ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 45(1): 93-100, (2007).

RESPONSE OF SOME LEGUMINOUS PASTURE SPECIES TO PHOSPHORUS FERTILIZATION LEVELS UNDER NEW RECLAIMED SOIL CONDITIONS

BY

El-Houssini, A.A.
Plant Ecology and Range Management Department Desert Research Center, Cairo, Egypt

ABSTRACT

Three legume pasture species were evaluated as pasture plants under the climatic conditions of Mariout region, North Egypt. Two field experiment were carried out during 2002 and 2003 summer seasons at Mariout Experimental Station Farm to study the effect of three phosphorus levels (0, 40 and 80 kg P_2O_5/fed.) on some growth parameters and forage yield of three leguminous pasture species: *Cyamopsis tetragonoloba* (S_1), *Clitoria ternatea* (S_2) and *Dolichus lablab* (S_3). Treatments were laid out in a Split Plot Design in three replicates.

Results revealed the following:

1- Most of growth characters and forage yield of the different legume pasture species under study were enhanced by increasing phosphorus levels.
2- *Dolichus lablab* was superior in some studied growth parameters as plant height, No. of branches per plant, leaf area per plant and leaf area index. Whereas, *Cyamopsis tetragonoloba* was superior in leaf: stem ratio and the specific leaf weight as compared with the other studied plant species.
3- Highest fresh and dry forage yields was recorded for *Dolichus lablab*. Such trend was noticed in the two cuts taken.
4- It is obvious clear that *Clitoria ternatea* had the lowest growth characters and forage yield.

Key words: *Cyamopsis tetragonoloba, Clitoria ternatea, Dolichus lablab,* Phosphorus, Pasture, Growth and Forage yield

INTRODUCTION

Pressure on land resources, lack of improved forage species, and improper management practices has led to shortages and poor quality of forage for animal production in Egypt. The situation is even worse under new reclaimed soils conditions, especially during the dry season "summer season".The use of untraditional summer forage legumes such as *Cyamopsis tetragonoloba, Clitoria ternatea* and *Dolichus lablab* in animal feeding is considered as a solution to this problem. Relatively anticipated high feeding value, possession of a deep tap root, and N-fixing ability are three important desirable characters common for these leguminous species.

There is thought to be direct effect of phosphorus on nitrogen fixation by legumes because the concentration of phosphorus coinciding with maximum legume production is usually less than that corresponding to maximum nitrogen concentration (Andrew 1976). Moreover, legume species are known to be of high demands for phosphorus, due to their production of compounds containing protein, of which phosphorus is an important constituent (Al-Abdulsalam and Al-Tahir 1991 and Abou-deya *et al.,* 1999). Silva and Faria (1989) studied the response of some tropical forage legumes included *Clitoria ternatea* to P fertilizer application rates of 0 or 60 Kg P_2O_5/ha. They stated that average yields over species and years were 2.58 t with and 2.53 t without P fertilizer application. They also found that applied P increased the average plant content of P from 0.19% to 0.22%. Seeds of *Lablab purpureus* were inoculated with *Rhizobium* and given 0 or 230 Kg P_2O_5/ha. Herbage yield was 31 t /ha without phosphorus fertilizer or rhyzobium inoculation and from 46:51 t in all other treatments (Abdel Magid 1992). Moreover, fresh and dry forage yield of pigeon pea (whole plant, leaves and stems) showed an increase in relation to the increase in phosphorus rates up to 45 Kg/fed (Reiad *et al.,* 2001). Furthermore, Abou-deya *et al.,* (1999) pointed out that both growth and forage yield parameters of different pasture legume species as *Vigna luteola, Vigna oblingifolia* and *Macroptilum lathyroids* were increased by increasing PK rates. Also, slight increase in growth parameters of *Cyamopsis tetragonoloba* was observed as a result of P foliar spray (El-Toukhy and El-Houssini 2005). Application of phosphorus fertilizer improved growth parameters as well as forage yield of most forage legumes. Many investigators came to similar conclusion among whom were Ibrahim *et al.,* 1996 on *Clitoria ternatea* and *Lablab purpureous,* Carsky *et al.,* 2001 on *Lablab purpureous,* Andrew and Robins, 1969 on some tropical pasture legumes, Munir *et al.,* 2003 on *Vicia narbonensis,* and Owolade *et al.,* 2006 on *Vigna unguiculata.*

Although the importance of phosphorus fertilizer to legumes has been recognized worldwide (Jin *et al.,* 1992; Mugwira and Hague, 1993). Such information is still very scanty in Egypt. Therefore, the objective of this study is to determine the effects of different phosphorus levels on growth and forage productivity of some pasture legume species under reclaimed soils conditions.

MATERIAL AND METHODS

The present investigation was conducted at Mariout Research Station, Desert Research Center, North western Coast of Egypt, during the two successive summer seasons of 2002 and 2003. Soil of the experimental site is characterized as sandy clay loam texture with PH of 8.3 and EC of 2.98 mmhos/cm having 46.56 % caleium carbonate. The studied treatments were nine combinations of three pasture leguminous species (*Cyamopsis tetragonoloba , Clitoria ternatea* L. and *Dolichus lablab*) and three levels of phosphorus fertilizer (0,40,and 80 kg P_2O_5/fed). The experiment was laid out in a split plot design where plant species randomly located in the main plots and phosphorus fertilizer levels were devoted to the subplots, the treatments were replicated thrice. Experimental unit area was 3x 3.5 m (10.5 m^2) contaning 6 ridges of 60 cm apart. Seeds of all plant species

under study were sown on May 17th and June 11st in 2002 and 2003 growing seasons, respectively. Total amount of phosphorus fertilizer was applied during soil preparation in form of Calcium superphosphat (15.5%P_2O_5). A basal application of 40 Kg N/fed. was added as ammonium sulfate (20.6 90 N) at the seedling stage. Plots were hand weeded frequently.

The first cut was taken at 70 days from sowing and the second one was harvested after 45 days from the first cut during the two seasons.

To monitor changes in above ground vegetative parts, ten guarded plants were randomly chosen from the interior of the plot border at before each cut and separated into leaves and stems to determine various vegetative characters including plant height (cm),No. of branches/plant, leaf area/plant (dm^2) , leaf area index (LAI), leaf : stem ratio and specific leaf weight (mg/cm^2). All plants of each experimental unit were harvested to determine fresh and dry forage yields of leaves, stems and whole plant in t/fed. The fresh vegetative samples were oven-dry in an air forced oven at 105 C° for 3 hours or until constant dry weight, then dry matter percentage was used for estimating dry forage yield and its components.

Data were exposed to the proper statistical analysis of variance of a split plot design according to the procedures outlined by Snedecor and Cochran (1985) using computer statistical program Co-STAT. Treatment means were compared by Lest Significant Differences (L.S.D.) test at 5% level of probability. Data of the two seasons was tested using homogeneity test which was valid for the combined analysis.

RESULTS AND DISCUSSION

1-Plant species:

a- Growth parameters:

Generally, it is obviously clear from results illustrated in Table (1) that the three legume pasture species under study varied in their ability to grow under the prevailing environmental conditions of Mariout region. Data obtained indicated that *Dolichus lablab* was significantly superior in most of studied growth parameters as plant height, No. of branches/plant, leaf area, leaf area index and specific leaf weight. Whereas, it had the lowest value of leaf : stem ratio compared to each of the other two plant species (*Cyamopsis tetragonoloba* and *Clitoria ternatea*). Such trend was observed in such of the two cuts harvested in the two experimentation years.

b- Forage yield:

Data presented in Table (2) indicate that fresh and dry forage yields of the three pasture legume species under study were significantly differed. This significant effect was clearly observed in all traits measured in the first cut. Whereas, in the second one stem fresh and dry yields as well as total fresh forage yield were only significantly responded in favour of *Dolichus lablab*. It could be noticed that *Dolichus lablab* surpassed the other two pasture plant species of *Cyamopsis tetragonoloba* and *Clitoria ternatea* in both of the total fresh and dry forage yields. Such trend was detected in each of the two cuts taken. The three

tested forage plant species could be arranged in a descending order regarding forage yield and its components as follows: *Dolichus lablab, Cyamopsis tetragonoloba* and *Clitoria ternatea.* This may be attributed to the differences among studied species in their genetical make up and their growth habit. In this respect, Abou-deya *et al.* (1999) studied the response of three pasture legumes of *Vigna luteola, Vigna oblingifolia* and *Macroptilum lathyroids* to different levels of PK fertilization. They revealed that *Vigina oblingifolia* produced the highest total fresh and dry forage yields compared with the other two studied species.

Table (1): Studied growth measurements of three pasture legume species at different cuts combined over the two years of 2002 and 2003

Traits	Plant species			
	S_1	S_2	S_3	LSD 5%
	First cut			
Plant height (cm)	60	44	103	20
No. of branches /plant	3	4.8	5.2	2.2
Leaf area /plant (dm^2)	5.9	8.9	13.6	NS
Leaf area index	0.584	0.887	1.361	NS
Leaf : stem ratio	2.3	2.3	1.0	1.0
SLW(mg/cm^2)	4.04	2.43	3.78	1.26
	Second cut			
Plant height (cm)	74	80	152	20
No. of branches /plant	5.0	6.0	8.0	2.0
Leaf area /plant (dm^2)	12.2	17.6	27.5	10.2
Leaf area index	1.2	1.8	2.7	0.9
Leaf : stem ratio	2.7	3.2	1.1	0.5
SLW(mg/cm^2)	3.37	2.08	2.84	1.49

S_1 = *Cyamopsis tetragonoloba,* S_2 = *Clitoria ternatea,* S_3 = *Dolichus lablab* and SLW = Specific Leaf Weight

2-Phosphorus fertilization:

a- Growth parameters:

The tested growth parameters of the three forage plant species under study were increased by increasing P application levels (Table 3). Such increase was significant for plant height and No. of branches/plant in the two cuts taken. While, leaf : stem ratio increased significantly in the first cut only. Combined analysis data revealed that P application at rate of 80 Kg P_2O_5/fed gave the highest values of studied growth parameters. The stimulatory effect of phosphorus which noticed in all growth characters may be due to its role in enhancing metabolic processes such as photosynthesis, starch synthesis, glycolysis and synthesis of fats and proteins and the other required plant components. Phosphorus is also found in plants as a constituent of nucleic acids, phospholipids, coenzymes and the high-energy phosphate compounds. This was in accordance with the results of Silva *et al.* (1989) on *Clitoria ternatea,* Abdel Maged (1992) on *Lablab purpureus,* Abou-deya *et al.* (1999) on some pasture legume species as well as El-Toukhy and El-Houssini (2005) on *Cyamopsis tetragonoloba.*

Table (2): Some forage yield measurements of three pasture legume species at different cuts (Combined analysis of 2002 and 2003 growing seasons)

Traits	Plant species			LSD 5%
	S_1	S_2	S_3	
First cut				
Fresh yield of leaves (Ton/fed.)	0.296	0.045	0.277	0.146
Dry yield of leaves (Ton/fed.)	0.043	0.013	0.068	0.023
Stem fresh yield (Ton/fed.)	0.196	0.028	0.321	0.197
Stem dry yield (Ton/fed.)	0.052	0.006	0.033	0.033
Total fresh forage yield (Ton/fed.)	0.491	0.084	0.597	0.338
Total dry forage yield (Ton/fed.)	0.056	0.019	0.102	0.056
Second cut				
Fresh yield of leaves (Ton/fed.)	0.996	0.744	1.175	NS
Dry yield of leaves (Ton/fed.)	0.201	0.185	0.196	NS
Stem fresh yield (Ton/fed.)	0.473	0.300	1.345	0.312
Stem dry yield (Ton/fed.)	0.184	0.062	0.071	0.044
Total fresh forage yield (Ton/fed.)	1.459	1.043	2.520	0.727
Total dry forage yield (Ton/fed.)	0.385	0.247	0.267	NS

Table (3): Some growth parameters of three pasture legume species as affected by phosphorus levels of the two cuts combined over the two growing years of 2002 and 2003

Traits	Phosphorus levels (Kg P_2O_5/fed.)			
	0	40	80	LSD 5%
	First cut			
Plant height (cm)	60	69	69	7.0
No. of branches/plant	3.3	4.0	4.0	0.6
Leaf area/plant (dm^2)	7.93	8.85	8.68	NS
Leaf area index	0.79	0.88	0.87	NS
Leaf : Stem ratio	1.9	1.9	2.3	0.4
SLW (mg/cm^2)	2.83	3.03	2.86	NS
	Second cut			
Plant height (cm)	80	94	95	14.0
No. of branches/plant	5	6	7	1.0
Leaf area/plant (dm^2)	22.1	19.0	24.5	NS
Leaf area index	1.9	2.5	2.3	NS
Leaf : Stem ratio	2.1	2.2	2.3	NS
SLW (mg/cm^2)	2.38	2.60	2.58	NS

b- Forage yield:

Data clarified that increasing phosphorus levels from 0 to 80 Kg P_2O_5/fed exerted positive effect on the studied forage yield characters for each cut (Table 4). All tested forage yield parameters were significantly increased as phosphorus rates increased. This significant effect was observed in all of the studied forage yield traits measured in the two cuts except for stem fresh and dry

yields harvested in the first cut. This increase may be due to the adequate supply of phosphorus for plants requirements. Which was unavailable to plants under the calcareous soil conditions of pH more than 7. Furthermore P helps the plants to enhance and develop more extensive functional root system, which absorb more water and nutrients from deeper soil layers. Such effect stimulate photosynthetic activity and translocation of metabolites consequently which increased the studied parameters. These findings are in a good line with those reported by Ibrahim *et al.* (1996) on *Clitoria ternata* and *Lablab purpureous*, Abou-deya *et al.* (1999) on some pasture legume species, Carsky *et al.* (2001) on *Lablab purpureous*, Androw and Robins (1969) on some tropical pasture legumes, Munir *et al.* (2003) on *Vicia narbonensis* and Owolade *et al.* (2006) on *Vigna unguiculata.*

3- The interaction between species and phosphorus levels:

It is worthnoting to mention that the interaction between the two main factors under the present study (legume pasture species and phosphorus levels) seemed to be of no specific effect on the studied grow parameters and forage yield. So, data of the interaction were excluded and implies that each factor acts independently.

Table (4): Some forage yield measurements of three pasture legume species as affected by phosphorus levels at different cuts (Combined analysis of 2002 & 2003 growing seasons)

Traits	Phosphorus levels (Kg P_2O_5/ fed.)			LSD 5%
	0	40	80	
First cut				
Fresh yield of leaves (Ton/fed.)	0.145	0.156	0.207	0.059
Dry yield of leaves (Ton/fed.)	0.029	0.032	0.040	0.010
Stem fresh yield (Ton/fed.)	0.132	0.140	0.163	NS
Stem dry yield (Ton/fed.)	0.022	0.023	0.027	NS
Total fresh forage yield (Ton/fed.)	0.260	0.296	0.394	0.132
Total dry forage yield (Ton/fed.)	0.044	0.057	0.072	0.022
Second cut				
Fresh yield of leaves (Ton/fed.)	0.795	0.834	1.166	0.300
Dry yield of leaves (Ton/fed.)	0.155	0.203	0.222	0.067
Stem fresh yield (Ton/fed.)	0.535	0.734	0.772	0.210
Stem dry yield (Ton/fed.)	0.089	0.101	0.122	0.026
Total fresh forage yield (Ton/fed.)	1.230	1.729	1.871	0.465
Total dry forage yield (Ton/fed.)	0.247	0.305	0.347	0.090

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استجابة بعض الأنواع الرعوية البقوليه للتسميد الفوسفاتي تحت ظروف الأراضي المستصلحة الحديثة

احمد عهد محمد الحسيني
قسم البيئة النباتية والمراعي – مركز بحوث الصحراء المطرية – القاهرة – ج.م.ع

تم تقييم ثلاثة أنواع نباتيه بقوليه رعوية كنباتات مراعي وذلك تحت الظروف المناخية السائدة بمنطقة مريوط بالساحل الشمالي لمصر. وقد أقيمت تجربتين حقليتين خلال الموسم الصيفي لعامي ٢٠٠٢ ، ٢٠٠٣ بمزرعة محطة مريوط للتجارب الزراعية التابعة لمركز بحوث الصحراء وذلك لمعرفة تأثير إضافة ثلاثة مستويات من السماد الفوسفاتي (صفر ، ٤٠ ، ٨٠ كجم فو٢أ٥/فدان علي بعض صفات النمو والمحصول العلفي لثلاثة أنواع نباتية بقوليه رعوية هي الجوار والكلاتيوريا واللبلاب. وقد وزعت معاملات التجربة في تصميم قطع منشقة مرة واحدة في ثلاث مكررات. ويمكن تلخيص أهم النتائج المتحصل عليها كالأتي:-

١- أدت زيادة معدلات التسميد الفوسفاتي إلي تحسين معظم صفات النمو والمحصول العلفي لمختلف الأنواع الرعوية المدروسة.
٢- تفوقت نباتات اللبلاب علي بقية الأنواع النباتية المدروسة في بعض صفات النمو (ارتفاع النبات – عدد الأفرع للنبات – مساحة أوراق النبات – دليل مساحة الأوراق) في حين تفوقت نباتات الجوار علي النوعين النباتيين الأخريين في نسبة مساحة الأوراق إلي السيقان وكذلك الوزن النوعي للورقة.
٣- سجلت نباتات اللبلاب أعلي قيم للمحصول العلفي الغض والجاف وقد تلاحظ هذا الاتجاه في كل من الحشتين.
٤- أوضحت النتائج أن نباتات الكلاتيوريا سجلت أقل قيم لصفات النمو والمحصول العلفي.