

Abstract

Climate change has affected several aspects of sustainable food production and food security. One of the major challenges of climate change is the prolonged drought that has led to water stress in crops, including sorghum (*Sorghum bicolor* L. Moench), in arid and semi-arid areas of Kenya. A study was conducted at the Nadapal irrigation scheme in Turkana County, Kenya, to determine the crop's performance under different water application regimes. Principal component analysis was used to compare phenotypic and genotypic characteristics and to study ontogenetic morphological integration leading to variation in sorghum yields. A path coefficient analysis was applied to estimate correlations between yield and yield-related traits and to determine the direct and indirect effects of these traits on yield per plant. It also enabled the identification of causal factors and other overlapping factors. The experimental design was a randomized complete block design (RCBD) with three replicates. From the analysis of variance, a highly significant and positive strong correlation was observed for seed index and plant height ($r = 0.76$) as well as head weight and grain yield ($r = 0.74$). Surprisingly, water use efficiency (WUE) showed a negative correlation with all other measured parameters. These kinds of interactions amongst WUE and other yield components depend on whether greater WUE is associated with equivalent carbon gain while using less water or greater carbon gain while using equivalent amounts of water (or a combination of the two). The correlation and path coefficient analyses carried out demonstrated that head weight, head length, and seed index were important selection criteria for high grain yields in sorghum. There were direct and indirect effects of the parameters on sorghum yield. This study evaluated other important correlations among sorghum characteristics that breeders can exploit to enhance the production of high-yielding sorghum cultivars. It revealed overlapping characteristics among head weight, head length, and seed index in relation to grain yield. As a result, these components could serve as selection criteria to improve sorghum seed yield.