Intercropping studies with grain sorghum

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This investigation was conducted at ShandaweelAgricultural Research station, Sohag Governorate, Egypt,during 1981 and 1982 seasons.The investigation included two studies.First study : Four field experiments were carried out to studythe effect of intercropping soybean with short and tallgrain sorghum cultivars under three plant populationdensities of either sorghum or soybean on the equantiative and qualitative characters of both crops The experimental design was factorial in a randomized complete blocks in four replicates.Each experiment included 36 treatments drived from a combination of four cropping systems 2 intercroppingpatterns (1:1, 2:1 sorghum:soybean) respectively compared with pure stand of each crop at three densities for eachcrop. (100,78, and 61% for sorghum and 100, 67, and 50% for soybean).Each plot had six ridges of 3.5 m long and 60 cmapart in an areB of 12.60 m •The normal cultural practices for growing each cropwere applied. Soybean was sown two weeks before sorghum planting.The two associated crops were harvested at the physiological maturity of each.Results could be summarized as follows:Effect of intercropping patterns and popUlation densities of sorghum and soybean on growth measurementstA) Plant height of sorghum. and soybean_ Any of the applied intercropping patterns produced shorter sorghum plants than the pure stand. However, the magnitude ~aS slightlY greater ~ith tall sorghum as cOlllpared~i th the short type. whereas soybean plant height ~as increased by intercroppingpatterns than the pure stand.Plant height of sorghum was not affected by sorghum population densities, ~hereas, increasingsoybean population densit·ies 01: the intercropped soybean1 : rom 700 to 140000 plants/1:ad increased the height 01 : either sorghum or Soybean plants signi1:icantB) Number of long lasting active leaves ofsorghum per plant_ Both of the applied intercropping patternsproduced Signi1:icantlY higher.number 01:long lastingective leaves/plant compared ~ith the pure stand._ As sorghum population densities decreased,the number 01:long lasting active. leaves 01:either shortor tall sorghum plants ~ere increased. whereas, soybeanpopulation densities increased the number 01:activel.eaves/short or tal.l.sorghum plant. This increases ~eresignif1can t ·The interaction effect of the tntercropping patternsand sorghum population densities ~as not signi1:icantc) Leaf/stem ratio: -,_ There.as no specifio effect of the leaf / stem ratiO 1:or either short or tall.sorghum at thevarioUS intercropping patterns and sorghum or soybeanpopulation densities.D) Leaf area index (L.A.I.) of sorghum andsoybean _ Pure stand of sorghum produced the lowest L.A.I. than intercropped ones with a significantdifferences. whereas, intercropped soybean with eithershort or tall sorghum significantly reduced L.A.I. ascompared with the soybean in pure stand._ As plant population densities of sorghum and soybean increased L.A.I. of each of the associated crops were increased Significantly.No significant interaction effect of the variousintercropping patterns and sorghum population densitieson L.A.!. of sorghum, and significant interaction effect of the various intercropping patterns andsoybean population densities on ~.A.I. of soybean. E) Number of branches/soybean plant:_ Number of branches/soybean plant decreasedsignificantlY by the various intercropping patternsintercropped with either short or tall sorghum than thesoybean in its pure stand._ The number of branches/soybean plant were increased as the plant population densities of any of the associated crops decreased. The interaction effectof the intercropping patterns and soybean densities wassignificant on number of branches/plant.Effect of intercropping patterns and different EOEulation densities on yield and yield compo;ents ofsorghum and soybean _ Yield components_ Sorghum F) Head length and ”,idth_ Intercropping pattern 1 : 1 produced longer and wider head than 2 : 1 pattern and/or the pure

standwith significant differences ~ith pure stand only. _ As sorghum population densities increasedhead length and width were decreased simultaneously.whereas, soybean population densities showed an oppositeresults than what waS mentioned with sorghum populationdensities. G) Number of grains and grain weight/head. and lOOO-grain weightIntercropping patterns. significantly increased number of grains and grain ~eight/head, and lOOO-grainweight as compared with the pure sorghum stand. _ The lighter population densities of short ortall sorghum and the heaviest soybean population densities produced the highest number of grainS/head,grain weight/head, and 1000 grains weight significantly._ The interaction effect of intercropping patternsand population densities of sorghum or soybean wassignificant.-Soybean : H) Number of pods and seed weight/plant. an.9 = lOOO-seed weightIntercropping patterns significantly ecreasednumber of pods and seed weight/plant, and lOOO-seedweight as compared with the pure stand._ The l~ghter the population densities of shortor tall sorghum and/or soybean produced the highestnumber of pods/plant, seed weight/plant, and 1000-seedweight of soybean.The interaction effect of intercroppingpatterns and sorghum or soybean papulation densities wassignificant.Yield: I) Biomass yield of sorghum and soybean (on dry:matter basis):_ Any of the two applied intercroppingpatterns produced significantly higher sorghum andlower soybean biomass dry matter yield than their purestands._ As the population densities of short ortall sorghum and/or soybean, increased, the biomassdry yield of either sorghum or soybean was increased.The obtained increase in sorghum biomass dry yieldwas 22.4 and 39.7% with short and tall sorghumcultivars, respectively and the biomass dry yield ofsoybean was 45.5 and 67.4% when intercropping withshort and tall sorghum by increasing the populationdensities from 70000 to 140000 plant/fad_ The interaction effect of the intercropping patterns and sorghum or soybean population densitieswas significant. J) Grain yield of sorghum : Intercropping patterns produced significant~Yhighergrain yie~d of sorghum than its pure stand. Intercropping pattern 1 : 1 produced significantlyhigher grain yield than 2 : 1 by 12.3% with short cultivar, whereas, 1:1 pattern produced 23.3% highergrain yield than the pure stand, corresponding to 9.2and 19.9%, respectivelY for tall sorghum. As sorghum population densities increased, grainsorghum yield of either short or tall cultivars wasincreased. This increase was 12.6 and 15.0% as the sorghum population density increased from 56000 to 72000and from 72000 to 92000 plant/fad respectively with shortsorghum, being 17.2 and 10% for tall sorghum. The interaction between intercropping patternsand short sorghum population densities was not significantand for tall sorghum was significant on grain yield ofsorghum.The interaction effect of the intercroppingpatterns and soybean population densities was significanton grain yield of sorghum.Soybean was more productive in its pure stand than 1:1 intercropping pattern with sorghum which inturn more productive than 2:1 pattern with a significantdifferences in soybean seed yie1d, and more soybean seed Soybean seed yieldproductivity was obtained in esse of intercropping withshort rather than the tall cultivars.There was a continuous and significant increase in soybean seed yield as the soybean populationdensities increased from 70000 to 94000, and up to140000 plant/fad when intercropped with short or tall sorghums- and by increasing the population density from70000 to 140000 plant/fad Soybean seed yield was increased by 43.) and 42.9% when intercropped withshort and tall sorghum, respectively-Interaction effect of intercropping patterns and sorghum or soybean population densites waBsignificanton soybean seed yield.The highest stover yield was produced byusing 1 : 1 intercropping pattern which was higher than the pure stand by 26.6 and2l.7% with short and tallsorghum respectively. stover yield of sorghum: - By increasing population density of short sorghumfrom 56000 to 92000 plant/fad and the tall sorghum from44000 to 72000 plant/fad the obtained increase in stover yield was 41.7% and 38.8%, respectively-It also clear that increasing soybean plant population densities increased stover yield of sorghumsignificantly.The interaction effect between intercroppingpatterns and sorghum or soybean population densitieswas significant • 0) Crude protein percentage and crude protein yieldof soybean Pure stand of soybean produced significantlyhigher cp yield than when intercropped with any the applied cropping patterns.Crude protein yield was increased in soybean seed significantly as soybean population densities increased from 70000 to 140000 plant/fad.pl, 011 percentage and oil yield of soybean Soybean oil yield was significantly increased inpure stand than when intercropped at any pattern the first pattern 1 : 1 produced higher oil yield than thesecond 2 : 1 pattern

significantly in association, witheither short or tall sorghum.Oil yield of soybean was significantly increased as the soybean population density increased either whenthe intercropped sorghum was short or tall. Effect of intercropping patterns and different populationdensities of sorghum and soybean on the competitive relationships.R) Land equivalent ratio (LER) of sorghum Vias higher than that of soybean,and intercropping pattern 1:1 had a higher LER than 2:1 pattern when either short or tallsorghum was associated with soybean.Land equivalent ratio increased by decreasing sorghum and increasing soybean population densities.S) Relative crowding coefficient (RCC) increased byincreasing soybean population densities and decreas~ that of sorghum. However the obtained RCC was higherwhen using short sorghum than the tall one.T) Aggressivity of sorghum was higher (dominant) thansoybean (dominated) in the two intercropping patternsand increased by increasing the population densities ofthe associated crops sorghum and soybean. The economic return (net income in EgyPtian pounds)from intercropping patterns and different populationdensities of sorghum and soybean:U) The net income increased by using intercropping pattern 1:1 than 2:1 and by increasing the populationdensities of the associated crops sorghum and soybean.Second study : Four field experiments were carried out to studythe effect of intercropping forage cowpea with shortand tall sorghum cultivars on the quantitative andqualitative characters of both crops.Each experiment included five treatments. threeintercropping patterns in alternative ridges of 1:1, 2:1 and 3:1 of sorghum : cowpea respectively andcompared with the pure stand for each crop. The five treatments were layed out in randomized completeblocks design in four replicates.Each plot had 12 ridges of 3.5 m long and 60 cm apart in an area of 25.20 m2•Cowpea was sown two weeks early before sorghum and the normal cultural practices for growing eachcrop were applied. Grain sorghum was harvested at physiOlogicalmaturity. whereas two cuts .ere taken from forage cowpea.Results could be summarized as follows : Effect of varioUS interaro atterns of fora e cow ea and sorghum on growth measurements of the associated cropS.sorghum:.A Plant height of either short or tall sorghum wasnot significantly affected by any of the applied intercroppingpatterns with cowpea.B Intercropping patterns of sorghum and cowpea produced the highest number of long lasting activeleaves/sorghum plant as compared with sorghum in pure stand.C Leaf/stem ratio of sorghum plant was higher inpure stand of sorghum than when intercropped with cowpeahaving a significant effect when using short sorghumcultivar.D Leaf area index of either short or tall sorghumculting was significantlY affected by the applied intercroppingpatterns with forage cowpea, where 1:1 intercroppingpattern produced the highest L.A.I. as comparedwith the other patterns and pure stand as well.Forage cowpeaE There .as a significant tendency fo the production of shorter cowpea plants as the associatedshort arta1l sorghum plantsyincreased in the pattern.F Number of branches per cowpea plant was significantlyhigher in pure stand as compared with the various intercropping patterns when using either short or tallsorghum cultivar. Higher number of leaves per cowpea plant wassignificantly produced from pure stand as compared with the applied intercropping patterns using short or tall sorghum.H The highest leaf area index was significantly obtained from cowpea in pure stand as compared with theother applied intercropping patterns.I _ Fresh and dry weight per cowpea plant were higher in pure stand of cowpea as compared with any of theapplied intercropping patterns using either short ortall sorghum cultivar. The obtained values were relativelY higher in the first than the second cut.Effect of various intercro atterns of sor urnnd cowpea on the yield components of sorghum~ _ Head length of either short or tall sorghum cultivar was increased when using the various intercroppingpatterns with forage cowpea as compared with pure stand especiaDywhen using tall sorghum where thedifferences were significant.K _ Head width of short and tall sorghum was increasedsignificantly by intercropping with forage cowpea as compared with their pure stand. L _ Number of grains/head of sorghum was significantlyincreased for short sorghum cultivar by the applied intercropping patterns with forage cowpea as comparedwith its pure stand.M Grain weight/head and IOOO-grain weight of eithershort or tall sorghum in pure stand produced signifioantlylower values of these characters as compared with any ofthe applied intercropping patterns.Effect of various intercropping patterns of sorghum andcowpea on the actual and adjusted yield of the associatedcrops. Sorghum : B Intercropping pattern 1:1 significantly producedthe highest adjusted grain yield of short and tall sorghum as compared with their pure stands.o stover adjusted yield of short and tall sorghum Wassignificantly increased when using the

applied intercroppingpatterns than their pure stands. whereas, intercropping pattern 1:1 produced the highest adjustedstover yield of sorghum.p Lowest adjusted biomass dry yield of either short or tall sorghum was obtained from their pure standcompared with any of the applied intercropping patterns.Forage cowpea : R _ Pure stand of forageproduced higher fresh and dand total yield than any ofpatterns when using eitherowpea significantlyyield of obtained two cutsthe applied intercroppinghort or tall sorghum.Also, there was a sigfresh and dry yield of foraincreased in the pattern, rficant reduction in thee cowpea as sorghum ratio spectively.The fresh and dry yields of forage cowpea werehigher in the applied intercropping patterns when using short rather than tall sorghum. This increase in freshand dry yield was true in the first cut than the second one.Effect of various intercropping patterns of sorghum andcowpea on crude protein percentage and crude protein yield of the associated crops.Grain sorghum:S - Higher crude protein yield of grain sorghum was obtained when the short or tall sorghum cultivarsgrown in association with forage cowpea as compared with their pure stands, also when using 1:1 intercroppingpattern than either 2:1 or 3:1.Forage cowpea : T - Pure stand of forage cowpea produced the highestcrude protein yield than when using the applied intercropping patterns. Also intercropping pattern 1:1produced significantly higher crud protein yield as compared with 2:1 and/or 3:1 pattern.Effect of various intercropping patterns of sorghum andcowpea on the competitive relationships:U - Land eqUivalent ratio (LER) of sorghtUllwas higherthan that of cowpea, and increased by increasing sorghum ratio in the pattern.v - The relative crowding coefficients for sorghum, cowpea and their mixture were decreased as the sorghumratio increased in the pattern from 1:1 to 2:1 and 3:1, respectively.The highest relative crowding coefficients of both sorghum cultivars were obtained when using 1:1 intercropping pattern.'W - The aggressivity was increased by increasing tall sorghum ratio in the applied patterns. However, oppositetrend was obtained when short sorghum was used. It was obviously clear that sorghum was the dominantintercrop component (and cowpea was dominated) over cowpea in all of the applied intercropping patterns.Effect of various intercroppipg patterns of sorghum andcowpea on the economic return (net income in Egyptian pounds).'X- The intercropping pattern 1:1 was the highest in the net income than 2:1 or 3:1 pattern, its mean thenet income was increased by increasingcowpea ratio in the intercropping pattern. The net income was increased when useding short rather thantall sorghum in intercropping patterns.