EVALUATION OF PROMISCUOUS SOYBEAN VARIETIES FOR AGRONOMIC AND GRAIN QUALITY TRAITS IN MAIZE/SOYBEAN INTERCROPPING SYSTEMS IN KENYA

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This thesis is my original work has not been published earlier in any other higher institution.

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ABSTRACT

Soybeans which nodulate effectively with diverse indigenous rhizobia are considered as promiscuous. As such, determination of their suitability in the intercrop system is important. Three varieties namely ; GAZELLE, SB19 and TGX1990 – 5F were used in this study to identify the most suitable promiscuous variety for intercropping with maize at KALRO Embu and KALRO Mwea, Kenya in the long rains of 2016 and short rains of 2016-2017. In addition, the varieties were used to determine the effects of intercropping maize-soybean on soil fertility and grain quality traits. The experimental design was laid out in randomised complete block design replicated three times with seven treatments where T1= SB19, T2 = GAZELLE, T3 = TGX1990 – 5F, T4 = SB19 + MAIZE, T5 = GAZELLE + MAIZE, T6 = TGX1990-5F + MAIZE, T7 = MAIZE (Duma 43). The spacing used was 80cm between rows of maize and 25cm within rows. Soybean was planted between 2 rows of maize at a spacing of 15cm within rows. The arrangement of intercropping was 1:1 which means, one row of maize intercepted with one row of soybean. Data collection was done on germination %, plant height (cm), days to 50% flowering, days to 75% maturity, yield biomass per plant, 100 grain weight, grain yield, harvest index and Land Equivalent Ratio for both crops. In addition, number of nodules per plant, shattering score (1-5), number of pods per plant, number of seeds per pod were collected for soybean only. Data were subjected to ANOVA and means separated using $LSD_{0.05}$. The results showed that growth and production parameters were significantly different ($p \leq 0.05$). The sole crops showed the highest plant height (PHt) compared to the intercropping indicating that intercropping reduced soybean plant height in both rainy seasons. Mwea recorded taller plants compared to Embu in both rainy seasons. TGX1990-5F showed taller PHt followed by SB19 while GAZELLE recorded the lowest PHt in both sites in both rainy seasons. The early variety to 50 % flowering and 75 % maturity was SB19 followed by GAZELLE and the late flowering and maturing variety was TGX1990-5F. Intercropping did not affect days to 50 % flowering and days to 75% maturity. Variety TGX1990-5F was resistant to pod shattering while SB19 and GAZELLE were moderately resistant. Intercropping did not affect pod shattering score. The number of nodules differed with varieties ($p \leq 0.05$) with TGX1990-5F recording the highest number of nodules of 43.7 followed by GAZELLE with 32.33 and SB19 with 29.80 in sole crop at Embu. In intercrop, TGX1990-5F presented higher number of nodules of 43.40 followed by GAZELLE with 33.67 compared to SB19 with 28.07. Soybean in Mwea presented the highest number of nodules compared to Embu in both seasons. Intercropping had no effect on the number of nodules per plant at both sites and both seasons. Variety TGX1990-5F recorded the highest number of pods followed by SB19 while GAZELLE presented the lowest number of pods in sole crop and in intercropping. Intercropping reduced the number of pods per plant in both seasons. Mwea site presented the highest number of pods compared to Embu in both seasons. The number of seeds per pod was not reduced by intercropping and they ranged from (1-3) for all varieties. TGX1990-5F produced higher biomass followed by SB19 while GAZELLE recorded the lowest biomass at both sites and rain seasons. Intercropping reduced soybean yield biomass at both sites and both rain seasons. Mwea produced higher biomass compared to Embu for both seasons. TGX1990-5F recorded the highest yields between sites during the long rains (1.07 t ha^{-1}) and short rains (0.62 t ha^{-1})

compared to SB19 with lower yields between sites (0.95 t ha^{-1} and 0.23 t ha^{-1}) during long rains and short rains respectively. There were significant differences in the intercropping systems in both sites and seasons, the variety TGX1990-5F indicating its suitability in the intercrops with maize. GAZELLE showed higher HI followed by SB19 while TGX190-5F recorded the lowest HI for both sites and seasons. Intercropping reduced HI in both sites and seasons. TGX1990-5F showed higher LER (1.7) compared to (1.51) for GAZELLE between sites in the long rains while in short season LER was 1.83 for TGX1990-5F compared to 1.19 for SB19 two sites. LER showed advantage between component crops in both sites and seasons. Finally TGX1990-5F was taken as suitable promisuous soybean variety for intercropping with maize. On the effects of intercropping maize-soybean on soil fertility and grain quality traits; results showed that, TGX1990-5F had significant difference ($p \leq 0.05$) fixing high amount of 0. 39 % N compared to 0.29 % for SB19 in sole crop respectively between sites for the first season after harvesting. Variety TGX1990-5F showed significant difference ($p \leq 0.05$) for 0.30 % N compared to 0.15 % of N for GAZELLE in intercrops between sites for the second season after harvesting. Depending on the requirement of the plants nutrients, TGX1990-5F fixed N which was moderate for feeding plant. However, for Organic Carbon (OC), Potassium (K) and phosphorus (P), TGX1990-5F occupied the second position at both sites and in both rain seasons compared to other varieties. TGX1990-5F variety presented high amount of protein content in sole crop and in intercropping of 42.96 % and 38.4 % ($p \leq 0.05$) between sites in the first season compared to GAZELLE with the same amount of protein content of 39 % in sole crops and in intercrops. In addition, TGX1990-5F showed significant difference ($p \leq 0.05$) of 40.84 % compared to 31.98 % GAZELLE in intercropping between sites in the second season. For the oil content, GAZELLE recorded the highest amount of 22 % and 21 % in the first season and second season respectively, in sole crop ($p \leq 0.05$). Variety SB19 recorded the lowest oil content of 13.98 % between sites. Thus, variety TGX1990-5F can be recommended to smallscale farmers for intercropping with maize because it recorded the highest LER and fixed more N , hence reducing the cost for N fertilizers and GAZELLE can be also recomended to farmers who want to produce oil because it produced higher amount of oil content than other varieties and it has big size which could justifty the highest amount of oil content produced.