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Effect of Rhizobium Inoculation and Diammonium Phosphate on Nodulation, Growth and Yield of Clitoria

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Abstract

A field trial study was conducted for two consecutive seasons (2014/15 and 2015/16), at the Demonstration Farm of faculty of Agricultural and Natural Resources, University of Bakhtalruda-Ed-Dueim, Sudan, to study the effect of rhizobium inoculation and diammonium phosphate (DAP) on the growth, and fresh yield of Clitoria (*clitoria ternate* L.) local genotype. The treatments consisted of control (without any fertilizer and inoculation), inoculation with rhizobium alone and rhizobium + 100 kg /ha (DAP) and rhizobium + 200 kg /ha (DAP). A complete randomized block design with four replicates was used. The results showed that rhizobium produced significant higher nodules number/plant, tallest plants, Relative growth rate was significantly highest, which was obtained by the treatment of rhizobium + 200 kg /ha (DAP). The obtained fresh yield was significantly greater with combinations of rhizobium + 200 kg /ha (DAP) and rhizobium + 100 kg /ha (DAP) In general, the interaction effect of rhizobium inoculation and significantly (3.35) increased nodules number per plant, plant height, relative growth rate and fresh yield of clitoria over the control. It can be concluded that genotype of irrigated clitoria produced significantly highest growth and fresh yield with combination of rhizobium inoculation and (DAP) when was used during summer season under Ed-Dueim condition

Key words: Effects, Inoculation, Rhizobium, Nodulation, DAP, clitoria

Introduction

Clitoria (*clitoria ternate* .L.) belongs to the family Fabaceae. It is also known as butter fly pea of Kordofan bean (Mahagob 2017). It is a twining perennial of the old world origin, now occurring throughout the low land of the tropics both naturally and cultivated (Yen, 1993). Clitoria is used in many ways. It is mainly used for grazing and it combined well with forage grasses, mainly sorghum when planted as a mixture. It is characterized by being alive under severe competition from other crops. About 30-40 species of clitoria occur throughout the tropics (Martin and Chanthy, 2009).In Australia, clitoria is highly thought of as a constituent of natural pastures. The strain that indigenous to Sudan central clay plain is less robust and less vigorous than that of Australia Strain (Duncan, 2017).

The leaves of this crop are used for animal feeding. Blue dye is extracted from seeds and the root bark contains tannins. Humans in some parts of the world sometimes eat pods. The plant also is grown as an ornamented plant and their leaves, roots and seeds have medicinal uses (Duke, 2012). Clitoria is well adapted to heavy cracking soils in many parts of the world, such as Queen land, India, Australia, Brazil and tropical Africa. In Sudan, it is grown as a rain-fed crop in the drier area of kordofan, as well as an irrigated forage crop in Khartoum State and Gezira state conditions. The cultivated area in Sudan is about 105.000

Fadden (1Fed=0.42 hectare). The average forage yield ranges between 7 to 12 tons per Feddans fresh forage, which is equivalent to 3-5 tons per feddan dry matter (Abdalla, 1999). In the Gezira scheme and other irrigated schemes its inclusion in the crop rotation has not been recommended because of the difficulty of eradication of its stubble, roots, and tends to ratoon in the following crops, since it has the ability to overcome the adverse conditions of the dry season (Thomas and Sumberg, 1995)

Clitoria nutritive value is not much different from that of alfalfa. It contains about 14 % crude protein, 9 %digestible protein and 56 % total digestible nutrient (TDN). The seed also contains 10 - 12 % oil, 73-78 % oleic acid and phosphorous which is occurring as soluble phosphorous, and sparingly solubles such as calcium, iron and manganese. Generally, the cultivation of clitoria in Sudan is relatively limited, research work on the crop is little, and more studies are therefore needed. In addition to that, farmers are not aware of most of its cultural practices. (Mohammed and Abu suwar 1996). Therefore the objectives of this study is to evaluate the effect of rhizobium inoculation and diammonium phosphate on nodulation, growth and forge yield of (*Clitoria ternate* L.) under White Nile State,E-Duiem locality conditions.

Materials and Methods

A field experiment was conducted for two consecutive seasons (2014/15 and 2015/16) at the Demonstration Farm of the Faculty of Agricultural and Natural Resources, Ed-Duiem, to study the effect of rhizobium inoculation and diammonium phosphate fertilization on growth and yield of clitoria (*Clitoria ternate* (L.) at Ed-Duiem locality (32^o 20^o E, Altitude 13^o 39^o and Attitude380 sea level). The soil of the experimental site is heavy clay with alkaline PH (8.4). The experiment was designed to study the effect of rhizobium inoculation and diammoniumphosphate fertilization on nodulation, growth and forage yield of clitoria (*clitoria ternate* L.). The land was prepared by disc plough, harrowed, levelled, and ridged. Spacing between ridges was 70cm, and then it was divided into plots 4×4 m with six ridges. The sowing date was on 4 th March in summer seasons for each season. Inter- row spacing was 20 cm with 4-5 seed per hole on the top of the ridges. Irrigation was carried throughout the growing season at 7-10 days intervals. Weeding was done manually in both seasons and whenever necessary. Seeds were inoculated by rhizobium. Diammonium phosphate fertilization (DAP) containing (16% N + 48% P_2O_5) was added at sowing.

The treatments of this study were:

C = control (without inoculation or fertilizer)

+R= inoculation with rhizobium

+R = inoculation with rhizobium + 100 kg/ha (DAP)

+R= inoculation with rhizobium 200 kg/ha (DAP)

Five plants were selected randomly from the inner ridges, leaving one meter at each end of the plot, then the mean plant height was recorded. Relative growth rate (RGR) was determined by taking the above soil biomass of sample from area of $4m^2$ twice: first after 5 weeks after germination (DW_1) and the second after 10 days from the first one (DW_2) and dried by oven immediately for 72 hours, then weighed and recorded according to the formula

DW2-DW1/time × area. Nodules number per plant was detected and was counted after 36 days from germination time.

Data generated was subjected to statistical analysis using GEN STAT software. Analysis of variance was carried out for all treatments and means were tested and separated using Duncan Multiple Range Test (DMRT).

Results and Discussion

Nodules number/plant and plant height (cm)

In this investigation as shown in the table (1) rhizobium inoculation (R) significantly increased nodules number/ plant and plant height. Similar results were reported by Majid*et al*. (2009) and Faisal .E. A. (1986). The interaction between rhizobium+100 and 200 kg/ha of diammonium phosphate increased number of nodules per plant and plant height over the control.

This positive result could be related to the increase of nutrients resulted by the rhizobium inoculation fixed nitrogen and phosphorus and nitrogen contained in DAP fertilizer. This result agreed with those of Maurya and Rathi (2000) and Mrkovacki, *et al*.,(2008) who reported in general that phosphorus, starter nitrogen, rhizobium inoculation and DAP increased nodules number/plant and plant height of clitoria. Nodulation failed in control treatment how which could be related to absence of suitable rhizobium strain on fields. Similar result was reported by Papastylianou ,(1986).; Salih S. H, *et al* (2017) who reported in general that soybean in non-inoculated plots with Rhizobium japonicum failed to nodulate.

Relative growth rate ($g/m^2/day$)

As shown in table (1), it is clear that rhizobium inoculation (R) significantly (3.35) increased relative growth rate over the control (C). Ali , et al.,(2011) found similar result on chickpea, by Combination of rhizobium inoculation + 200 kg/ha DAP (DAP1) which significantly obtained higher relative growth rate (RGR) as compared to the control. The best relative growth rate was recorded in the combination of rhizobium inoculation + 100 kg/ha DAP and rhizobium inoculation + 200 kg/ha DAP . This may be related to DAP mineral contents and the nutrient nitrogen fixed by the rhizobium inoculation. Similar results were obtained by Salih S. H, *et al* (2017) and Ali et al.,(2011) They were agreement with this findings of this study. Also they reported that the interaction between chemical and bio-fertilizers significantly increased growth attributes of clitoria.

Fresh yield (t/ha)

It is evident from the data presented in table (1), that rhizobium inoculation (R) significantly (5.35) increased fresh forage yield, over the control (C). Ibrahim *et al*. (2011) also observed that at Ed-Duiem region that inoculation significantly improved forage yield,. The interaction between rhizobium and diammonium phosphate (DAP) significantly increased fresh forage yield as compared to the control. Young et al., (1989) reported that inoculation with rhizobium and DAP increased forage yields of clitoria. The fresh forage yield/ha obtained from combinations of rhizobium inoculation and 150kg/ha DAP was found to be in agreement at par with that of combination of rhizobium +100kg/ha DAP which significantly produced the highest freshforage yield /ha. This might be due to the

combine effect of DAP, which contains phosphorus and nitrogen as well as enhancement of phosphorus and nitrogen availability to plants.

Conclusion

The above-mentioned results indicated that genotype of clitoria significantly produced highest nodules number per plant, tallest plants, higher relative growth rate and fresh forage yield by the combination of rhizobium inoculation and diammonium phosphate (DAP)when was used during summer season under white Nile State-Ed-Duiem conditions.

Table 1. The effect of rhizobium inoculation and diammonium phosphate (DAP) on relative growth rate, Nodulation, plant height and fresh forage yield of clitoria during the cropping seasons 2014/15 and 2015/16.

Treatment	Relative growth rate		No. of nodules/p		Plant height (cm)		Fresh forage yield	
	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16	2014/15	2015/16
Control ©	14.87 b	23.0 b	56.67c	31.67 c	67.03 c	50.10 c	3.10 c	3.33 b
Rhizobium ®	14.13 b	22.0 b	63.00 bc	39.00 bc	91.56 ab	61.40 b	3.50 bc	3.63 ab
Rhizobium + DAP100	18.55 a	30.7 a	69.47 ab	45.00 b	86.81 b	68.38 ab	4.00 ab	4.70 ab
Rhizobium + DAP200	20.95 a	35.3 a	71.13 a	57.00 a	101.28 a	71.30 a	4.23 a	5.35 a
SE ±	1.26	0.31	2.96	3.16	4.18	3.40	0.21	0.75
CV %	9.03	13.70	5.56	8.97	5.91	6.62	7.01	21.66

Means followed by the same letter are not significantly different at 5% level according to(DMRT)..

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