Abstract

Soil fertility depletion is a major limiting factor affecting crop production in Kenya's arid and semi-arid lands (ASALs). In lower eastern Kenya, low crop yield has been associated with moisture deficiency and low usage of commercial fertilizers. Amongst unexplored solutions that can mitigate these constraints includes potential role of rhizobia in crop performance under water deficit conditions. Thus the present study analyzed the effects of drought stress on nodule formation, growth and yield of four legumes (beans, cowpeas, dolichos lablab and green grams) commonly cultivated in Kenya's ASALs county of Kitui. The two seasonal field-based trials involved randomized complete block design with drought stress treatment (DST) induced through withholding total irrigation and well watered treatment (WWT) maintained as a control. Four blocks, each with four plots, were demarcated. The four legumes were randomly assigned to the plots and maintained under WWT. One month after planting (MAP), DST was randomly induced by withholding irrigation in two blocks while WWT was maintained in the other two blocks as controls. Upon termination of field experiment, root nodules were carefully harvested from each legume in both DST and WWT. The nodules were then cultured in the laboratory for isolations of rhizobia as well as preparation of an inoculant for specificity assays under greenhouse conditions. Results showed that plants subjected to DST had significantly ($p \leq 0.05$) less TND, NoP, lower LAI, more WIX and lower GYD compared to control or plants under WWT indicating the general deleterious impact of water deficit on legume nodulation, growth and yield. The reduced TND under DST could inhibit nitrogen fixation further lessening GYD in legumes. Amongst the legumes, green grams had significantly ($P \leq 0.05$) higher GYD, TND and least WIX, dolichos, lablab and cowpeas exhibited moderate performance of the three traits while beans showed the least TND, GYD and high WIX under DST. Under DST, Green grams had significantly ($p \leq 0.05$) the highest yield followed by Cowpeas, Dolichos lablab and Beans was significantly affected by water stress to give lowest yield. Generally, TND positively correlated with GYD and negatively with wilting (WIX), potentially implying that higher nodulation might have enhanced nitrogen fixation thus higher legume YLD and tolerance to water deficit. Based on observed performance i.e. wilting index, root nodules number per plant and grain yield, green grams was considered drought tolerant and beans drought susceptible, therefore this study recommends adoption and growing of green grams (variety KS-20) in the ASALs of Lower Eastern Kenya.