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EFFECT OF PHOSPHORUS, LIME AND CUTTING INTERVAL ON GREEN FODDER YIELD, NODULATION AND PROTEIN ENRICHMENT OF *STYLOSANTHES GRACILIS* AND NITROGEN IN SOIL

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Stylo or Brazilian lucerne is a leguminous fodder rich in protein content compared to fodder grasses. Being a legume it fixes atmospheric nitrogen symbiotically enriching the plant and soil and the plant availing very little of the soil nitrogen especially from poor soils. *Stylosanthes gracilis,* a perennial, whose above ground parts are cut and fed to cattle, leaves the nitrogen accumulated nodule rich roots to decay in soil which build up the nitrogen status of soil.

Application of phosphatic fertilizers to legumes increases the nitrogen content (Acharya *et al.,* 1953). Liming stimulates the activity of nitrogen fixing bacteria enabling more nitrogen fixation from atmosphere (Buckman and Brady, 1964). Very little work has been done in Kerala to study the effect of added doses of phosphorus, lime and cutting interval on *Stylosanthes gracilis* on green fodder yield, nodulation, protein enrichment of fodder and nitrogen accumulation in soil. Hence the present investigation was carried out with five levels of phosphorus (P_2O_5), two levels of lime (CaO) and two intervals of cutting.

Materials and Methods

A field experiment was conducted in the red loam soils (0.058% N, 0.0015% available P_2O_5 and pH 5.2) of the Instructional Farm, College of Agriculture, Vellayani during 1977-78 to study the effect of graded levels of phosphorus (0, 40, 80, 120 and 160 kg P_2O_5/ha) and lime (0 and 500 kg CaO/ha) with two cutting intervals to *Stylosanthes gracilis* on grean fodder yield, nodulation, protein enrichment of fodder and nitrogen build up in soil. The experiment was laid out as a factorial experiment in RBD having 20 treatment combinations with three replications. Phosphorus was given at planting followed by lime application. The seeds, which were scarified with concentrated sulphuric acid, were sown (@ 2.5 kg/ha) in line in the already prepared field and covered with a layer of 7 to 13 mm thickness of soil. Pot culture studies were also conducted simultaneously having the above treatments which were used to observe the number and weight of root nodules. The crop was weeded twice, 45 days after sowing and immediately after harvest. After making a uniform cut at 90 days of crop growth four cuts were made from plots under 30 days interval and three cuts from plots under 45 days interval of cutting and their wet weight recorded. The root nodules of five plants from pot culture were counted and the average number of root nodules per plant and their weight worked out and recorded.

The samples collected soon after harvest were dried in shade and then dried to constant weight in an air oven at 80°C and was ground in a mill for chemical analysis and estimation of total nitrogen in the samples. Modified micro-kjeldahl method (Jackson, 1958) was employed for the purpose. From the total nitrogen content, crude protein content was computed.

The total nitrogen content of the soil after the conduct of the experiment was also determined by modified microkjeldahl method (Jackson, 1958) and available nitrogen by alkaline permanganate method (Subbiah and Asija, 1956).

Results and Discussion

The data on green fodder yield, protein content, protein yield, number of root nodules, nodule weight, total nitrogen content of soil and available nitrogen content of soil are presented in Table 1, 2, 3, 4, 5, 6 and 7 respectively.

Table 1

Green fodder yield (t/ha) as influenced by levels of phosphorus, lime and cutting intervals

Phosphorus levels (kg/ha)	Without lime application	With lime 500 kg/ha	Mean
0	16.73	19.59	18.16
40	19.09	19.14	19.12
80	17.62	21.47	19.55
120	22.59	20.74	21.66
160	19.99	16.72	18.35
Cutting intervals			
30 days	19.02	19.52	19.27
45 days	19.38	19.53	19.46
Mean	19.20	19.53	

Cutting interval	30 days	45 days	Mean
Phosphorus (kg/ha)			
0	17.82	18.49	18.16
40	18.82	19.41	19.12
80	19.03	20.06	19.55
120	21.65	21.67	21.66
160	19.04	17.97	18.35
Mean	19.27	19.46	

CD (0 05) for levels = 1 97 CD (0.05) for P x L = 1.76

Green fodder yield, protein content and protein yield

Increasing the levels of phosphorus from 0 to 120 kg/ha increased the green fodder yield. The combination of phosphorus and lime also had significant influence in increasing the green fodder yield. Addition of phosphorus to legumes generally increases the green matter yield (Hensell *et al.*, 1966). Liming might have enhanced both soil calcium status and pH which in turn possibly favoured the better availability and utilization of phosphorus resulting in increased green fodder yield. Cutting interval of 45 days recorded more green fodder yield. The longer interval of cutting enabled increased vegetative growth and hence higher green fodder yield.

There was progressive increase in protein content with increase in the levels of phosphorus upto 120 kg/ha, but beyond that it showed a decline indicating that addition of phosphorus beyond 120 kg per hectare may not be required for the crop. A combination of 120 kg phosphorus and 500 kg lime per hectare recorded maximum protein content. The shorter interval of cutting tended to accumulate more protein than longer interval of cutting. The observation in

Table 2

Protein content as influenced by levels of phosphorus, lime and cutting interval (percent)

Phosphorus levels kg/ha	Without lime application	With lime 500 kg/ha	Mean
0	15.16	13.19	14.18
40	13.44	15.57	14.50
80	16.66	13.77	15.21
120	14.97	17.27	16.12
160	12.66	12.23	12.45
Cutting interval			
30 days	15.81	15.33	15.57
45 days	13.35	13.48	1341
Mean	14.58	14.40	
Cutting interval	30 days	45 days	Mean
Phosphorus (kg/ha)			
0	14.97	13.38	14.18
40	15.31	13.70	14.50
80	15.90	14.53	15.21
120	17.35	14.89	16.12
160	14.32	10.57	12.45
Mean	15 57	13.41	

CD (0.5) for P levels = 0.779 **CD (0 05) for CL = 0.493**
CD (0.05) for PxL, PxC combinations = 1.103

Table 3

Protein yield (kg/ha) as influenced by levels of phosphorus, lime and cutting interval

Phosphorus levels (kg/ha)	Without lime application	With lime 500 kg/ha	Mean
0	438	421	429
40	420	523	471
80	513	508	519
120	578	612	595
160	439	399	419
Cutting interval			
30 days	521	500	510
45 days	441	485	463
Mean	481	492	
Cutting interval	30 days	45 days	Mean
Phosphorus (kg/ha)			
0	446	412	429
40	481	462	471
80	525	513	519
120	634	556	595
160	466	372	419
Mean	510	463	

CD (0.05) for P levels = 57
CD (0 05) for Px L x C combinations = **81.63**

this case supports the general view that younger the plants, higher the protein content. Similar results have been reported by Hussain *et al*. (1969) in berseem. The phosphorus level of 120 kg/ha in combination with 30 days interval of cutting recorded the maximum protein content.

Graded doses of phosphorus significantly increased the protein yield and found that phosphorus dose of 120 kg/ha was better in increasing the protein yield. As the green fodder yield was maximum with 120 kg phosphorus per hectare, the same trend was shown in the case of protein yield also.

Number of root nodules and nodule weight

It has been shown that phosphorus application has got significant influence in increasing the number of root nodules. Similar results have been reported by Olsen and Moe (1971) in *Stylosanthes gracilis*. Although cutting intervals had no significant influence, 45 days interval of cutting gave more number

of root nodules. This may possibly be due to the regrowth of lateral roots and formation of more root nodules at longer interval of cutting (Butler and Bathurst, 1956). Liming also had no significant influence in increasing the number of root nodules.

An increase in nodule weight was noticed due to the application of graded doses of phosphorus and there was response upto 120 kg phosphorus per hectare. Gates (1970) recorded similar results in *Stylosanthes humilis*. However, decrease in nodulation and nodule weight noticed in the present study at 160 kg phosphorus application is inconsistent with the general observation that increasing the level of phosphorus application increases nodulation in legumes.

Total and available nitrogen content of soil

There was no significant difference between the different levels of phosphorus, lime and cutting interval and their combinations on the total nitrogen content of soil. However, it could be noted that the general mean of the nitrogen

Table 4

Number of root nodules as influenced by levels of phosphorus, lime and cutting interval

Phosphorus Levels (kg/ha)	Without lime application	With lime 500 kg/ha	Mean
0	285.33	227.50	256.41
40	321.00	250.60	285.80
80	338.33	305.33	321.83
120	425.66	504.16	464.91
160	243.33	206.50	224,91
Cutting intervals			
30 days	287.26	295.40	291.33
45 days	358.20	302.26	330.23
Mean	322.73	298.81	
Interval of cutting	30 days	45 days	Mean
Phosphorus (kg/ha)			
0	238.33	274.50	256.41
40	259.00	312.60	285.80
80	319.00	324.00	321.83
120	392.00	537.83	464.91
160	247.00	202.16	224.91
Mean	291.33	330.23	

CD (0.05) for P levels = 141

content of soil under various treatments recorded higher value of 1400 kg N/ha compared to the initial soil nitrogen content of 13.05 kg/ha before the experiment. This corresponds to an increase of 7.3 per cent.

With regard to the available nitrogen content of soil, phosphorus application induced more nitrogen fixation. Lime would have enabled the release of nitrogen in an available form. Thus phosphorus and lime together might have subscribed to the increase in available nitrogen. A general improvement in the available nitrogen content of the soil has been observed. The original soil contained only 270 kg of available nitrogen, whereas the mean value for the soil after the experiment was 311.69 kg/ha. This increase in available nitrogen might be due to the higher degree of microbial fixation and subsequent release in the soil in an available form.

Table 5

Nodules weight (mg) as influenced by levels of phosphorus, lime and cutting intervals

Phosphorus levels (kg/ha)	Without lime application	With lime 500 kg/ha	Mean
0	296.83	303.83	300.33
40	330.00	323.66	326.83
80	376.33	400.16	388.24
120	405.33	499.66	452.49
160	259.66	234.50	247.08
Cutting intervals			
30 days	312.66	398.60	355.63
45 days	334.60	306.13	33036
Mean	333.63	352.36	

Interval of cutting	30 days	45 days	Mean
Phosphorus (kg/ha)			
0	425.83	274.85	350.33
40	364.16	289.50	326.83
80	426.66	349.83	388.24
120	458.00	447.00	452.49
160	203.50	290.66	247.08
Mean	375.63	330.36	

CD (0.05) for P levels = 123.54

Table 6

Total nitrogen content of soil (kg/ha) as influenced by levels of phosphorus, lime and cutting intervals

Phosphorus levels (kg/ha)	Without lime application	With lime 500 kg/ha	Mean
0	1390	1247	1319
40	1350	1394	1372
80	1323	1567	1445
120	1511	1395	1453
160	1396	1432	1414
Mean	1394	1407	
Cutting interval			
30 days	1360	1486	1423
45 days	1428	1328	1378
Mean	1394	1407	
Cutting intervals	30 days	45 days	Mean
Phosphorus (kg/ha)			
0	1323	1315	1319
40	1379	1365	1372
80	1436	1454	1445
120	1522	1384	1453
160	1456	1372	1414
Mean	1423	1378	

Summary

An experiment was conducted at the Instructional Farm, College of Agriculture, Vellayani, Kerala during 1977-78 to study the effect of phosphorus levels, lime and cutting intervals on green fodder yield, protein enrichment and nodulation of *Stylosanthes gracilis* and nitrogen build up in the soil. The treatments constituted five levels of phosphorus viz., 0, 40, 80, 120 and 160 kg P_2O_5/ha, two levels of lime viz., 0 and 500 kg CaO/ha and two intervals of cutting viz., 30 days and 45 days. The green fodder yield, protein content and protein yield were found to increase progressively upto 120 kg P_2O_5/ha. The combination of phosphorus and lime had significant influence in increasing the green fodder yield and protein content. Cutting interval of 45 days recorded more green fodder yield and the combination of 120 kg phosphorus per hectare with 30 days interval of cutting recorded the maximum protein content. Nodule number and weight were found to increase progressively upto 120 kg P_2O_5/ha, but lime and cutting interval had no significant influence. An increase of 7.3% of total nitrogen content of soil with increase in the levels of phosphorus was observed. Phosphorus and lime together contributed for the increase in the available nitrogen.

Table 7

Available nitrogen content of soil (kg/ha) as influenced by levels of phosphorus, lime and cutting intervals

Phosphorus levels (kg/ha)	Without lime application	With lime 500 kg/ha	Mean
0	304.90	311.48	308.15
40	307.85	315.72	311.79
80	309.58	317.02	313.30
120	308.15	323.27	315.71
160	307.20	311.83	309.52
Cutting intervals			
40 days	291.11	302.67	296.89
45 days	323.97	329.05	326.51
Mean	307.54	315.86	

Cutting intervals	30 days	45 days	Mean
Phosphorus (kg/ha)			
0	290.85	325.53	308.15
40	296.20	327.37	311.79
80	298.08	328.51	313.30
120	307.13	324,28	315.71
160	292.18	326,85	309.52
Mean	296.89	326.51	

CD (0.05) for P levels = 1.11
CD (0.05) for L/C levels = 0.71
CD (0.05) for Px LP x C combinations = 1.58
CD (0.05) for L x C combinations = 1.00
L = lime
C = cutting interval

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