PhD Abstract (Dr C N Onyari)

Effects of Irrigation and Nitrogen Fertilizer Levels on Water and Nitrogen Use Efficiency and Yield of Drought Tolerant Hybrid Maize (*Zea mays* L.) in Embu County, Kenya

ABSTRACT

Food grain shortage in Kenya is attributed to low rainfall and poor distribution in maize growing areas particularly as well as low soil fertility associated mainly with nitrogen deficiency. Use of irrigation water and nitrogen fertilizer is likely to solve this food security challenge. This study was conducted over two seasons covering 2012 and 2013 with the aim of establishing optimal irrigation and nitrogen fertilizer rates for drought tolerant hybrid maize (*Zea mays* L.), DK8031, grown in furrows to optimize rainfall capture with the objective of simultaneously achieving high water and nitrogen use efficiencies and yields. Four irrigation levels allocated as main plots were given: I_{119} - only once at sowing with 119 mm; I_2 = 238 mm - at sowing and two weeks after sowing (WAS); I_{357} – at sowing followed by applying at two and six WAS; I_{476} - at sowing, followed by applying at two, six and ten WAS. These totaled to 119.05, 230.10, 357.15 and 476.2 mm of applied irrigation water, respectively, exclusive of the 542.4 and 780.0 mm seasonal rainfall received in 2012 and 2013. Nitrogen was allocated to the subplots incrementally at N_0 = 0, N_{30} = 30, N_{60} = 60, N_{90} = 90 and N_{120} = 120 kg-N/ha application rates. It was observed that application of irrigation water and nitrogen positively and significantly affected biomass and grain yields as well as the yield components of the DK8031 maize variety. The highest dry matter and grain yields of 13,200 and 4,000 kg/ha were obtained with 476.6 mm applied irrigation water and 120 kg/ha nitrogen rate. The aboveground biomass and grain yields varied from 11.8 to 16.3 and 3.7 to 4.0 t/ha. The highest number of cobs per ha (47,500 to 62,778 cobs/ha), cob length (17.5 to 19.9 cm) and lines per cob (12.9 to 13.4) were achieved at $I_{476}N_{120}$ treatment combination in both season and increased with additional inputs, implying higher production potential at higher values of irrigation levels and fertilizer rates. The biomass and grain based water use efficiencies decreased with increase in irrigation but increased with increasing nitrogen rates and ranged from 8.2 to 12.8 kg-DM/ha-mm and 4.3 to 4.4 kg-grain/ha-mm in Season I and II, respectively. Linear and quadratic production functions developed predicted yields with high certainties (R^2) ranging between 0.60 and 1.00. Optimal yield was obtained with 357 mm supplemental irrigation water and 90 kg-N/ha of application nitrogen. Farmers in Embu can grow the DK8031 maize with at least 238 mm and 357 mm depth of supplemental irrigation at nitrogen rates of 90 and 100 kg/ha to promote productivity of the crop in the October to March and April to September seasons, respectively.