

Dedication

I dedicate this study to my son Azhari, my family and friends from whom I derived encouragement that I needed, and to all those to whom sorghum is a staple food and their sole source of income.

With love

SUAD

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ABSTRACT

A study was conducted at Shambat, in the Experimental Farms of the Agricultural Research Corporation and College of Agricultural Studies / Sudan University of Science and Technology, during 2010-2013 with the objectives of investigating the possibility of developing high yielding dual purpose fodder / grain sorghum varieties. 21 sorghum genotypes selected from a replicated breeding nursery comprising 122 genotypes were tested against 3 checks in Alpha lattice design with 3 replicates. Six dual purpose genotypes were identified and evaluated against a dual check under two harvest options across summer and winter seasons for two consecutive years. Split plot design was used with harvest option assigned to main plot. Data for forage and grain yields and their related traits were collected. Proximate analysis was carried out for some quality traits of grain and forage materials. Association study between different agronomic traits was carried out. The study revealed the possibility of selecting sorghum cultivars with high capacity for dual fodder/ grain production. This has been enhanced by the high significant differences encountered among genotypes for all studied traits. Six genotypes were identified as having the best performance for dual grain/fodder outyielding the standard dual check 'Abnaffain '. Of these, Abjaro seemed to be the best genotype combining the highest fodder and grain yields and was among the best in leaf to stem ratio. The Abu Sabein selections S.25Abu70 and S.03Abu70, though less leafy, ranked second to Abjaro in fodder/grain productivity and excelled Abjaro in earliness. ArfaaGadamak and WadAhmed, the standard grain checks, exhibited below average performance in both grain and fodder yields but were among the best in leaf to stem ratio. Abnaffain the standard dual check gave the lowest dry matter yield with below average grain yield. The best regrowth values were shown by the Sudangrass genotypes SG32-2A and SG08.

The study revealed positive highly significant correlation between green matter yield and grain yield pointing to the possibility of simultaneously combining high levels of grain and fodder yields in one cultivar. This was further supported by the positive and highly significant correlation between plant height and each of grain and fodder yields. Correlations of days to flower with each of forage and grain yield were weak and insignificant allowing development of early and high yielding dual fodder/ grain cultivars. Differences among harvest options and genotypes were significant for grain yield, plant height and days to boot in both seasons. Genotype x harvest option interaction was highly significant for the three traits in both seasons indicating the need for evaluating the dual sorghum cultivars under different harvest options. To maximize grain and fodder yields from dual sorghum cultivars, different genotypes were suggested for different harvest options in different seasons. The study revealed that when harvesting forage from the main crop and grain from ratoon, the best choice is to grow S.25Abu70 during summer and the cultivar Abjaro during winter. Ratoon cropping had resulted in significant reductions in grain yield amounting to more than two thirds of that of the main crop. The study revealed that when harvesting grain and stover from the main crop, Abjaro ranked top in both attributes followed by Abu Sabein selections, but still farmers may favour growing Abu Sabein due to lateness of Abjaro unless the stover value of the summer season is high enough to justify growing Abjaro. The data presented for protein content of the grain revealed that ratooning has no negative impact on protein content. Abjaro was the best in forage quality in terms of protein content, NDF and ADF but it showed below average protein content of the grain. The study concluded that direct selection for high yielding dual fodder/grain sorghum cultivars is possible. High levels of grain and fodder yields coupled with some desirable agronomic traits could be incorporated in one sorghum cultivar. Dual sorghum cultivars should be assessed under different harvest options to maximize the benefits gained from developing dual

fodder/grain cultivars. The traditional cultivar Abjaro and Abu sabein selections S.25Abu70 and S.03Abu70 were identified as dual fodder/grain cultivars under different harvest options. Future studies in collaboration with animal nutrition specialists should focus on developing dual sorghum cultivars having high stover quality with special emphasis on improved digestibility. Studies to maximize the benefits gained from dual cultivars should explore variety choice and cultural practices for different harvest options.

مستخلص الأطروحة

تربية أصناف ثنائية الغرض من الذرة الرفيعة

لإنتاج العلف و الحبوب

اجريت التجربة بالمزرعة التجريبية بهيئة البحوث الزراعية وكلية الدراسات الزراعية / جامعة السودان للعلوم والتكنولوجيا (شمبات) خلال الاعوام ٢٠١٣-٢٠١٠ بهدف دراسة امكانية تطوير اصناف ثنائية الغرض من الذرة الرفيعة لأنتاج العلف و الحبوب . تم انتخاب ٢١ سلالة من الذرة الرفيعة من حقل الانتخاب الذي يضم ١٢٢ نمطا جينيا و تم اختبار اداءها داخل تصميم الفا الشبكي Alpha lattice design. تم تحديد ستة انماط جينية ثنائية الغرض وتقييم اداءها مع شاهد ثنائي الغرض تحت خيارين للحصاد خلال موسمين متتالين (صيف- شتاء) وذلك باستخدام تصميم القطع المنشقة مع تعيين القطاع الرئيسي لخيارات الحصاد. جمعت بيانات انتاجية الحبوب والعلف والصفات المرتبطة بها واجري التحليل الكيميائي لبعض الصفات النوعية. تم دراسة الارتباط بين الصفات الحقلية المختلفة للعلف و الحبوب. اظهرت الدراسة امكانية انتخاب اصناف لها المقدرة العالية على الانتاج المتزامن للعلف و الحبوب وساعد في ذلك الاختلافات عالية المعنوية بين الانماط الجينية للصفات قيد الدراسة . الانماط الجينية الستة ثنائية الغرض اظهرت تفوقا عتى الشاهد "أب نفعين" في انتاجية العلف و الحبوب .

تفوق الصنف عجارو على جميع الانماط الجينية في الانتاجية المتزامنة للحبوب والعلف وكان من بين الافضل في نسبة الاوراق للساق. جاءت السلالات S.25Abu70 (منتخب ابو سبعين) و S.03Abu70 (منتخب ابو سبعين) في المركز الثاني لانتاج العلف و الحبوب وتوقفت في التباين على الصنف عجارو لكنها متدنية في نسبة الاوراق للساق.

الشاهدان النموذجان لأنتاج الحبوب ود أحمد و أرفع قدمك اظهرا مستويات متدنية من انتاج العلف و الحبوب لكنهما من بين الافضل في نسبة الاوراق للساق. اعطى الشاهد ثنائي الغرض (أب نفعين) ادنى انتاجية للعلف الجاف مع انتاجية متدنية للحبوب. السلالات المنتخبة من حشيشة السودان SG32-2A و SG08 كانتا الافضل في اعادة النمو بعد القطع (Regrowth)

اظهرت الدراسة ارتباطا معنويا موجبا بين انتاجية العلف الاخضر و الحبوب مما يشير الى امكانية الانتخاب المتزامن لدمج مستويات عالية من انتاجية العلف و الحبوب في صنف واحد. ودعم هذا وجود ارتباط معنوي وموجب بين طول النبات و انتاج الحبوب و العلف. الارتباط بين عدد الايام للازهار و انتاج العلف و الحبوب كان ضعيفاً وغير معنوي مما يسهل تطوير اصناف مبكرة ذات انتاجية عالية للعلف و الحبوب.

تم العثور على اختلافات معنوية بين الانماط الجينية و خيارات الحصاد لصفات انتاج الحبوب و طول النبات و عدد الايام للحمل خلال موسمي الصيف و الشتاء. تفاعل الانماط الجينية مع خيارات الحصاد كان

معنوياً للصفات الثلاثة مما يستوجب اختبار الاصناف ثنائية الغرض تحت خيارات حصاد مختلفة. لتعظيم انتاجية العلف والحبوب من الأصناف ثنائية الغرض تم ترشيح أصناف مختلفة لخيارات حصاد مختلفة لمواسم مختلفة.

أظهرت الدراسة أنه عند حصاد العلف من المحصول الرئيسي و حصاد الحبوب من البتقة (Ratoon crop) يفضل اختيار السلالة S.25Abu70 (منتخب ابو سبعين) لموسم الصيف والصنف عجارو لموسم الشتاء. انتاج الحبوب من محصول البتقة (Ratoon crop) تسبب في تدني معنوي وصل الى اكثر من ثلثي انتاجية الحبوب من المحصول الرئيسي.

أظهرت الدراسة أنه عند حصاد الحبوب والعلف التبن (Stover) معاً من المحصول الرئيسي حقق الصنف عجارو المركز الاول وتبعه السلالات المنتخبة من ابوسبعين S.25 Abu70 و S.03 Abu70 ولكن بالرغم من هذا قد يفضل المزارعون زراعة ابوسبعين لأنه أبكر في الازهار من الصنف عجارو، الا اذا كانت قيمة العلف التبن عالية بما يكفي لتبرير زراعة الصنف عجارو .

اظهرت النتائج أن انتاج الحبوب من البتقة (Ratoon crop) ليس له تأثير سلبي على نسبة البروتين في الحبوب. اظهر الصنف عجارو افضل نوعية للعلف من حيث نسبة البروتين والهضمية ADF والعلف المأكول أرايا NDF لكنه كان متدنيا في نسبة البروتين في الحبوب.

خلصت الدراسة الى امكانية الانتخاب المباشر لاصناف ثنائية الغرض من الذرة الرفيعة ذات انتاجية عالية من الحبوب والعلف. يمكن الجمع بين مستويات عالية من انتاجية الحبوب و العلف وبعض الصفات الحقلية المرغوبة في صنف واحد. لتحقيق اقصى قدر من الفوائد المكتسبة من الاصناف ثنائية الغرض يجب تقييم تلك الاصناف تحت خيارات حصاد مختلفة. تم تحديد الصنف التقليدي عجارو وسلالتي ابو سبعين S.25Abu70 و S.03Abu70 كأصناف ثنائية الغرض تحت خيارات مختلفة للحصاد.

الدراسات المستقبلية يجب أن تركز على تحسين نوعية العلف التبن (Stover) للاصناف ثنائية الغرض وذلك بالتعاون مع مختصي تغذية الحيوان و التركيز بشكل خاص على الهضمية. الدراسات المتعلقة بتعظيم الفوائد المكتسبة من الاصناف الثنائية يجب أن تشمل العمليات الفلاحية و اختيار الصنف لخيارات الحصاد المختلفة.