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Comet Parade

	(Harm)	(MP)	(STI)	(GMP)
(DRI)		(SSI)	(TOL)	
MP STI GMP				

Harm

Amica Opera Parade

Lethbridge Landrace J98/102/51/5

() :

(*B. campestris* L.)

(*Brassica napus* L.,)

(*B. juncea* L.)

(*B. rapa* L., or

2. Indian Mustard

1. Rapeseed

E-mail:m_jmoghaddam@yahoo.com

: : *

(Bhowmik, 2003)

(Olsson, 1960)

)

(

(Kimber & McGregor, 1995)

(Ghatak et al., 1992 ; Sharma, 1994)

(Bhowmik, 2003)

(1978a) Richards .

()

(Woods et al., 1991)

(*B. carinata* L.)

(1983) Kondra et al. .

Kumar &)

(Singh,1998

(Lewis &

.Thurling, 1994)

(1993) Fernandez

(1975) Tayo & Morgan .

(STI)

(1981) Rosielle & Hamblin

(MP)

(TOL)

-
1. Stress Tolerance Index
 2. Tolerance
 3. Mean Productivity

(Morrisson & Stewart, 2002; McGregor, 1981)

:

(1978) Fischer & Maurer
(SSI)

(Maguire, 1962)

$$G_{\max} (\%) = n_g \times 250^{-1} \times 100$$

$$GRI (\%/d) = \sum_{i=1}^8 \left[\frac{(G_i - G_{i-1})}{i} \right]$$

(1987) Bidinger et al. .
(DRI)

i

n_g :

G_i

G_{i-1}

()

/

() Nkobilbao

Opera Parade () Ebonite

Regent () Hyola 401 Comet Amica

J98/102/51/5 Bard-1 Westar

Lethbridge Landrace

Tobin Rainbow Goldrush

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(/ /)

NMR

(Michel & Kaufman, 1973)

%

(Gmax)

(GRI)

5. Nuclear Magnetic Resonance

1. Stress Susceptibility Index
2. Drought Response Index
3. Maximum Germination
4. Germination Rate Index

Rainbow
 /)
 .(/
 .
 (Rao & Dao, 1987; Richards, 1978a)
 (Bouslama & Schapauch, 1984 ;
 Froozan, 1997)
 Hyola401
 Tobin Bard-1 J98/102/51/5
 .
 Tobin
 .
 /)
 . (/
 Parade
 Westar Hyola401
 .
 Tobin Goldrush
 /)
 / /) (/)
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 Regent Opera Comet Parade
 Tobin Goldrush . Comet Parade
 . Regent Ebonit
 .
 (/ /)
 Regent Landrace Bard-1
 . Goldrush
 .
 Bard-1

$$\begin{aligned} & (OY_s) \quad (OY_p) \\ & (O\bar{Y}_p) \\ & (O\bar{Y}_s) \\ & : \\ & MP = (OY_s + OY_p) / 2 \\ & GMP = \sqrt{(OY_s \times OY_p)} \\ & Harm = \frac{2 \times (OY_s \times OY_p)}{(OY_s + OY_p)} \\ & TOL = (OY_p - OY_s) \\ & SSI = \frac{[1 - (OY_s / OY_p)]}{SI} \\ & SI = [1 - (O\bar{Y}_s / O\bar{Y}_p)] \\ & STI = \frac{(OY_s \times OY_p)}{(O\bar{Y}_p)^2} \\ & OY_s = a + b OY_p + c FL + DR + E \end{aligned}$$

$$\begin{aligned} & (\sigma^2) \quad E \\ & : \quad (OY_s) \\ & (FL) \quad (OY_p) \\ & . \quad (DR) \end{aligned}$$

(Singh et al., 1987) (Sana et al., 2003) (Abou El-Nasr et al., 2006; Labana et al., 1987) (Woods et al., 1991; Oram et al. 2005)

Letbridge Opera Rainbow
 Landrace
 Parade Comet
 Bard-1
 Ebonite Amica
 NKbilbao
 Parade Comet Amica Opera
 Opera Parade

() ()	() ()	() ()	() ()	() ()	() ()	() ()	() ()	() ()	() ()	() ()	() ()	() ()
/ a	/ bc	/ a	/ b	/ c	/ ab	/ c	/ ab	/ a	/ a	/ d	/ c	Nk bilbao
/ a	/ ab	/ a	/ bc	/ ab	/ ab	/ a	/ a	/ a	/ b	/ a	/ a	Parade
/ a	/ a	/ a	/ a	/ ab	/ a	/ a	/ ab	/ a	/ a	/ bc	/ bc	OPera
/ a	/ bc	/ a	/ b	/ c	/ ab	/ b	/ abc	/ a	/ b	/ bc	/ ab	Ebonite
/ a	/ ab	/ a	/ bc	/ abc	/ bc	/ b	/ ab	/ bc	/ d	/ e	/ de	Amica
/ a	/ ab	/ a	/ d	/ ab	/ cd	/ a	/ abc	/ c	/ d	/ ab	/ a	Comet
/ a	/ c	/ a	/ d	/ ab	/ d	/ b	/ c	/ bc	/ e	/ e	/ e	Hyola401
/ a	/ bc	/ a	/ bc	/ a	/ abc	/ a	/ ab	/ b	/ c	/ cd	/ abc	Regent
/ a	/ c	/ a	/ c	/ bc	/ d	/ b	/ bc	/ bc	/ d	/ d	/ cd	Westar
/ a	/ ab	/ ab	/ b	/ b	/ ab	/ a	/ a	/ a	/ b	/ b	/ c	J98/102/51/5
/ ab	/ b	/ a	/ b	/ b	/ b	/ a	/ a	/ a	/ b	/ a	/ a	Bard-1
/ ab	/ a	/ b	/ b	/ a	/ a	/ a	/ a	/ a	/ a	/ a	/ a	Landrace
/ a	/ a	/ ab	/ a	/ a	/ a	/ a	/ a	/ a	/ a	/ b	/ b	Lethbridge
/ a	/ a	/ b	/ b	/ a	/ a	/ a	/ a	/ b	/ b	/ a	/ a	Goldrush
/ a	/ a	/ a	/ a	/ b	/ a	/ b	/ b	/ a	/ a	/ b	/ ab	Rainbow
/ a	/ ab	/ b	/ b	/ ab	/ a	/ ab	/ ab	/ c	/ c	/ b	/ b	Tobin
/ a	/ ab	/ a	/ a	/ b	/ a	/ b	/ b	/ a	/ a	/ a	/ a	
/ b	/ a	/ b	/ c	/ a	/ b	/ a	/ a	/ a	/ a	/ ab	/ ab	
/ a	/ b	/ b	/ b	/ a	/ b	/ a	/ b	/ b	/ b	/ b	/ b	

Comet Parade
 Opera
 Amica Lewis & Thurling
 Letbridge J98/102/51/5 (1994)

()
 (Richards & Thurling, 1979b)
 Opera Harm MP STI GMP
 Letbridge Parade
 SSI TOL Goldrush
 Hyola401 Comet DRI
 Rainbow Bard-1
 Harm MP STI GMP
 SSI TOL
 () DRI

DRI	STI	SSI	TOL	Harm	GMP	MP	OY _p	OY _s	
/	/	/	/	/	/	/	/ ^a	/ ^{bc}	Nk bilbao
/	/	/	/	/	/	/	/ ^{ab}	/ ^{ab}	Parade
/	/	/	/	/	/	/	/ ^{abc}	/ ^a	OPera
/	/	/	/	/	/	/	/ ^{a-d}	/ ^{bc}	Ebonite
/	/	/	/	/	/	/	/ ^{abc}	/ ^{ab}	Amica
/	/	/	/	/	/	/	/ ^{bcd}	/ ^{ab}	Comet
/	/	/	/	/	/	/	/ ^d	/ ^c	Hyola 401
/	/	/	/	/	/	/	/ ^{bcd}	/ ^{bc}	Regent
/	/	/	/	/	/	/	/ ^{cd}	/ ^c	Westar
/	/	/	/	/	/	/	/ ^a	/ ^a	J98/102/51/5
/	/	/	/	/	/	/	/ ^b	/ ^b	Bard -1
/	/	/	/	/	/	/	/ ^a	/ ^a	Landrace
/	/	/	/	/	/	/	/ ^a	/ ^a	Lethbridge
/	/	/	/	/	/	/	/ ^a	/ ^a	Goldrush
/	/	/	/	/	/	/	/ ^a	/ ^a	Rainbow
/	/	/	/	/	/	/	/ ^a	/ ^{ab}	Tobin
/	/	/	/	/	/	/	/ ^{ab}	/ ^a	
/	/	/	/	/	/	/	/ ^a	/ ^a	
/	/	/	/	/	/	/	/ ^b	/ ^b	

Harm MP STI GMP TOL
 / DRI %
 SSI TOL %
 DRI OY_p
 »
 « (Bidinger et al., 1987; Abebe et al., 1998)

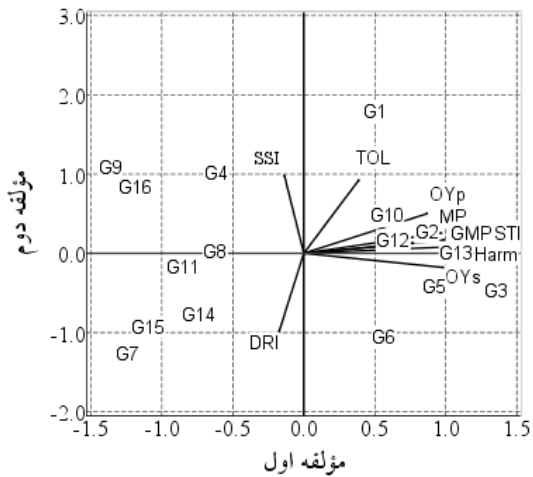
SSI TOL DRI SSI

Amica Opera Parade SSI TOL
 Lethbridge Landrace J98/102/51/5

Harm MP STI GMP DRI SSI TOL DRI
 SSI TOL
 DRI

SSI TOL

DRI
 MP STI



MP STI GMP OY_p OY_s
 » Harm
 «

OY _s	OY _p	GMP	STI	TOL	MP	SSI	Harm	DRI
/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/

Lethbridge Landrace J98/102/51/5

Nkobilbao

()

Comet

TOL

OY_s

(2004) Zeinaly Khanghah et al.

Parade Opera

(Bidinger et al., 1987; Abebe et al., 1998)

Amica

NKobilbao

REFERENCES

1. Abebe, A., Brick, M. A. & Kirkby, R. A. (1998). Comparison of selection indices to identify productive dry bean lines under diverse environmental conditions. *Field Crops Research*, 58, 15-23.
2. Abou El-Nasr, T. H. S., Ibrahim, M. M. & Aboud, K. A. (2006). Stability parameters in yield of white mustard (*Brassica alba* L.) in different environments. *World Journal of Agricultural Sciences*, 2(1), 47-55.
3. Amiri-oghan, H., Moghaddam, M., Ahmadi, M. R. & Davari, S. J. (2004). Gene action and heritability of drought stress tolerance indices in rapeseed (*Brassica napus*). *Iranian Journal of Field Crop Science*, 35(1), 73-83. (In Farsi)
4. Bhowmik, T. P. (2003). *Oilseed brassicas: constraints and their management*. CBS Publishers & Distributors, New Delhi, India.
5. Bidinger, F. R., Mahalakshmi, V. & Rao, G. D. P. (1987). Assessment of drought resistance in pearl millet. II. Estimation of drought response to stress. *Australian Journal of Agricultural Research*, 38, 49-59.
6. Bouslama, M. & Schapauch, W. T. (1984) Stress tolerance in soybean. I. Evaluation of free screening techniques for heat and drought tolerance. *Crop Science*, 24, 933-937.
7. Engqvist, G. M. & Becker, H. C. (1993). Correlation studies for agronomic characters in segregating families of spring oilseed rape (*Brassica napus* L.). *Heredity*, 118, 211-216.
8. Fernandez, G. C. J. (1993) Effective selection criteria for assessing plant stress tolerance. In: C.G. Kuo (Ed.), *Adaptation of food crops to temperature and water stress*. pp. 257-270. AVRDC, Shanhua, Taiwan.
9. Fischer, R. A. & Maurer, R. (1978). Drought resistance in spring wheat cultivars. *Australian Journal of Agricultural Research*, 29, 897-912.
10. Froozan, K. (1997). A technique for screening of drought and saline resistant safflower varieties during germination and plant growing. In: *Proceedings of IVth International Safflower Conference*, Bari, Italy, June 2-7, pp. 170-171.
11. Ghatak, S., Sounda, G. & Jana, P. K. (1992). Effect of irrigation and nitrogen on seed and oil content of Indian mustard (*Brassica juncea*). *Indian Journal of Agricultural Sciences*, 62 (10), 664-668.
12. Kimber, D. & McGregor, D. I. (1995). Brassica Oilseeds: Production and Utilization. In: Kimber, D. & McGregor, D.I. (Eds.), *The species and their origin, cultivation and world production*. (pp. 1-7). CAB International, Wallingford, UK.
13. Kondra, Z. P., Campbell, D. C. & King, J. R. (1983). Temperature effects on germination of rapeseed (*B. napus* L. and *B. campestris* L.). *Canadian Journal of Plant Science*, 63, 1063-1065.
14. Kumar, A. & Singh, D. P. (1998). Use of physiological indices as a screening technique for drought tolerance in oilseed Brassica species. *Annals of Botany*, 81, 413-420.

15. Labana, K. S., Ahuja, K. L. & Banga, S. S. (1987). Evaluation of Ethiopian mustard (*Brassica carinata* L.) genotypes under Indian conditions. In: Proceedings of 7th International Rapeseed Congress, Pozan, Poland, pp.115.
16. Lewis, G. J. & Thurling, N. (1994). Growth, development, and yield of three oil seed Brassica species in a water limited environment. *Australian Journal of Experimental Agriculture*, 34 (1), 93-103.
17. Maguire, J. D. (1962). Speed of germination aid in selection and evaluation for seedling emergence and vigor. *Crop Sciences*, 2, 176-177.
18. McGregor, D. I. (1981). Pattern of flower and pod development in rapeseed. *Canadian Journal of Plant Science*, 61, 275-282.
19. Michel, B. E. & Kaufman, M. R. (1973). The osmotic potential of polyethylene glycol 6000. *Plant physiology*, 51, 914-916.
20. Morrisson, M. J. & Stewart, D. W. (2002). Heat stress during flowering in summer Brassica. *Crop Science*, 42, 797-803.
21. Olsson, G. (1960). Some relations between number of seeds per pod, seed size and oil content and the effects of selection for these characters in *Brassica* and *Sinapsis*. *Hereditas*, 46, 27-70.
22. Oram, R. N., Kirk, J. T. O., Veness, P. E., Hurlstone, C. J., Edlington, J. P. & Halsall, D. M. (2005). Breeding Indian mustard (*Brassica Juncea* L.) for cold-pressed, edible oil production- a review. *Australian Journal of Agricultural Research*, 56(6), 581-596.
23. Rao, S. C. & Dao T. H. (1987). Soil water effects on low-temperature seedling emergence of five Brassica cultivars. *Agronomy Journal*, 79, 517-519.
24. Richards, R. A. (1978a). Variation within and between species of rapeseed (*Brassica campestris* and *B. napus*) in response to drought stress. III. Physiological and physicochemical characters. *Australian Journal of Agricultural Research*, 29, 491-501.
25. Richards, R. A. (1978b). Genetic analysis of drought stress response in rape seed (*Brassica campestris* and *B. napus*). I. Assessment of environments for maximum selection response in grain yield. *Euphytica*, 27(2), 609-615.
26. Richards, R. A. & Thurling N. (1979a). Genetic analysis of drought stress response in rapeseed (*Brassica campestris* and *B. napus*). II. Yield improvement and the application of selection indices. *Euphytica*, 28(1), 169-177.
27. Richards, R. A. & Thurling N. (1979b). Genetic analysis of drought stress response in rapeseed (*Brassica campestris* and *B. napus*). III. Physiological characters. *Euphytica*, 28(3), 755-759.
28. Rosielle, A. A. & Hamblin J. (1981). Theoretical aspects of selection for yield in stress and nonstress environments. *Crop Science* 21, 943-946.
29. Sana, M., Ali, A., Malic, M. A., Saleem, M. F. & Rafiq M. (2003). Comparative yield potential and oil contents of different canola cultivars (*Brassica napus* L.). *Pakistan Journal of Agronomy*, 2(1), 1-7.
30. Sharma, J. P. (1994). Response of Indian mustard (*Brassica juncea*) to different irrigation schedules, and nitrogen and sulphur levels. *Indian Journal of Agronomy* 39 (3), 421-425.
31. Singh, R. P., Malik, B. P. S. & Singh D. P. (1987). Variations for morphological characters in genotypes of India mustard. *Indian Journal of Agricultural Science*, 57, 225-230.
32. Tayo, T. O. & Morgan D. G. (1975). Quantitative analysis of the growth, development and distribution of flowers and pods in oilseed rape (*Brassica napus* L.). *Journal Agriculture Science (Cambridge)*, 85,103-110.
33. Thurling, N. (1974). Morphophysiological determinants of yield in rapeseed (*B. campestris* and *B. napus*). II. Yield components. *Australian Journal of Agricultural Research*, 25, 711-721.
34. Woods, D. L., Capcara, J. J. & Downey R. K. (1991). The potential of mustard *Brassica juncea* as an edible oil crop on the Canadian prairies. *Canadian Journal of Plant Science*, 71, 195-198.
35. Zeinaly Khanghah, H., Izanloo, A., Hosein Zadeh, A. H. & Majnoun Hosseini, N. (2004). Determination of the suitable drought resistance indices in commercial soybeans varieties. *Iranian Journal of Field Crop Science*, 35(4), 875-885. (In Farsi).