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Comparative study on various statistical methods for genotype × environment interaction of chickpea genotypes

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Abstract
Fourteen chickpea genotypes were evaluated using Randomized complete block design with three replications for evaluating genotype x environment interaction (GEI) and yield stability across 6 environments during 2015-2016 at Chhattisgarh. The objectives were to compare various statistical methods of analyzing yield stability and to determine the most suitable parametric procedure to evaluate and describe yield stability of chickpea genotypes performance under Chhattisgarh conditions. Several statistical analyses were conducted: Coefficient of Variance (CV_i); Wricke's Eco valence parameter (W_i); Lin and Binns cultivar performance measure (P_i); Finlay and Wilkinson's regression coefficient (b_i); and Shukla's stability variance parameter (σ_i^2) and Additive main effect and multiplicative interaction (AMMI).

Keywords: Chickpea, genotype x environment interactions, yield stability

Introduction
Across different regions of the state show wide variation in agricultural productivity and performance of chickpea genotype. The genotypes of chickpea are study in different agro-ecological regions for adaptability to varying climatic and soil conditions. These trials are commonly referred to as multi-location variety adaptability trials-"MVATs" (Abeysiriwardena *et al.* 1991) [1] or Multi-environment trials-"MET" (Crossa, 1992). The yield variation due to changing environment is commonly referred to as G x E interaction (Kempton, 1984) [7]. The occurrence of G x E interaction complicates the selection of a genotype with superior adaptability to varied environments.

Comparison of genotype performance across environments major problem for finding out the Genotype x environment interaction (GEI). So it is necessary to use corresponding statistical techniques for the efficient assessment of interaction. Interaction among genotypes and environment studied and interpreted by a wide genotype of statistical models and methodologies. The performance of any crop genotype actually depends on the effect of its genotype and environment in which it grows. Therefore, the phenotypic variation can be expressed as the sum of the two component representing genotype and environmental source of variation. Genotypes under assessment are grown in various locations and over a number of years to know the importance of G x E interaction and the stability of performance. A wide array of statistical techniques has been proposed to analyze the adaptability of genotypes.

A number of parametric statistical procedures have been developed over the years to analyze genotype x environment interaction and especially yield stability over environments.

The various statistical techniques on stability performance of promising genotypes in varied environment. Multi-environment trials (METs) are used to accurately estimate and predict yield based on limited experimental data, determine yield stability and the pattern of response of genotypes across environments and provide reliable assistance for selecting the best genotypes for planting in future years and at new sites (Crossa, 1990) [2].

The present study were carried out (1) To compare the various statistical methods to describe chickpea genotype performance in the chickpea producing areas of Chhattisgarh. (2) To measure the genotype-environment interaction in chickpea. (3) To estimate rank correlations between stability statistics.

Result and Discussion
Coefficient of variation (CV %)
Indira Chana -1, R G 2009-16 and R G 2009-10 are stable genotype fall into the high yield and low variation group. The chickpea growing areas of

Chhattisgarh and their mean yield ranking and CV of the fourteen genotype were evaluated at six location in the year 2015-2016.

Lin & Binn's cultivar performance measure (P_i)

JG-16© rank first followed by R G 2009-01 ranked second for P_i are the most stable genotypes. RG 2011-06, RG 2011-01, Vaibhav © and Indira Chana-1 are the some other genotype which having an P_i low values and high ranking for mean yield.

The ranks of the P_i measure and the mean yield of genotype. P_i Measure not really an indication of stability but an indication of performance. JG 14©, Jaki 9218©, R G 2011-02 and R G 2010-18 were the most unstable genotype.

Shukla's stability model (σ_i^2)

The method which decide the most stable genotype are Vaibhav ©, RG 2011-06, RG 2009-05 and Jaki 9218©. The genotype that have poor stability are RG 2009-01, RG 2011-04 and JG -14 © determined by this model. The genotype which is ranked 1st for mean yield, showed intermediate stability also ranked 2nd for Shukla's stability is RG 2011-06.

Finlay and Wilkinson's joint regression analysis (*bi*)

Figure 4.2 indicates RG 2011-01(G4), RG 2011-02 (G8) and RG 2010 -18 (12) that are the most stable and adapted to most of the environments. Jaki 9218 ©, Vaibhav © (G11), RG 2009-01 (G3) and RG 2009-16 (G5) below average stability but specifically adapted to high yielding environments respectively, Indira Chana-1 (G9), RG 2011-04(G6) and RG 2009-10 (G7) have above average stability, but are more specifically adapted to lower yielding environments. JG 14© (14) respectively, are not adapted to any of the environments, and are low yielding.

Wricke's eco valence analysis

RG 2011-01,Vaibhav ©, RG 2009-05 and RG 2011-06 are the most stable genotype according to the eco valence method whereas some genotype are not best ranked to mean yield are 10th, 4th, 5th & 13th, respectively. According to eco valence method, most unstable genotype are RG 2009-01, JG-14 ©, RG 2009-16 and JG -16 © are the genotype which ranked as 11th, 9th, 14th & 1st for mean yield, respectively.

The AMMI stability value (ASV)

Fourteen genotype which indicated its ASV with its ranking and the AMMI 2 model IPCA 1 and IPCA 2 scores for each genotype. RG 2011-06, Vaibhav©, RG 2009-05, Indira Chana-1 and JK 9218 © are the most stable genotype analysed by the ASV ranking. RG 2009-01, RG 2011-04, RG 2009-16 and RG 2011-02 are the most unstable genotype.

Comparison of the stability procedure

According to the different stability parameter Table 1 indicate the value & ranking order for stability of fourteen genotype.

RG 2009-11 and Vaibhav© are the stable genotype according to the ranking order of the different method i.e. Shukla's (1972) [10], Wricke's (1962) [11] eco valence and ASV.

Table 2 depicts each of the possible pair wise comparisons of the ranks of different stability statistics which is determined by the spearmen's coefficient of rank correlation (steel & Torrie 1980). Mean yield was highly significantly positive (P<0.01) with W_i and but non–significantly negatively correlated with all other parameters.

All the result of spearman's rank correlation coefficient when treated equal with shukla stability variance procedure. Wricke eco valence procedure & the ASV procedure from the AMMI model which is highly significant (p<0.01). The procedures of Shukla & Wricke had a total correspondence (r=1.000). These procedures were equivalent for ranking purposes which correspond with previous finding (Wricke & Wiber 1980, Purchase 1997) [13, 9].

Lin & Binn's procedure (P_i) value was significantly correlated to b_i, CV and ASV. Lin & Binn's defined as the performance of best cultivar in a trail but specific genotype have deviation in its performance. One that performs finally with the environment is stable genotype.

This procedure does not measure the stability over site but measure of genotype performance. To identify a superior yield performing cultivar a genotype mean yield is used. JG 16 was ranked first on mean yield, also most stable genotype. According to Lin & Binn's, JG 14 and Jaki 9218 @ were unstable.

With the procedure of Shukla's, ASV and Finlay &Wilkinson procedure show limited correspondence with CV% (r = 0.43) it shown on significant positive rank correlation with Mean yield, W_i and ASV and non-significant negative correlation with σ_i^2. For assessing yield stability, this shows a big deviation from other procedure.

Table 1: Stability measurements and their ranking orders of 14 chickpea genotype evaluated across 6 environments for the year 2015-2016 in the main chickpea growing areas Chhattisgarh

Genotype	Yi Mean	R	CV	R	P_i	R		R	W_i	R	b_i	R	PC1	PC2	ASV	R
Indira chana-1	1548.16	9	15.83	1	115.85	7	219.01	10	164518.54	9	0.78	4	-3.9	1.70	6.77	4
RG 2011-01	1612.02	4	25.46	6	98.78	4	215.25	9	30891.242	1	0.96	6	-5.95	-13.3	14.13	10
RG 2011-02	1553.88	8	21.81	4	135.73	12	209.41	7	156959.63	8	1.01	8	-5.69	9.35	12.51	9
RG 2011-04	1587.88	6	24.15	5	109.40	6	263.89	13	10211519	6	0.60	1	7.42	16.67	19.88	12
RG 2011-06	1682.05	2	26.61	8	83.09	3	113.9	2	74925.288	4	0.76	3	-1.64	0.64	2.63	1
Vaibhav©	1529.44	11	30.59	11	118.40	9	107.71	1	39398.668	2	1.14	10	-1.2	4.31	4.31	2
JAKI 9218	1467.66	13	34.09	13	159.99	13	151.36	5	128768.27	7	1.23	12	-0.95	-7.5	8.82	5
JG -14	1378.83	14	32.84	12	263.15	14	245.6	12	333836.1	13	1.05	9	7.06	3.82	21.35	13
JG-16	1682.38	1	29.35	10	56.33	1	225.08	11	189539.56	11	0.83	5	2.25	-11.26	11.84	8
RG 2009-01	1626.44	3	38.82	14	75.22	2	404.54	14	765187.27	14	1.29	13	25.0	-4.09	37.68	14
RG 2009-05	1546.72	10	26.54	7	103.62	5	121.54	3	59539.357	3	1.45	14	3.89	-1.38	5.94	3
RG 2009-10	1576.94	7	18.88	3	118.85	8	132.18	4	86595.206	5	0.62	2	-5.49	5.94	10.31	6
RG 2009-16	1599.27	5	16.62	2	120.09	10	212.46	8	214057.68	12	1.22	11	-10.36	0.97	15.58	11
RG 2010-18	1497.11	12	27.67	9	130.91	11	198.35	6	180957.91	10	0.99	7	7.06	3.82	11.30	7

Table 2: Spearman rank correlation for all the stability parameters for 2015-2016

	Mean	CV_i	P_i	W_i	b_i	**ASV**	σ_i^2
Mean	1						
CV_i	-0.19	1					
P_i	-0.91	0.12	1				
W_i	0.08	-0.06	-0.06	1			
b_i	-0.29	0.43	0.13	-0.42	1		
ASV	-0.006	0.42	0.07	0.28	0.17	1	
σ_i^2	-0.06	-0.16	0.06	-0.33	-0.06	-0.38	1

With ASV (0.28138) procedure of stability showed highest significant positive correlation (P<0.01). Shukla's stability or Eco valence of Wricke's is a linear combination of deviation mean square. This equivalency for ranking was reported by (Wricke & Wiber, 1980; Purchase, 1997) [13, 9].

The Wricke's procedure of stability statistics showed the significant positive correlation (P<0.01) with ASV (0.2813). Shukla's stability model or Eco valence of wricke is a linear combination of deviation mean square. The equivalency for ranking was reported by Wricke and Wiber 1980, purchase 1917) [13, 9].

Purchase's AMMI stability value was positively significantly correlated with σ_i^2, b_i and W_i but it did not correspond with P_i and Mean yield.

Table 3: Combined analysis of variance (ANOVA) according to the AMMI 2 model for a year 2015-2016.

Source	**Df**	**Sum.sq**	**Mean.sq**	**F value**	**Pr (>F)**
Locations	5	36026258 7	7205252	38.90	5.226e-07
Rep within Env.	12	2222369	185197	3.04	0.0007206
Genotype	13	1537157	118243	1.94	0.0292973
Genotype x Env.	65	9261376	142483	2.33	9.335e-06
Residual	156	9499806	60896		
IPCA 1	17	4194785.1	246752.06	4.05	0.0000
IPCA 2	15	1879754.2	125316.95	2.06	0.0145
IPCA 3	13	1587672.7	122128.67	2.01	0.0231
IPCA 4	11	858547.0	122128.65	1.28	0.2406
IPCA 5	9	545813.2	78049.73	1.00	0.4424

References

1. Abeysiriwardena DS, de Z, Buss GR, Jr. Reese PF. Analysis of multi environmental yield trails for testing adaptability of crop genotypes, Tropical Agriculturist. 1991; 147:85-97.
2. Crossa J. Statistical analysis of multi-location trials. Advances in Agronomy. 1990; 44:55-85.
3. Finlay KW, Wilkinson GW. The analysis of adaptation in plant breeding programmes. Astln. J Agric. Res. 1963; 14:742-754.
4. Francis TR. Yield stability studies in short-season maize (*Zea mays* L.) Ph.D. Thesis, University of, Guelph, Guelph Ont, 1977.
5. Francis TR, Kannenberg LW. Yield stability studies in short season maize. I. a descriptive method for grouping genotypes. Can. J Plant Sci. 1978; 58:1029-1034.
6. Gauch HGJR, Zobel RW. Predictive and postdictive success of statistical analyses of yield trials. Theor. and Appld. Gen. 1988; 76:1-10.
7. Kempton RA. The use of bi-plots in interpreting variety by environment interaction. J Agric. Sci. Camb. 1984; 103:123-135.
8. Lin CS, Binns MR. A superiority measure of cultivar performance for cultivar x location data. Can. J Plant Sci. 1988; 68:193-198.
9. Purchase JL. Parametric analysis to describe G x E interaction and yield stability in winter wheat. Ph. D. Thesis. Department of Agronomy, Faculty of Agriculture, university of the Orange Free State, Bloemfontein, South Africa, 1997.
10. Shukla GK. Some aspects of partitioning genotype-environmental components of variability. Heredity. 1972; 28:237-245.
11. Wricke G. Uber eine methode zur erfassung der ökologischen Streubreite in feldversuchen. Z. Pflanzenzüchtung. 1962; 47:92-96.
12. Wricke G. Zur berechnung der ökovalenz bei sommerweizen und hafer. Z. Pflanzenzüchtung. 1964; 52:127-138.
13. Wricke G, Weber WE. Erweiterte Analyse von Wechselwirkungen in Versuchsserien. In: Köpcke, W. & K. Überla (Eds). Biometrie-heute und morgen. Springer, Berlin, 1980; 87-95.
14. Zobel RW, Wright Gauch MJ. Statistical analysis of a yield trial. Agron. J. 1988; 80:388-393.