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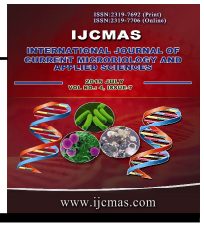

Original Research Article

Effect of Shelterbelts on Crop Yield in Al-Rahad Agricultural Scheme, Sudan

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A B S T R A C T

The study was conducted in Al-Rahad Agricultural Scheme (RAS) during the period as from 2003 to 2006. The objective of the study was to assess the impact of forest plantations (shelterbelts) on crop yield, micro-environment and benefits created by these forests. The data collected through a pre-designed schedule, field visits and observations. Crop yield measurements were done from 0H-30H (30 times height of trees) in the protected area during seasons 2004–2005 and 2005–2006 and also for the open area (The control). The study revealed that there was significant increase in crop yield in the protected zones compared with the open area, and the effect of shelterbelts extended to 30H of the shelterbelts. For *Eucalyptus camaldulensis* shelterbelt equal (30×17 = 510 m) and for the *Acacia seyal* shelterbelt is (30×9= 270 m). The study recommended that, a shelterbelt of one row of trees should be established after 30 H by using *Cajanus cajan.* SPSS software and SAS software programmes were used for analysis the data.

Keywords

Arid zone, Crops, Environmental Parameters, Plantations and production

Introduction

Rahad Agricultural Scheme (RAS) is a national multi-crops irrigated scheme established in early 1974 with a total area of 800000 feddanes, to be executed in two phases namely phase (1) 300000 feddanes and phase (2) 500000 feddanes. The research problem is that the Rahad Scheme was established in the arid and semi-arid climatic zones with maximum temperature ranging from 34 to 42 ºC and minimum 14 to 23 ºC. The relative humidity varies from 21% in April to 70% in August. The rainfall in the northern varies from the southern parts of the Rahad Scheme. The northern part has an annual rainfall average just below 300 mm, with a dry period of about eight months, while the southern part has an annual rainfall of 500 mm, with a dry period of seven to eight months, so the above mentioned factors necessitate the study of this area. According to the Forest National Corporation policy, 5% of irrigated agricultural schemes, as well as 10% of rain-fed mechanized schemes should be planted with trees (Abdalla, 2002, 2006).

In 1990 RAS introduced tree planting as one of main crops in the scheme and considered it as a cash crop. According to (UNEP, 1987), farm trees are very important for agriculture and livestock production, and provide essential tree products. They are

able to sustain agricultural production capacity via improving the microclimate, protecting and ameliorating the soil. Forests are one of the world's most vital renewable resources. They have four vital functions: They contribute to soil and water conservation.

Provide rural people with sustainable needs such as firewood, income generating and they are important source of industrial raw materials, hence foreign exchange and they harbour vast genetic resources.

There are some considerations for tree wind breaks and shelterbelts like choice of trees species, spacing, the orientation, length, height, density, gaps, position and number of rows. Tree planting and forest have a role to play in this endeavour by building greater resilience into traditional framing systems through improved soil and water conservation and by improving income generation from the sale of tree plantations, (World Bank Records, 1986).

There are many factors affecting the crops yields like, differences in forest plantations structure and orientation, soil type, crop species and variety, experimental procedures, agricultural practices, climate and seasonal differences, soil fertility and water content, and animal damage influence crop response to shelterbelts (Marshall, 1967).

Materials and Methods

Experiments: Two compartments of *Acacia seyal* and *Eucalyptus camaldulensis* were randomly selected to represent the main shelterbelts.

Site (1) *Acacia seyal*: This compartment was located west of *Acacia nilotica*, between stand of Eucalyptus and *Acacia seyal* (it is considered the compartment No.4 from the beginning of the main shelterbelt). The distance from the canal was 15 m, the width 75 m, orientation was east- west, and the distance from the farms to the shelterbelt is 42 m. The length was 300 m; and the length determines the extent of protected area downwind.

The growth was good and has a close crown and good regeneration. Tree spacing was 6 x 3m. Agricultural seasonal crops on the leeward of the shelterbelt were groundnuts, cotton and Sourghum (Dura). They were planted during May –June, the Groundnuts was grown before Sourghum because of its rotation i.e. it's longer than Dura. Mean tree height was 9 m.

Site (2) *Eucalyptus camaldulensis*

This site is located before the last compartment in El Fau shelterbelt, east of the river Rahad near village 19 (it is considered the compartment No.18 from the beginning of the main shelterbelt). It has the tallest trees in El Fau shelterbelts with height of 17 m. The length was 300 m; width, orientation and distance from canal were similar to that of site (1). Tree spacing was 4 x 4m. Agricultural seasonal crops were groundnuts, Sorghum, cotton and vegetables. Numbers of rows were 16 rows, with good growth.

Crop yield measurements: Crop yield was measured along transects extending at right angles from the outside edge of forest plantations from (0 H) to (30 H) 30 times the height of trees and the measurements included sorghum, cotton and groundnuts in Hawashas (farms) that were protected with forest plantations and this was replicated until the end of the farms. Also for unprotected area which is located 300 m north the shelterbelt and measurement for farm crops were done

Results and Discussion

Impact of Rahad forest plantations on crop yield

According to crop measurements in season 2004-2005(A) and season 2005-2006 (B) a significant increase in crop yield have been reported in the protected area (Fig. 1 and 2). The neighboring agricultural crops are (groundnuts, dura and cotton).

In zone 3, 13 H-20 H, the effect of forest protection declined and reduced so the area behind that would be out of protection. The effect of plantation forests extend to 30H downwind and 5H upwind, so for example a 10 m height forest will provide protection over an area extending to 300 m downwind. Wind speed gradually increases in the (Wake zone) down of Quiet zone until the impact of shelterbelt disappears. The protection that plantation forests provide depends mainly on its height, permeability (the extent to which gaps let the wind through), the vegetation cover upwind, and the angle at which the wind meets forest.

Table.1 Effect of tree species on crop yield kg/feddan

Tree species	Agric season (A)	Agric season (B)
Eucalyptus spp.	1091.89 a	1233.00 a
A. seyal	1103.22 a	1197.20 a

Means with the same letters in columns are not significantly different.

Fig.1 Effect of forest protection on crop yield kg/ feddan

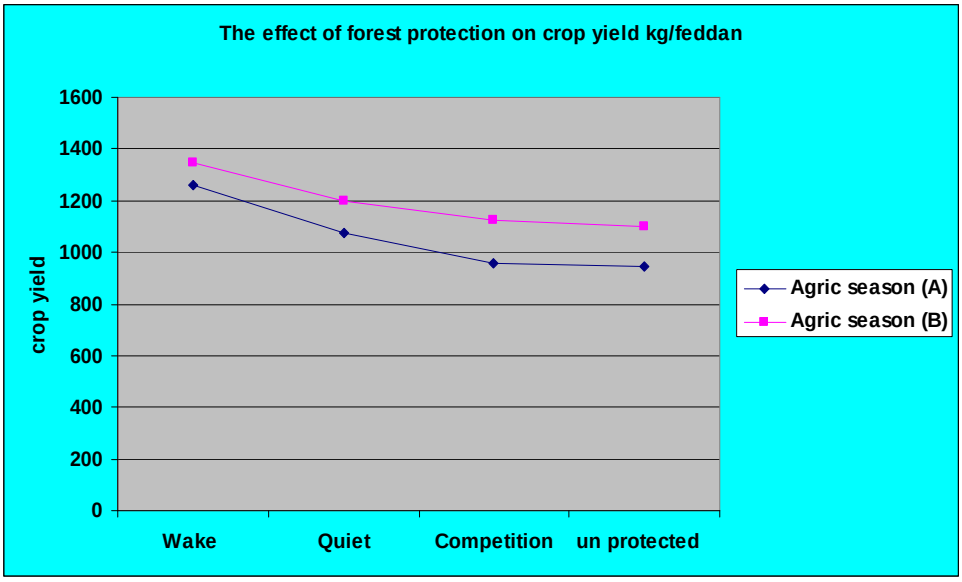
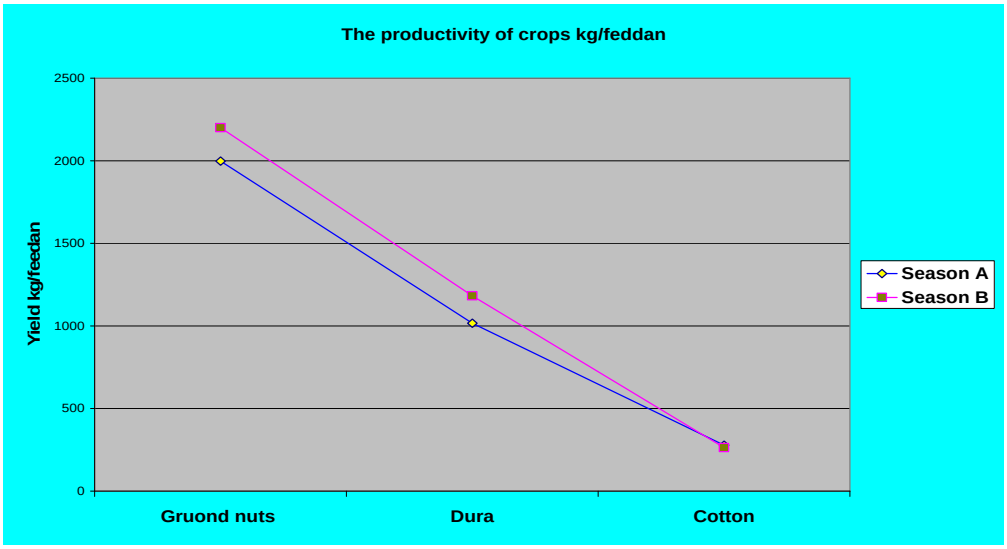


Fig.2 Productivity of crops kg/ feddan



Forest plantations at Rahad Scheme have a significant impact on crop yield. In zone 2, (Quiet zone), crop yield gave higher productivity compared with zone 1 (competition zone), zone 3 (wake zone) and unprotected area. The effect of Forests (shelterbelts) extends to 30 H of the shelterbelts e.g. For *Eucalyptus camaldulensis* shelterbelt equal (30×17 = 510 m) and for the *Acacia seyal* shelter belt is (30×9= 270 m).

Recommendations

The study has come out with the following recommendations:

The effect of forest protection extends to 30 H, so the study recommended that, a shelterbelt of one row of trees should be established after 30 H by using *Cajanus cajan.*

The government should further encourage the shelterbelt plantations on the boundaries of agricultural fields to minimize the harmful effects of strong winds and increase the farm returns.

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