IMPROVING RESOURCE USE EFFICIENCY OF FORAGE PRODUCTION SYSTEM BY INTERCROPPING SYSTEMS

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INTRODUCTION

Sustainability of agriculture is a major concern in the Southern High Plains, where demand for good quality forages by the large dairy industry and declining water resources are threatening the future of irrigated crop production. The lower water use of forage sorghum (*Sorghum bicolor* (L.) Moench) compared to corn (*Zea mays* L.), makes it a better alternative for the region. Typically sorghum is grown at row spacing wider than 75 cm, in which the inter-row space is not occupied by the crop for the major part of vegetative growth. Research has also indicated that biomass productivity increases with mixing of diverse species (Szumigalski and VanAcker, 2006).

Intercropping is a system of growing two diverse species of crops on a piece of land at the same time with the assumption that they improve the use of both above ground and below ground resources more efficiently compared to growing them separately (Zhang and Li, 2003). Component crops in an intercropping system can also compliment each other (Hauggard-Nielsen and Jensen, 2005), which can also contribute to increased productivity per unit area. Inability to harvest intercropping systems for grain production by mechanical means is limiting intercropping systems to developing countries. However, in a forage production system both crops can be harvested together for silage.

Selection of a crop for intercropping systems depends on the goals for developing the system. For forage production systems in the region, crops that improve biomass production, resource use efficiency, forage quality, and fit well in the rotation system are suitable. Legumes are a group of crops that are rich in proteins, have wide adaptability, and possess the unique ability to fix atmospheric nitrogen. They have been recognized for their role in supplying nitrogen to the ecosystem and also improve phosphorous solubility.

Competition in an intercropping system can be for sunlight, nutrients and water. A legume crop that can tolerate lower light intensity or that can climb on the main sorghum crop to receive its share of radiation will be of great benefit. The objective of this field study was to understand radiation use pattern and radiation use efficiency of legume based intercropping systems compared to a monocrop of forage sorghum.

MATERIALS AND METHODS

A field trial was conducted at the New Mexico State University Agricultural Science Center at Clovis, NM during summer of 2008. Fertilizer was applied based on soil test results for forage sorghum. A two row plot planter with seed cones for each row was used to plant forage sorghum (cv. FS-5) at 75 cm row spacing and 3 cm deep. Legumes [*Lablab vulgaris* Savi cv. Rongai and Pole bean (*Phaseolus vulgaris*) cv. Genuine cornfield], were planted halfway between sorghum rows. Forage sorghums were planted at the recommended population density of 250,000 plants ha^{-1}, while legumes were planted at 150,000 plants ha^{-1}. A surface drip irrigation system with water meters for regulating amount of water applied was used to maintain crops relatively water stress free condition.

Biomass accumulation patterns of all crops were observed by harvesting 0.5 m of row length of both main and intercrops every 7-10 days. Sensors were installed to continuously monitor the microclimate parameters of wind, solar radiation, soil and air temperature. Leaf area index and interception of solar radiation was observed with Sunscan equipment. Periodic photosynthesis of crops in both systems was recorded using a photosynthesis unit (Li 6400, LiCor Inc).

RESULTS AND DISCUSSION

Intercropping systems developed leaf area faster and intercepted solar radiation more in the beginning of the season when it needed to use greater proportion of radiation (Fig. 1a). The advantage gradually decreased and by 60 days after planting there was no difference. Legume contribution to total biomass gradually decreased. At the termination of the trial, intercropping increased total biomass production by 15% (Fig. 1b). Net photosynthesis by legumes gradually decreased (data not presented), suggesting shading and/or competition for resources that reduced legume productivity. Lablab was more indeterminate and had longer duration compared to pole bean used, suggesting it may be better suited for the intercropping systems. A series of trials are being conducted to identify suitable legume crops, planting patterns and understanding of resource use patterns. Results may help in designing intercropping systems that increase resource use efficiencies and forage productivity.

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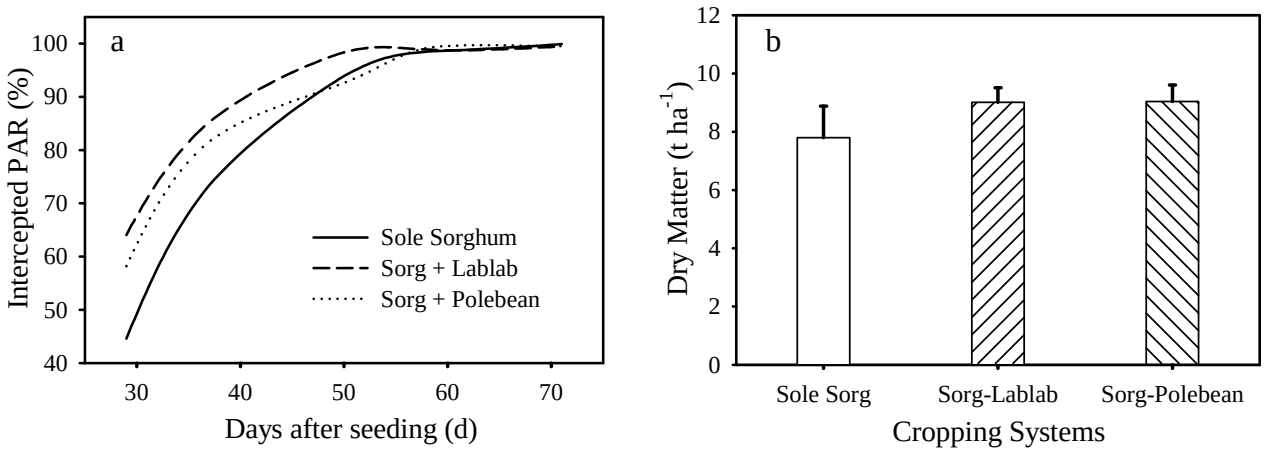

Figure 1. Seasonal radiation interception pattern of forage sorghum and legume intercropping systems in comparison to sole forage sorghum (a) and biomass production by sole and intercropped forage sorghum at the end of the trial (b) at Clovis, NM during 2008. Vertical bars are standard error of means.