Indirect Selection for Grain Yield Using Parameters Locally Determined in NW Mexico in Diverse Worldwide Nurseries in Spring Bread Wheat

Mario Gutierrez[3], Matthew P. Reynolds[2], William R. Raun[1], Marvin L. Stone[1] and Arthur R. Klatt[1]

[1]Dep. of Plant and Soil Sciences and Dep. of Biosystems and Agricultural Engineering, Oklahoma State University. Stillwater, OK 74078.
[2]International Maize and Wheat Improvement Center (CIMMYT), Apartado Postal 6-641, 06600 Mexico, D.F. Mexico
[3]Maricopa Agricultural Center, University of Arizona. Maricopa, AZ 85138

Introduction

A typical wheat breeding program must evaluate a large number of advanced lines to select the most high yielding, and this process normally involves field evaluation during several years and locations (Ball and Konzak, 1993). Indirect selection through an early yield prediction is an alternative approach for screening large genotype to detect, identify and select high yielding genotypes (Richards, 1982).

Spectral reflectance indices (SRI) are a potential tool for assessing yield among genotypes in optimal and adverse growing conditions (Araus *et al.*, 2001). Several water indices offer great advantages for predicting yield in spring and winter wheat under well irrigated, water deficit stress, and rainfed conditions (Babar *et al.*, 2006; Prasad *et al.*, 2007).

The main goal of the present work was to determine the level of association between NWI-3 (water index), and canopy temperature determined in Northwest, Mexico (Yaqui Valley) during three growing seasons to predict yield performance of the respective advanced lines at international testing sites.

Methodology

Advanced wheat lines developed by The International Maize and Wheat Improvement Centre (CIMMYT) and included in the 24th ESWYT (elite spring wheat yield trial), 11th SAWYT (semi-arid wheat yield trial), and 11th HTWYT (high temperature wheat yield trial) were used in the present study.

In NW Mexico, NWI-3, canopy temperature, and grain yield were determined in three growing seasons (2006, 2007, and 2008) and in three environments (well irrigated, water stress, and high temperature) (Table 1).

The database from CIMMYT was used to obtain grain yield data of worldwide nurseries for the year 2003 that corresponded to the same lines tested during 2006, 2007, and 2008 in NW Mexico.

Table 1. Correlation among NWI-3, canopy temperature, and grain yield from NW Mexico and grain yield of diverse nurseries for ESWYT, SAWYT, and HTWYT.

Trial	NWI-3	CT	Yield
24th ESWYT		Watered	
Central Asia	5	5	4
North Africa	3	1	4
Central Africa	1	-	-
South Africa	1	1	1
Southern Europe	2	1	1
Central Europe	-	-	1
South America	2	1	1
11th SAWYT		Watered	
Central Asia	-	1	-
North Africa	2	-	2
Southern Europe	-	1	1
		Drought	
Central Asia	1	3	4
West Asia	1	-	-
Central Africa	-	-	1
South Africa	1	-	-
11th HTWYT		Watered	
Central Asia	2	-	1
West Asia	1	-	-
North Africa	3	1	3
		Drought	
Central Asia	2	2	2
West Asia	1	-	-
North Africa	-	-	4
North America	-	-	2
		Heat	
Central Asia	1	2	2
North Africa	1	-	1
Southern Europe	-	-	1

Results

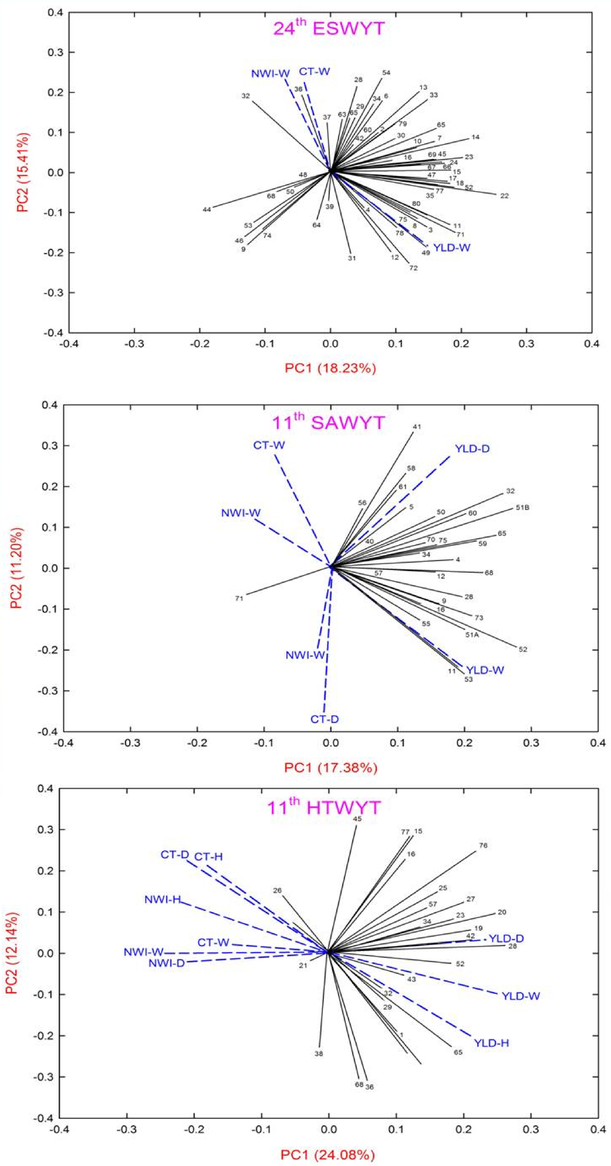

Figure 1. PCA's for NWI-3, canopy temperature, and grain yield of NW Mexico and grain yield of diverse nurseries for ESWYT, SAWYT, and HTWYT.

Discussion

The diverse sites presented a large range in grain yield (Fig. 1). The mean grain yield ranged from 0.75 to 9.0 t ha^{-1} for the 24th ESWYT (55 entries), from 0.62 to 8.17 t ha^{-1} for the 11th SAWYT (29 entries), and from 0.41 to 6.98 t ha^{-1} for the 11th HTWYT (22 entries).

NWI-3, canopy temperature, and grain yield obtained from NW Mexico in distinct environments showed significant associations with the grain yield of several worldwide nurseries in the three trials (Table 1).

The major number of significant correlations were obtained for the 24th ESWYT for the well irrigated environment.

Less sites presented significant correlations for 11th SAWYT and 11th HTWYT for the watered, water stress and high temperature environments.

Using NWI-3 and CT determined in NW Mexico, the yield of certain locations can be predicted for 24th ESWYT, 11th SAWYT, and 11th HTWYT trials.

Conclusions

Depending on the environment where the NWI-3 and canopy temperature where determined, these parameters demonstrated significant associations with certain nurseries for the 24th ESWYT, 11th SAWYT, and 11th HTWYT.

References

- Babar M.A. *et al.*, (2006). *Crop Sci.* 46: 578-588
- Ball S.T. and Konzak C.F. (1993). Plant Breed. 110: 277-282
- Prasad B., B.F. et al., (2007). *Crop Sci.* 47: 1416-1425
- Araus J.L. et al. (2001). *In* M.P. Reynolds, *et al.*,. CIMMYT..
- Richards (1982). IRRI, Manila, Philippines