Space-planted condition abates the GxE interaction in maize inbred lines and hybrids

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Introduction

Strong yield by density interaction resulting in considerable variation in optimum population is a root cause of GxE interaction in maize genotypes. Ultra-low density to ensure absence of competition has been asserted as a unique presupposition to tackle the problem (Tokatlidis 2013).

Methods

Thirty-one inbred lines, twenty five of commercial interest provided by the 'American Genetics Inc.' as well as six experimental lines selected in the absence of competition and on the basis of the single-plant yield were tested during the 2012 growing season at ultra-low density (ULD) and typical dense stand (TDS) under both normal (NI) and water-stressed (DI) regimes. Thirty one hybrids, obtained from single-crosses among the above lines, were tested during the 2013 season. Field experiments were established in three locations in Northern Greece, the two common for both seasons, henceforth named Site1 (Thessaloniki), Site2 (Florina), and Site3 (Giannitsa for the lines, and Serres for the hybrids).

Results

The lines averaged 102 - 697 g/plant and 3,160 - 13,760 kg/ha when spaced and crowded, respectively. The respective values for the hybrids were 645-1,377 g/plant and 8,850 - 13,210 kg/ha.

Table 1. The simple correlation coefficients among the six environments under the ULD for grain yield.

ULD Environment	Site3(DI)	Site3(NI)	Site2(DI)	Site2(NI)	Site1(DI)
Inbred lines					
Site1(NI)	0.86 ***	0.91 ***	0.86 ***	0.86 ***	0.94 ***
Site1(DI)	0.90 ***	0.92 ***	0.89 ***	0.91 ***	
Site2(NI)	0.93 ***	0.88 ***	0.95 ***		
Site2(DI)	0.88 ***	0.83 ***			
Site3(NI)	0.94 ***				
Hybrids					
Site1(NI)	0.88 ***	0.82 ***	0.73 ***	0.77 ***	0.85 ***
Site1(DI)	0.82 ***	0.78 ***	0.69 ***	0.70 ***	
Site2(NI)	0.86 ***	0.85 ***	0.92 ***		
Site2(DI)	0.62 ***	0.74 ***			
Site3(NI)	0.87 ***				

*, $P<0.05$; **, $P<0.01$; *** $P<0.001$

For the inbred lines, at the ULD all the 15 among environments linear correlations were very high (r=0.83-0.95, $P<0.001$); at the TDS two r values were non-significant, eight indicated moderate correlation (0.36-0.56, $P<0.05$-0.01), and five met the $P<0.001$ level. For the hybrids, at the ULD all the 15 among environments linear correlations were significant at $P<0.001$(r=0.69-0.93), while at the TDS just two out of the 15 r values were significant (Tables 1 and 2) .

Table 2. The simple correlation coefficients among the six environments under the TDS for grain yield.

TDS Environment	Site3(DI)	Site3(NI)	Site2(DI)	Site2(NI)	Site1(DI)
Inbred lines					
Site1(NI)	0.45*	0.55**	0.36 *	0.59***	0.46**
Site1(DI)	0.40*	0.50**	0.26ns	0.34 ns	
Site2(NI)	0.56**	0.52**	0.65***		
Site2(DI)	0.76***	0.65***			
Site3(NI)	0.88***				
Hybrids					
Site1(NI)	0.27ns	0.06 ns	0.23 ns	0.26 ns	0.53**
Site1(DI)	0.32 ns	0.15 ns	0.03 ns	0.09 ns	
Site2(NI)	0.07 ns	0.25 ns	0.28 ns		
Site2(DI)	0.08 ns	0.09 ns			
Site3(NI)	0.69***				

ns, non-significant; *, $P<0.05$; **, $P<0.01$; *** $P<0.001$

Conclusions

- **The absence of competition rather than the typical density exhibited less GxE interaction.**
- **For the inbred lines, assuming the overall yield at the TDS as index of the crop yield potential, it was positively correlated with the across-environment genotype performance at both densities. The ULD gave considerably higher r values, hence foresaw better the crop yield.**
- **In overall, the results were contrasting with the recommendation that there is no relationship between yield of isolated plants and crop yield, which presumably is valid when tested genotypes are heterogeneous, due to catalytic role of the yielding by competitive ability interference at the dense stand.**

References

Tokatlidis I.S. (2013). Adapting maize crop to climate change: a review. Agronomy for Sustainable Development 33:63-79

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