}	0.57	0.862	0.83 ^{NS}	1649.81
Monarch black eye	11.60	1.26**	0.14	9.22	2.36*	2.59	34.78	0.75*	0.87	17.35	1.00 ^{NS}	0.16	37.87	4.26*	42.68	63.81	1.06 ^{NS}	0.79	0.941	1.55**	1822.09
Azmerly	15.98	0.65 ^{NS}	0.72	10.47	1.20 ^{NS}	0.37	58.25	0.73*	0.78	18.34	0.97 ^{NS}	0.28	58.33	0.20**	1.47	69.50	0.99 ^{NS}	0.57	0.914	2.57**	6115.00
Black Crowder	15.34	0.96 ^{NS}	0.25	11.19	0.80 ^{NS}	0.29	56.83	0.73 ^{NS}	1.29	13.99	0.99 ^{NS}	0.15	56.48	0.50 ^{NS}	1.39	72.75	0.95 ^{NS}	1.04	0.980	1.76**	3986.68
Mean	14.26			10.20			47.49			14.89			48.05			65.43			0.706		
L.S.D of G. M	0.528			0.434			0.602			0.331			0.743			0.839			17.503		
S. E (bi)	0.240			0.866			0.246			0.062			1.790			0.046			1.089		

localities or other similar environments.

Conflict of Interest

The authors have not declared any conflict of interest.

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