

NUTRITIVE VALUE OF MAIZE (*Zea Mays*) AND DOLECOUS (*Lablab Purpureus*) AS AFFECTED BY PHOSPHOROUS FERTILIZATION AND INTERCROPPING

E.O. AMASAIB*, BALGEES, A, ATTA ELMNAN, A.G. MAHALA and A.M.A. FADEL ELSEED

University of Khartoum, Faculty of Animal Production, Department of Animal Nutrition, Sudan

*E-mail: samaniamasaib@gmail.com

ABSTRACT: A field experiment was conducted at the Demonstration Farm of University of Khartoum to determine the effect of phosphorous fertilization and intercropping on the nutritive value of *Zea mays* and *Lablab purpureus*. The field experiment was arranged as Split Plot Design with four replications. The main plots were (*Lablab purpureus* as sole crop, *Zea mays* as sole crop, *Lablab purpureus* and *Zea mays* in the mixture). The sub plot treatments were phosphorous fertilization at the rate of (0, 50 and 75 kg P₂O₅ / ha) which were then referred to as P₀, P₁ and P₂ respectively. The plants measured were *Lablab purpureus* as pure stand, *Lablab purpureus* in the mixture, *Zea mays* as the pure stand and the *Zea mays* in the mixture. Samples of 45 days cut from sowing were used to assess the ash, crude protein (CP), ether extracts (EE), crude fiber (CF), neutral detergent fibre (NDF) and dry matter digestibility. The data were statistically analyzed using complete randomized design. The results revealed that intercropping and phosphorous fertilization caused a significant (P<0.05) increased on the CP content and dry matter digestibility of all forages under estimation. Intercropping and phosphorous fertilization caused slight increase on the Ash content for all crops in this study. Moreover, Intercropping and phosphorous fertilization caused a decrease on the CF and NDF content of all forages under estimation but with no significant difference. However, Intercropping caused non-significant effect (P<0.05) on the EE content of *Zea mays* while, intercropping had a positive influence (P<0.05) on the EE content of *Lablab purpureus*. The data obtained indicated that phosphorous fertilization caused non-significant effect on the EE content of all crops in this study (P<0.05) except *Lablab purpureus* in the mixture with *Zea mays* which increased significantly (P<0.05) by increasing phosphorous level. It can be concluded that intercropping and phosphorous fertilization improved the nutritive value of both maize and lablab bean.

Key words: Nutritive Value, Digestibility, Forage Corn, Dolecous, Intercropping, Phosphorous Fertilization

ORIGINAL ARTICLE

INTRODUCTION

The nutritive value of the tropical grasses and legumes is characterized by low quality in term of crude protein and digestibility. Around cities in the Sudan milk and meat production depends on crossbred animals which require high quality feed for maximum production potential. The major problems faced the producers is how to supplement their animals with protein source which is very expensive. So the improvement of these tropical grasses is one of most important issue so as to provide livestock with an affordable source of protein. Recently intercropping grasses with legumes gained an increasing interest in an attempt to substantiate functionalable biodiversity agricultural production (Baumann, 2004), through improving soil fertility and hence plant quality. Moreover, a unique approach in enhancing plant quality and quantity is through integration of fertilization program. The objective of the current study is to examine the effect of intercropping and phosphorous fertilization on nutritive value of maize and lablab bean.

MATERIAL AND METHODS

Site of the study

The study was conducted at the University of Khartoum Demonstration Farm of the Faculty of Agriculture at Shambat, Khartoum North, Sudan.



Land preparation

The treatment(s) were arranged in split plot design with four replications. The main plots were (*Lablab purpureus* as sole crop, *Zea mays* as sole crop, *Lablab purpureus* mixture, *Zea mays* mixture), while the sub plot treatments were phosphorous fertilization. The application of super phosphate was in the levels of 0, 50 and 75 kg P₂O₅ / ha., which were denoted as P₀, P₁ and P₂ respectively.

Chemical analysis

Proximate analysis: Samples of 45 days cut from sowing were analyzed, for determination of crude protein, (CP), ether extract (EE), crude fibre (CF) and ash (AOAC, 1980). Neutral detergent fiber (NDF) was determined using procedures Van Soest et al. (1991).

In vitro digestibility: *In vitro* DM digestibility of samples was determined using methods of Tilly and Terry (1963). Rumen fluid was collected from local breed calves at the morning before feeding.

Statistical Analysis

The data collected were subjected to analysis of variance (ANOVA) using statistical analysis system, followed by Duncan's multiple range test and differences were considered significant at P<0.05.

RESULTS

Table 1 shows the effect of intercropping on the nutritive values of *Lablab purpureus* as pure stand, *Lablab purpureus* in the mixture, *Zea mays* in the pure stand and *Zea mays* in the mixture. The data showed that intercropping for both maize and lablab bean improved significantly (P<0.05) the CP, ash and EE content and DM digestibility with slight decrease in CF and NDF. Table 2 illustrates the effect of phosphorous fertilization on the nutritive values of *Lablab purpureus*. CP content and DM digestibility were found to be positively affected by phosphorous fertilization (P<0.05). The rank was found to be as follows P₂ > P₁ > P₀ for both in pure stand and the mixture.

In respect to the effect of phosphorous fertilization on the CF content and the NDF content for *Lablab purpureus* in the pure stand and the mixture, there were non-significant differences (P>0.05) among all phosphorus levels, with the least value attained for the plots applied with P₂ level of fertilization.

Table 1 - Effect of intercropping on chemical composition (%) and *in vitro* DM Digestibility of *Lablab purpureus* and *Zea mays*

Crop type	Ash	CP	EE	CF	NDF	DM dig.
<i>Lablab purpureus</i> Pure stand	14.5 ^a	18.5 ^b	2.20 ^b	21.0 ^b	38.8 ^b	59.40 ^b
<i>Lablab purpureus</i> in the mixture	16.8 ^a	26.5 ^a	6.03 ^a	20.2 ^b	35.3 ^b	66.80 ^a
<i>Zea mays</i> Pure stand	13.1 ^a	15.7 ^b	2.9 ^b	27.1 ^a	49.1 ^a	55.01 ^b
<i>Zea mays</i> in the mixture	14.5 ^a	22.2 ^a	3 ^b	26.5 ^a	47.5 ^a	64.70 ^a
SEM	8.19	5.11	1.02	1.80	8.06	3.73

a,b,c values within columns with different superscript differ significantly (P< 0.05). CP = crude protein; EE = ether extract; CF = crude fiber; NDF = neutral detergent fibre; SEM = standard error of means; Dig. = digestibility.

Table 2 - Effect of phosphorous fertilization and intercropping on chemical composition (%) and *in vitro* DM digestibility of *Lablab purpureus*

Crop type	Fertilizer	Ash	CP	EE	CF	NDF	DM dig.
<i>Lablab purpureus</i> in pure stand	P ₀	13.4 ^a	13.7 ^c	1.6 ^d	23.5 ^a	49.9 ^a	67.42 ^b
	P ₁	13.9 ^a	18.9 ^c	2.3 ^d	23 ^a	46.9 ^a	68.16 ^b
	P ₂	15.5 ^a	23.2 ^b	2.6 ^d	22.3 ^a	46 ^a	75.65 ^a
<i>Lablab purpureus</i> in the mixture	P ₀	14.6 ^a	23.1 ^b	3.7 ^c	22.3 ^a	48.9 ^a	68.67 ^b
	P ₁	16 ^a	25.6 ^b	5.8 ^b	22 ^a	47.9 ^a	69.70 ^b
	P ₂	16.9 ^a	30.7 ^a	8.8 ^a	21 ^a	47.7 ^a	77.15 ^a
	SEM	14.18	8.85	1.77	3.13	13.97	6.46

a,b,c Values with in columns with different superscript differ significantly (P< 0.05). CP = crude protein; EE = ether extract; CF = crude fiber; NDF = neutral detergent fibre; SEM = standard error of means; Dig. = digestibility. P₀= 0 kg /ha P₂O₅; P₁= 50 kg /ha P₂O₅; P₂=75 kg /ha P₂O₅.

Table 3 - Effect of phosphorous fertilization and intercropping on chemical composition (%) and *in vitro* DM digestibility of *Zea mays*

Crop type	Fertilizer	Ash	CP	EE	CF	NDF	DM dig.
<i>Zea mays</i> in pure stand	P ₀	12.2 ^a	14 ^c	1.2 ^a	33.7 ^a	54.1 ^a	60.11 ^b
	P ₁	12.9 ^a	14.2 ^c	1.6 ^a	31.5 ^a	52.4 ^a	62.45 ^b
	P ₂	13.2 ^a	19.1 ^b	2.2 ^a	30.2 ^a	51.8 ^a	70.51 ^a
<i>Zea mays</i> in the mixture	P ₀	13.1 ^a	14.9 ^c	1.6 ^a	31.4 ^a	53.1 ^a	62.68 ^b
	P ₁	15.1 ^a	15.8 ^c	2 ^a	30 ^a	52.4 ^a	63.06 ^b
	P ₂	16 ^a	24.9 ^a	2.2 ^a	29 ^a	52 ^a	72.52 ^a
	SEM	10.2	6.8	1.1	5.1	11.9	4.46

a,b,c Values with in columns with different superscript differ significantly (P< 0.05). CP = crude protein; EE = ether extract; CF = crude fiber; NDF = neutral detergent fibre; SEM = standard error of means; Dig. = digestibility. P₀= 0 kg /ha P₂O₅; P₁= 50 kg /ha P₂O₅; P₂=75 kg /ha P₂O₅.

The effect of phosphorous fertilization on the nutritive value of *Zea mays* is illustrated in Table 3. The data revealed that plots applied with P2 had a significant influence ($P>0.05$) on the CP content with the highest value recorded for P2 level of fertilization for *Zea mays* in pure stand and in the mixture. On the other hand, the effect of phosphorous fertilization on the CF content and the NDF content, was found to be non significant ($P>0.05$) among all various levels of phosphorous fertilization. DM digestibility for *Zea mays* in pure stand was increased significantly by increasing the level of phosphorous fertilization with the following trend: P2>P1>P0.

DISCUSSION

CP content

The CP content of *Zea mays* in the mixture (22.2%) was significantly ($P<0.05$) higher than CP *Zea mays* in pure stand (15.7%). It could be concluded that lablab bean as leguminous plant has supplied the grasses with nitrogen in the grass-legume mixtures. This results in the line of Mehdi Dahmarden et al (2009) who stated that *Zea mays* when sown in mixture with cow pea secured a higher CP than *Zea mays* when sown alone. Moreover, this results were in the harmony with Fujita et al. (1992) who reported that protein concentration was increased from 69-81 g.kg⁻¹ for Maize sole cropping to 88-108 g.kg⁻¹ for various intercropping pattern.

In this study *Lablab purpureus* in the mixture had recorded the highest value of CP 26.5%. In USA Armstrong et al., (2008) found that CP was higher for lablab bean when sown in intercropping with *Zea mays* (13%) than sole cropping (6.1%). Contradicting results were found by Ibrahim et al. (2006) who noted that the Cowpea sown alone produced more crude protein (18.10%).

Phosphorous fertilization was found to have a positive effect on CP of *Zea mays*. This result may be attributed to the fact that Phosphorous fertilization often increases nodulation and hence increase nitrogen or CP content in grasses (Hauque and Mohammed, 1985). This result was not in the line of Eltelib et al. (2006) who found none significant effect of phosphorous fertilization of *Zea mays* fodder. More over in Nigeria, Kombiok, and Elemo (2004) found non consistent effect of phosphorous fertilization on *Zea mays*. Based on the results, phosphorous fertilization significantly increased the CP content of lablab bean. Increasing the proportion of the legume particularly the leaves as affected by phosphorous fertilization may increase the CP concentration of the legume. In Turkey Tahir et. al. (2007) stated that When P fertilization was applied alone, crude protein concentration increased. In contrast Mullenr et.al (2000) observed no change in yield or protein for alfalfa when applied with 30 kg P/ ha.

DM digestibility

Inter-seeding grasses with legumes has a significant effect on DM digestibility of *Zea mays* ranging from 55.01 % for sole seeding to 64.70 % for mixed seeding. The positive effect of intercropping on DM digestibility may be attributed to the higher protein concentration for *Zea mays* when sown in the mixture with *Lablab purpureus*. These results were in the line with Javanmard et al., (2009) who found that intercropping of legumes with *Zea mays* significantly increased digestibility of the forages. With the increase of phosphorous fertilization level DM digestibility increased for *Zea mays*. This indicated that phosphorus fertilization has raised the nutritive value of *Zea mays*. These results were in conformity with Rathore and Kumar (1977) who noted that phosphorous fertilization increased digestibility of sorghum in the pure stand and sorghum in the mixture. Moreover, as it was obvious from this study phosphorous fertilization had a positive impact of DM digestibility of lablab bean. This result was in the consistency of Colomb et al., (2002) who noted that phosphorous fertilization increased digestibility for alfalfa in the pure stand and in the mixture.

NDF and CF content

Intercropping grasses with legumes reduced both NDF and CF. These results were consistent with the results stated by Eskandari (2012), Dahmardeh (2009) and Lauriault et al. (2004). On the other hand Armstrong et al., (2008) reported that intercropping climbing beans with corn increased neutral detergent fiber concentration and decreased digestibility compared to monoculture corn. Phosphorous fertilization caused little reduction on CF and NDF of both *Zea mays* and lablab bean. Same results were obtained by Dianati Tilaki et al., (2010).

Ash content

Although intercropping caused non-significant influence on the ash content for *Lablab purpureus* and *Zea mays* however, slight increase was recorded on the ash content in the mixtures. These were contradicting with many researchers who reviewed that intercropping can raise the Ash content of the crops. These findings were not similar to Ibrahim et al. (2006) who noted that the Cowpea sown alone produced the lowest ash content. In addition, these results not confirmed the observation reported by Javanmard et al., (2009) in which they found that ash content of Maize forage increased by intercropping as compared with Maize sole crop. The effect of phosphorous fertilization and intercropping on the ash content was non-significant for all forages under estimation. These results were not confirmed the earlier reports by Habib et al., (1971); Colomb et al., (2002); Ayub et al., (2002), in which they found that application of phosphate increased the percentage of ash in legumes. In addition to that Colomb et al., (2002) stated that phosphorus fertilization increase the ash content in alfalfa when intercropped with *Zea maize*.



EE content

The EE content was found to be higher in *Lablab purpureus* in the mixture when compared to *Lablab purpureus* in pure stand. These results were not supported by Boufaied et al. (2003) who noted that intercropping had no effect on concentration of the EE content for legumes. On the other hand, non-significant effect was observed between *Zea mays* in pure stand and *Zea mays* in the mixture in respect to the influence of intercropping. These results however, were in the line with Boufaied et al. (2003) who noted that intercropping had no effect on concentration of EE content for grasses. Phosphorous fertilization had non-significant effect on concentration of EE content of all crops under estimation except for *Lablab purpureus* in the mixture. These results were not in the line of the earlier report by (Ibrahim, 1996) in which he found that increased application of phosphorous up to 200 kg P₂O₅ / ha resulted in a significant decrease in the EE content of *Clitoria* when intercropped with *Zea maize*. While these results were in conformity with Boufaied et al., (2003) who noted that phosphorous fertilizer had non-significant effect on concentration of total and individual fatty acids in grasses and legumes.

CONCLUSION

The results indicated that phosphorous fertilization and intercropping contributed significantly to improve the nutritive values for both *Zea mays* and lablab bean.

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