

()

*

(// : // :)

x

()

x

%

IPC1
EV4 SIP4) AMMI4

Sc 76

(AMGE4
Sc 76

/ /

(Kang & Gorman, 1989)

)

(

()

(Bidinger et al., 1996)

(Evans et al., 2002; Lin et

(Khodabandeh, 1995)

(1951) Sprague & Federer .al., 1986)

×

(Farzad, 1997)

FAO

×

(Khodabandeh, 1995)

×

(Crossa, 1990)

(Fehr &

Hadley, 1980)

(G×E)

%

(G×E)

(%)

(%)

(Fatahi et al., 2003)

(FAO)

:

G×E

/

/

()

GEI ()

%

(Crossa et al., 1991)

(1990) Gauch

(×)

(1983) Clements et al. (1981) Byth

" " " "

" " ()

PCA

(Zij) ×

(Marcelo Soriano Viana & Cruz, 2002)

(AMMI)

N

×

(Bidinger et al., 1996)

$$Y_{ger} = \mu + \sum_{n=1}^N \sigma_n \zeta_{gn} \eta_{en} + \theta_{ge} + \varepsilon_{ger}$$

θ_{ge} μ

ε_{ger} ()

δ_n :

ζ_{gn} (λ^{05}) n

n η_{en} n

(Kang, 2002)

(Hayward et al., 1993)

E

G×E

(Crossa et al., 1991)

(MET)

(1984) Kempton . ×

(F.A) (Tai, 1979)

(P.A)

(1988, 1990) Gauch & Zobel ×

FANOVA

×

-
1. Ordination
 2. Hierarchical Methods
 3. Full Model
 4. Reduced Model
 5. Multi-Environmental Trials
 6. Factor Analysis
 7. Pattern Analysis

(Crossa et al., 1990; Kearsay & Pooni, 1996;
(1990) Gauch & Zobel .Kempton, 1984)

G×E

×

.(Willers et al., 1995)

F

/ %

F

F

(FGH₂)

.(Baker, 2002)

)

(1990) Gauch

(

(2000) Burak & Broccoli

()

.(Crossa et al., 1990)

()

()

(Kearsay & Pooni,

.1996)

()

(2000) Torrecillas & Bertoia

IPC

P2 P1

()

IPC

(ECT)

IPC

... :
 % / (PCA)
 ×
 . (/ × / ×) ECT .

×

%

N

IPCA

PCA

G+E-2n-1

IPCA

)

$$Y_{ijk} = \mu + g_i + e_j + \sum_{n=1}^N \delta_n \zeta_{in} \eta_{jn} + \theta_{ij} + \varepsilon_{ijk}$$

(

j i Yijk
 e_j g_i μ k
 n δ_n

N

(I.P.C.)

$$\zeta_{in} \cdot (N \leq \min(g-1), (e-1))$$

(IPC)

n i
 n j η_{jn}

θ_{ij} (IPC)

ε_{ijk} ()

SIPC

(Gauch, 1988)

AMGE EV

(Sneller et al., 1997)

$$SIPC = \sum_{n=1}^N |\lambda_n^{0.5} \zeta_{in}|$$

$$EV = \frac{\sum_{n=1}^N \zeta_{in}^2}{N}$$

$$AMGE = \sum_{n=1}^N \sum_{j=1}^M \lambda_n \zeta_{in} \eta_{jn}$$

N

λ_n

M

n

SIPC1 N

F .() SIPCv .

SIPCf

()

. ()

g+e-2n-1
.(Cossa et al., 1990; Zobel et al., 1988)

. ()

()

× × ×

×

EV₄, SIPC₄, AMGE₄

Z

Z

Z'

IPC₂

IPC₁

IPC₃-, IPC₁

×

×

%

GEST EXCEL SPSS Minitab SAS
IRRISTAT

()

	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	**	**	n.s.	n.s.	n.s.	**	**	**	**	*	n.s.	**			
	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	n.s.	n.s.	**	n.s.	n.s.	n.s.	**	**	**	n.s.	n.s.	n.s.			
	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	/	/	/	/	/	/	/	/	/	/	/	/	/	/	% CV

	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	n.s.	n.s.	*	**	n.s.	**	*	n.s.	n.s.	**	**	n.s.			
	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	n.s.	n.s.	**	**	*	n.s.	**	n.s.	*	**	**	n.s.			
	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
	/	/	/	/	/	/	/	/	/	/	/	/	/	/	% CV

.% %

:** * n.s.

...

:

()

F

x

% /

x

G×E

% /

x

()

F	
n.s.	/
/ n.s.	/
/ **	/
/	/
/ **	/
/ **	/
/ **	/
/ n.s.	/
/ n.s.	/
/ **	/
-	/
-	/

%. **: n.s.

(α = %)

SC 725	/	a
SC 726	/	a
SC 73	/	a
SC 722	/	b
SC 704	/	b
SC 75	/	b
SC 76	/	b
SC 723	/	b
SC 708	/	b
SC 647	/	bc
SC 724	/	bc
SC 707	/	c

11/18

F	
/	/
/ **	/
/ **	/
/ **	/
**	/
/ **	/
/ **	/
/ **	/
/ n.s.	/
/	/

x

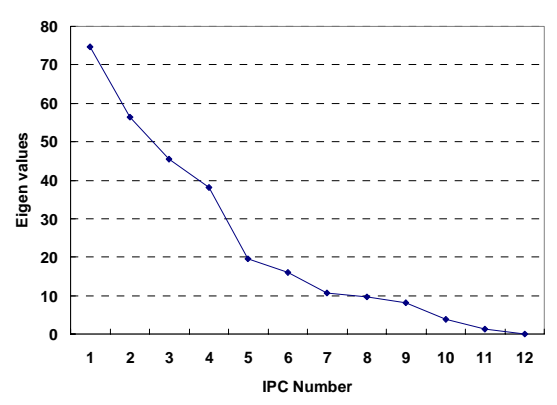
IPCA 1

IPCA 2

IPCA 3

IPCA 4

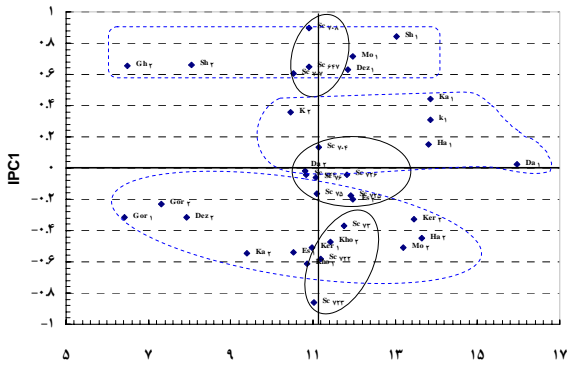
**: n.s.



()

x

1. Scree graph



()

IPC1

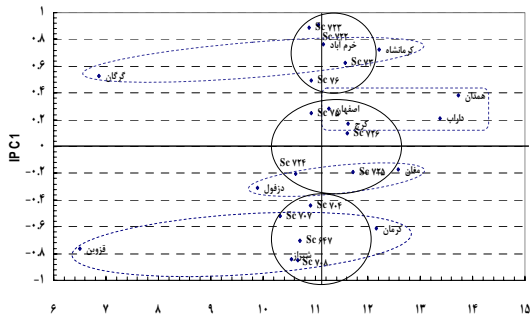
IPC

() IPC1

×

IPC1

IPC1



()

IPC1

×

()

F

SIPC4

AMGE4 EV4 SIPC4

$$\frac{1}{\lambda^4} \gamma_{ik}$$

()

EV4

()

AMGE4

AMMI4

	SIPC ₄	EV ₄	AMGE4
SC 708	/	/	/
SC 76	/	/	/
SC 75	/	/	/
SC 73	/	/	/
SC 707	/	/	/
SC 722	/	/	/
SC 723	/	/	/
SC724	/	/	/
SC 725	/	/	/
SC 726	/	/	/
SC 647	/	/	/
SC 704	/	/	/

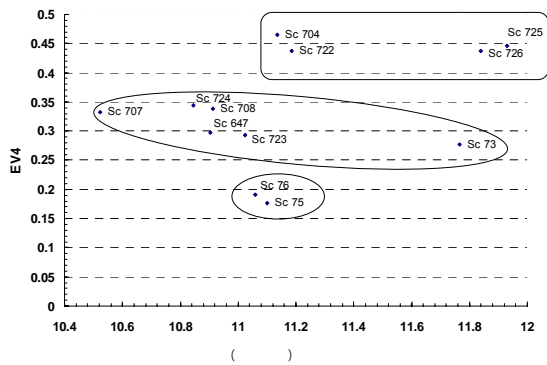
AMMI4

EV4 SIPC₄ AMGE4

SIPC4

SC76 SC75

×



شکل ۵- نمودار دو بعدی حاصل از مقادیر میانگین عملکرد دانه و EV4 ژنوتیپها. خطوط پیوسته گروه‌بندی‌های حاصل از تجزیه خوشه‌ای ژنوتیپها را بر مبنای مقادیر EV4 نشان می‌دهند.

(1977) Chapman et al.

SC722
SIPC4

SIPC4
SC707 SC704

()

SC75 SC76

EV4

EV4

EV4

EV4

EV4

SIPC4

SC76 SC75

()

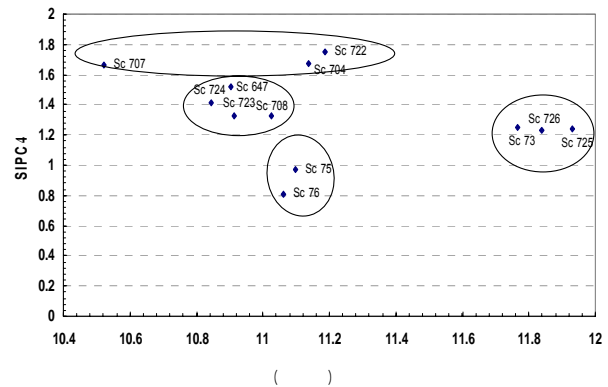
SIPC4 EV4

(2003) Shah Mohammadi

(1997) Chapman et al.

(2003) Shah Mohammadi

(1997) Chapman et al.

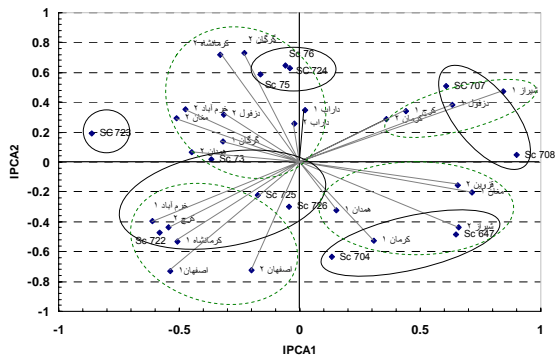


(1997) Chapman et al.

()

SIPC4

SIPC4



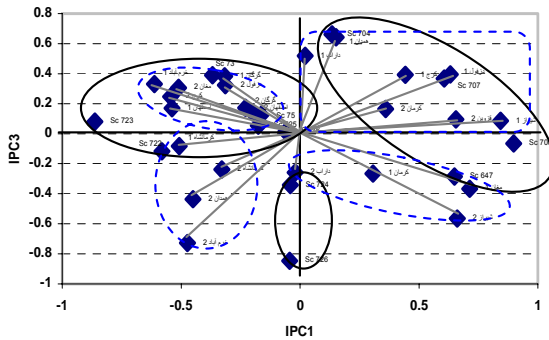
IPC IPC

(2000) Burak & Broccoli

x

(2001) Mohammadinejad

IPC IPC1



IPC IPC

%

x

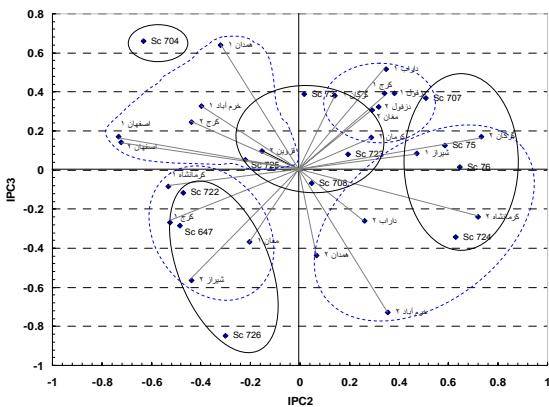
%

x

IPC2 IPC1

IPC IPC1

SC SC SC



IPC IPC

IPC
IPC1

()

(IPC3) (IPC1)

SC SC
()

SC

SC 708 SC 723 SC 725 SC 73

IPC IPC2

()

()

AMMI

SC75 EV4 SIPC4
 SC726 SC725 SC76
 SC725

SC76

()

×

IPC

SC724 SC726
 SC704 SC707 SC725
 SC722

SC647 IPC1
 SC704
 SC722

IPC1

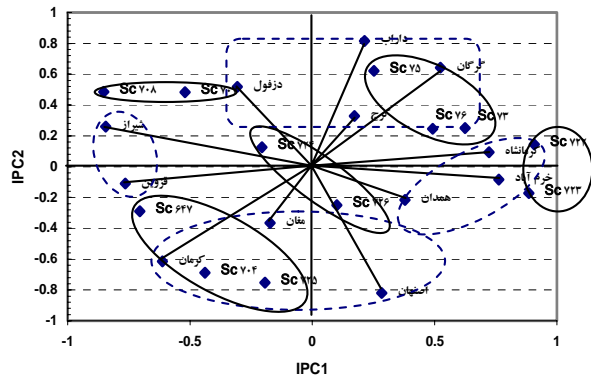
IPC1

IPC

SC723
 SC76 SC75 SC73

()

IPC1



(IPC)

()

IPC

IPC IPC

()

IPC IPC1

×

IPC1

IPC2

(2003) Shah Mohammdi

(2002) Mohammadinejad

%

%

×

(1997) Annicchiarico .

SC SC SC ×

IPC1 SC

SC × × ×

SC SC SC ×

×

SC SC F

FGH2 F

F

FGH₂

×

(1998) Fatahi et al.

REFERENCES

1. Allard, R. W. & Bradshaw, A. D. (1964). Implications of genotype-environment interactions in applied plant breeding. *Crop Sci*, 4, 503-508.
2. Annicchiarico, P. (1997). Joint regression vs AMMI analysis of genotype – environment interactions for cereals in Italy. *Euphytica*, 94, 53 – 62.
3. Arnulf Kanzler. (2002). *Genotype x Environment Interaction in Pinus patula and its implications in South Africa*, A Doctoral thesis of Philosophy to the Graduate Faculty of North Carolina State University.
4. Baker, R. B. (2002). *Additive main effect and multiplicative interaction*, http://chke.usask.ca/r_baker/gxe/html/
5. Bidinger, F. R., Hammer, G. L. & Muchow, R. C. (1996). The physiological Basis of genotype by Environment Interaction in Crop Adaptaion, *Canadian Journal of Plant Science*, 68, 405-410.
6. Burak, R. & Broccoli, A. M. (2000). Genotype by environment interaction on popping expansion and yield in popcorn hybrids cultivated in Argentina , *MNL*, 74, 44
7. Byth, D. E. (1981). A conceptual basis of genotype x environment interaction for plant movement. p.27-50. In D.E. Byth, and V.E. Mungomery (eds). Interpretation of plant response and adaptation to agricultural environments. Queensland Branch, Australian Institute of Agricultural Science, Brisbane.
8. Chapman, S., Crossa, J. & Edmeades, O. G. (1997). Genotype by environment effects and selection for drought tolerance in tropical maize. I. Two mode pattern analysis of yield, *Euphytica*, 95,101-109

9. Clements, R. J., Williams, R. J., Grof, B. & Hacker, J. B. (1983). In R. L. Burt, P. P. Rotar, J. L. Walker and M. W. Silvey (eds), "The Role of Centrosema, Desmodium and Strlosanthes in Improving Tropical Pastures", Westview Tropical Agriculture Series No 6 pp. 69-96.
10. Crossa, J. (1990). Statistical analyses of multilocation trials. *Adv Agron*, 44, 55-85.
11. Crossa, J., Fox, P. N., Pfeiffer, W. H., Rajaram, S. & Gauch, H. G. (1991). AMMI adjustment for statistical analysis of an international wheat yield trial. *Theor Appl Genet*, 81, 27-37.
12. Crossa, J., Gauch, H. G., Jr. & Zobel, R. W. (1990). Additive main effects and multiplicative interaction analysis of two international maize cultivar trials. *Crop Sci*, 30, 493 – 500.
13. Eberhart, S. A. & Russell, W. A. (1966). Stability parameters for comparing varieties, *Crop Sci*, 6, 36 – 40.
14. Evans, D. M., Gillespie, N. A. & Martin, N. G. (2002). Biometrical genetics, *Biological Psychology*, 61, 33-51.
15. Farzad, M. (1997). *Maize hybrid introduction*, Agricultural Research and Education Organization (AREO).
16. Fatahi, F., Moghadam, M., Gerami, A. & Yusefi, A. (2003). Stability Analysis in Barley Cutivares Using Redundancy Analysis and LISREL Methods, *Agricultural Science Journal*, 13 (4), 87-102.
17. Fatahi, F., Moghadam, M., Gerami, A. & Yusefi, A. (1998). Repeatability assessment of some stability parameters in Barley, Abstract book, In: Proceedings of 5th Iranian Agronomy Congress, Seed & Plant Certification and Registration Research Institute, P.23
18. Fehr, W. R. & Hadley, H. H. (1980). Hybridization of Crop Plants. American Society of Agronomy, Inc. Madison, Wis.
19. Gauch, H. G. & Zobel, R. W. (1988). Predictive and postdictive success of statistical analyses of yield trials. *Theor Appl Genet*, 76,1-10.
20. Gauch, H. G. (1990). Full and reduced models for yield trials, *Theor Appl Genet*, 80, 153 – 160.
21. Gauch, H. G. & Zobel, R. W. (1990). Imputing missing yield trial data. *Theor Appl Genet*, 79, 753-761.
22. Gauch, H. G. (1988). Model selection and validation for yield trials with interaction. *Biometrics*,44,705-715.
23. Hayward, M. D., Bosemark, N. O. & Romagosa, I. (1993). *Plant breeding, principles and prospects*, Chapman and Hall. London, U. K.
24. Kang, M. S. (2002). *Quantitative Genetics, Genomics and Plant breeding*. CRC Press, Louisiana state University, USA.
25. Kang, M. S. & Gorman, D. P. (1989). Genotype×environment interaction in maize. *Agron J*, 18, 662 – 664.
26. Kearsay, M. J. & Pooni, H. S. (1996). *The genetical analysis of quantitative traits*. Chapman and Hall, London.
27. Kempton, R. A. (1984). The use of biplots in interpreting variety by environment interaction. *Agr Sci* 103, 123–135.
28. Khodabandeh, N. (1995). *Cereals*, 4th Ed., UT Press
29. Lin, C. S., Binns, M. R. & Lefkovitch, L. P. (1986). Stability analysis: where do we stand? *Crop Sci*, 26, 894 – 899.
30. Marcelo Soriano Viana, J. & Cruz, C. D. (2002). Analysis of stability and adaptability through different models of linear regression, *Ciênc Agrotec Lavras*, 26, 455-462.
31. Mohammadinejad, G. (2002). *Comparison of different stability parameters in Oat varieties*, M. Sc. thesis in Plant breeding, Isfahan University of Technology
32. Shah Mohammadi, M. (2003). *Yield stability determination in Barley using different stability methods*, M.Sc. thesis, Tarbiat Modarres University
33. Sneller, C. H., Kilgore, L. & Dombek, D. (1997). Repeatability of yield stability statistics in soybean. *Crop Sci*, 37, 383 – 390.
34. Sprague, G. F. & Federer, W. T. (1951). A comparison of variance components in corn yield trials. 2. Error, year x variety, location x variety, and variety components. *Agron J*, 43, 535-541.
35. Tai, G. C. C. (1979). Analysis of genotype environment interaction of potato yield. *Crop Sci*, 19, 434 – 438.
36. Torrecillas, M. G. & Bertoia, L. M. (2000). Stability analysis of forage response in maize. *Maize Genetics Cooperation Newsletter*, 74, 45.
37. Willers, J. L., Wagner, T. L., Sequeira, R. A., Theseirea, G. W. & Boykin, D. L. (1995). Analysis of deterministic simulation models using methods application. *Agron J*, 87, 478 – 492.
38. Zobel, R. W., Wright, M. J. & Gauch, H. G. (1988). Statistical analysis of a yield trial. *Agron J*, 80, 388 – 393.

