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PERFORMANCE OF FODDER LEGUMES UNDER LIME AND PHOSPHORUS NUTRITION IN SUMMER RICE FALLOWS

Legumes are palatable and protienacious fodder crops, which have pivotal role in animal production systems. Summer rice fallows offer a good opportunity for fodder production in a state like Kerala where land available for fodder cultivation is limited. Liming increases the nutrient availability in acid soils and phosphorus is considered to be the most important nutrient for growth, better nodulation and higher nitrogen fixation of legumes as reported by Whyte *et al.* (1953). Among the legumes tried, Co-5 is a fodder cowpea variety released from the Tamil Nadu Agricultural University in 1986. Karnataka local is a cowpea variety from Karnataka introduced as a fodder variety for summer rice fallow cultivation in Kerala and C-152 is a cowpea variety known for its fodder production potential under rainfed conditions. *Sesbania rostrata* is a promising legume to be tried as a fodder crop owing to its higher biomass production and nutrient contents. Hence the present study was undertaken to investigate the comparative performance of three varieties of cowpea and *Sesbania rostrata* under lime and phosphorus nutrition in summer rice fallow condition.

The experiment was conducted at the Cropping Systems Research Centre, Karamana, Thiruvananthapuram during Feb-May 1992. Soil of the site was acidic in reaction, low in CEC, medium in organic carbon, available nitrogen, phosphorus and potassium. The experiment was laid out as split plot experiment in RBD with three replications. Gross plot size and net plot size were 3 x 3 m and 2.5 x 1.5 m respectively. Combinations of three levels of lime (l_0 - 0 kg, 1, - 125 kg, l_2 - 250 kg ha^{-1}) and three levels of phosphorus (p_0 - 0 kg P_2O_5, p_1 - 30 kg P_2O_5, p_2 - 60 kg P_2O_5 ha^{-1}) constituted the main plot treatments. Three cowpea varieties (v_1 - Co-5, v_2 - C-152, v_3 - Karnataka Local) and *Sesbania rostrata* (v_4) were laid out as sub-plot treatments. Nitrogen and phosphorus were given to the legumes @ 25 kg N and 30 kg P_2O_5 ha^{-1}. Other cultural operations were done as per the package of practice recommendations of the Kerala Agricultural University. Biometric observations were taken at 50% flowering just before fodder harvest.

Effect of lime: Application of 250 kg lime increased the plant height, number of leaves per plant, number of branches per plant and LAI (Table 1). Similar observations were made by Ramanagowda (1981) in fodder cowpea and Murali (1989) in *Sesbania rostrata.* The increased vegetative growth consequent to liming is probably due to the better availability of nutrients due to moderation of soil reaction. Favourable influence of liming on legume growth has been pointed out by Tisdale *et al.*, (1990).

Table 1. Effect of lime, phosphorus and legumes on fodder yield and yield attributes

Treatment	Plantheight (cm)	No. of leaves /plant	No. of branches /plant	LAI	Green fodder yield (t ha^{-1})	Dry fodder yield (t ha^{-1})
LO	78.21	24.69	3.25	7.18	25.86	3.66
L1	80.11	24.81	3.17	7.24	25.52	3.66
L2	86.04	38.07	4.33	10.75	26.54	3.97
PO	75.07	22.94	3.34	6.62	24.38	3.77
P1	83.11	30.46	3.48	8.16	25.71	3.47
P2	86.19	34.17	3.92	10.38	27.84	4.06
CD (0.05)	1.26	0.73	0.12	0.94	-	-
SE	0.59	0,34	0.06	0.44	2.35	0.53
V1	84.48	18.67	3.33	6.95	30.66	3.98
V2	65.83	24.19	3.70	9.93	31.19	3.78
V3	53.05	20.02	2.97	6.23	15.39	2.31
V4	122.47	53.87	4.33	10.44	26.67	4.99
CD (0.05)	1.42	0.75	0.17	1.09	3.28	1.08
SE	0.71	0.38	0.09	0.55	1.64	0.54

Table 2. Interaction effects of lime, phosphorus and legumes on fodder yield and yield attributes

Treatment	Plant height (cm)	No. of leaves /plant	No. of branches /plant	LAI	Green fodder yield (t ha^{-1})	Dry fodder yield (t ha^{-1})
l_0v_1	76.58	14.44	2.36	5.09	30.99	3.84
l_0v_2	66.20	22.76	3.93	9.96	29.63	3.24
l_0v_3	50.96	17.16	3.02	5.31	15.31	2.34
l_0v_4	113.12	44.40	3.69	8.38	27.53	5.23
l,v,	85.68	17.51	3.11	6.27	31.36	4.28
l_1v_2	61.41	21.96	3.20	9.00	33.09	3.88
l_1v_3	51.20	17.78	2.56	5.58	13.09	1.92
l_1v_4	122.17	42.00	3.82	8.09	24.57	4.57
l_2v_1	91.18	24.07	4.51	9.50	29.63	3.82
l_2v_2	69.88	27.84	3.98	10.83	30.86	4.23
l_2v_3	57.00	25.13	3.33	7.80	17.78	2.68
l_2v_4	132.11	75.22	5.49	14.85	27.90	5.17
CD (0.05)	2.46	1.29	0.30	1.88	-	-
SE	1.23	0.65	0.15	0.94	2.84	0.94
p_0v_1	80.42	17.22	3.60	6.07	29.26	4.33
p_0v_2	57.28	19.98	3.60	7.93	30.86	4.36
p_0v_3	46.73	18.69	3.16	6.45	13.46	2.09
p_0v_4	115.83	35.89	3.02	6.02	23.95	4.30
p_1v_1	87.57	17.82	3.41	6.70	30.62	3.71
p_1v_2	66.20	24.29	3.69	9.65	32.34	3.28
p_1v_3	56.91	20.47	2.78	5.32	13.95	1.81
p_1v_4	121.78	59.24	4.36	10.97	25.43	5.09
p_2v_1	85.44	,20.98	3.47	8.08	32.10	3.90
p_2v_2	74.01	28.29	3.92	12.20	29.88	3.71
p_2v_3	55.51	20.91	2.98	6.91	18.77	3.03
p_2v_4	129.79	66.49	5.62	14.33	30.62	5.58
CD (0.05)	2.46	1.29	0.30	1.88	-	-
SE	1.23	0.65	0.15	0.94	2.84	0.94
l_0p_0	62.39	18.02	3.35	4.51	21.95	3.18
l_0p_1	87.13	31.02	3.32	9.48	26.02	3.48
loP2	85.13	25.03	3.08	7.56	29.63	4.33
l_1p_0	78.63	22.23	3.47	5.89	22.13	3.26
l_1p_1	86.05	29.12	3.58	8.03	27.59	3.61
l_1p_2	75.67	23.08	2.47	7.78	26.85	4.11
l_2p_0	84.18	28.58	3.22	9.46	29.07	4.87
l_2p_1	76.17	31.23	3.55	6.98	23.52	3.33
l_2p_2	97.78	54.38	6.22	15.80	27.04	3.73
CD(0.05)	2.19	1.26	0.202	1.63	-	-
SE	1.03	0.59	0.095	0.77	4.08	0.91

*Effect **of phosphorus:*** Application of 60 kg P_2O_5 ha^{-1} produced taller plants (86.19 cm) and more number of leaves than other levels of application. Increasing levels of application of P increased the LAI and branching in legumes. Similar trend was reported by Singh and Singh (1991) in cowpea. Phosphorus is known to promote the development of roots thereby favouring the N fixation in legumes. This increased amount of N fixed might be utilized by the host plant for its own growth as reported by Singh and Thrivedi (1981).

Effect of legumes: Comparative performance of legumes in Table 1 showed that C-152 produced more branches and LAI while Co-5 had more plant height among cowpea varieties. *Sesbania rostrata* recorded more plant height, number of leaves and branches than cowpea varieties in general. The cowpea varieties C-152 and Co-5 were equally superior with respect to green fodder yield and dry fodder yield and *Sesbania rostrata* out-yielded the cowpea varieties in dry fodder yield. The inherent genetic make up of the plant, which decides the biometric parameters, varies in each variety. The highest green matter production potential of cowpea variety C-152 was previously reported by AICRP (1984). According to Jindal (1989), number of branches and plant height are important parameters deciding fodder yield in a variety. The more number of branches observed in C-152 or the tallness of Co-5 variety might have contributed to the higher green fodder yield in these varieties. *Sesbania rostrata* produced almost two times taller plants than other legumes and had more number of branches and was less succulent than cowpea varieties which might have contributed to its higher dry matter yield.

Interaction effects in legumes: All legumes recorded maximum plant height and LAI with highest level of lime (250 kg) application (Table 2). Increasing levels of lime from 0 to 250 kg increased the number of leaves/plant in all the legumes. Application of 250 kg lime produced more number of branches in Co-5 and *Sesbania rostrata.* Favourable influence of liming on growth of legumes is due to the indirect effect of increasing the nitrogen availability to the plants through increased nitrification by moderating the pH in an acid soil. Similar observation was made by Ramanagowda (1981) in fodder cowpea.

All legumes except cowpea variety Karnataka Local and Co-5 produced greater plant height with 60 kg P_2O_5 ha^{-1}. Application of 60 kg P_2O_5 ha^{-1} produced more number of leaves in all legumes except in cowpea variety Karnataka Local which responded only up to 30 kg P_2O_5 ha^{-1}. More LAI and more branches were produced with 60 kg P_2O_5 in cowpea variety C-152 and *Sesbania rostrata.* All legumes were found to be highly responding to the P application except cowpea variety Karnataka Local. Phosphorus application increases the root proliferation and also favours the extensive exploitation of treated soil areas for nutrients and moisture, which eventually reflects in better vegetative growth. Variation in the legume response to applied P is probably due to inherent variation in plant uptake, characteristic to the variety.

Combined application of highest level of lime (250 kg) and phosphorus (60 kg) produced more plant height, number of leaves per plant, number of branches per plant and LAI just before harvest which might be due to better root growth and nutrient uptake.

Interaction effect in Sesbania rostrata: Enhancing the lime level from 0 to 250 kg significantly enhanced the LAI, number of leaves per plant, plant height and number of branches per plant (Table 2).

The LAI, number of leaves per plant, plant height and number of branches per plant enhanced with each level of increase in P application and highest values were recorded with 60 kg P_2O_5 ha^{-1}. Response of *Sesbania rostrata* to applied nutrients was previously reported by Murali (1989). Positive response of *Sesbania rostrata* to lime and phosphorus nutrition further points out the suitability of this legume for summer rice fallow conditions.

Interaction effect in cowpea varieties: **In Co-**5 and Karnataka Local, enhancing the lime level to 250 kg increased the LAI while C-152 did not show significant variation. Enhancing the lime levels from 0 to 125 and 250 kg increased the number of leaves per plant in Co-5, while in C-152 and Karnataka Local, lime levels from control to 125 kg produced the same effect. With each level of increase in lime, the plant height increased in Co-5 and maximum height was obtained with highest level of lime application. In all cowpea varieties except C-152, maximum number of branches were obtained with the application of highest level of lime while in C-152, first dose of lime reduced the branching while it was improved with the highest dose of application. Differential response of cowpea varieties to lime application is due to varietal variation in calcium affinity as suggested by Tisdale *et al.* (1990).

Enhancing the P level to 60 kg increased the LAI in Co-5 and C-152 and number of leaves per plant in CO-5. In C-152, there was an increase in number of leaves per plant with each level of increase in phosphorus. In Karnataka local, response to P was noted only up to 30 kg P_2O_5 ha^{-1} in case of number of leaves per plant. Response to applied P was seen only up to 30 kg in respect of plant height in Co-5 and Karnataka Local while in C-152, enhancing the P level from 0 to 30 or 60 kg P_2O_5 ha^{-1} increased the number of branches per plant. All the cowpea varieties except Karnataka Local were found to respond positively to phosphorus application, which is in line with the results obtained by Geethakumari (1981) and Jain *et al.* (1986).

The investigation pointed out the superiority of C-152 and Co-5 as fodder cowpea varieties in summer rice fallow conditions as they exhibited higher biomass production potential in rice fallows apart form being more responsive to applied nutrients. The study also suggested the possibility of introducing *Sesbania rostrata* as a legume fodder in rice fallows.

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