Enhancing productivity of Rajma (*Phaseolus vulgaris* L.) by managing soil acidity and organic nutrient management under Arunachal hills Conditions

ABSTRACT

A study was conducted at farmers' field of Tirap District of Arunachal Pradesh to test the effect of organic sources of soil nutrient management with Lime for soil acidity management and for yield improvement of Rajma (*Phaseolus vulgaris* L.) variety Chitra. The experiment was conducted by following 3 treatments: T_1: (Lime @ 350 kg/ ha+ FYM @ 4 t/ha + Neem cake @300 kg/ha+ vermicompost @ 4 t/ha + Azospirillum 10kg/ha, T_2: FYM @ 4 t/ha + Neem cake @ 300 kg/ha + vermicompost @ 4 t/ha + Azospirillum 10 kg/ha. T_3: (Farmers' Practice) -FYM + N: P_2O_5: K_2O: 40:20:15 kg/ha (imbalance doses of fertilizers) with 5 replications following randomized block design during 2021-22. From the results it is revealed that T_1: (Lime @ 350 kg/ ha+ FYM @ 4 t/ha + Neem cake @300 kg/ha+ vermicompost @ 4 t/ha + Azospirillum 10kg/ha, had showed significantly higher seed yield (10.2 q/ha), gross return (Rs 1,53,000/), net return (Rs 106,824) and B:C ratio (2.31), followed by T_2 (FYM @ 4 t/ha + Neem cake @ 300 kg/ha + vermicompost @ 4 t/ha + Azospirillum 10 kg/ha), seed yield 9.3 q yield, Rs. 1,39,500/ gross return, Rs 95,620 net return and 2.17 B:C ratio. While, lowest yield and B:C ratio was recorded (7.1 q/ha, B: C ratio 1.84) with T_3 (Farmer's practice). Moreover, improved soil nutrient status was achieved in T_1 followed by T_2 and T_3.

Keywords:*On farm testing, lime, organic nutrient management, biofertilizer, vermi-compost, Rajma*

INTRODUCTION

The NE region of India has very low productivity of rajma crop due to the inappropriate soil nutrient management and other factors like – acidic soil management, heavy rainfall etc. Though the >80% population is depends on agriculture and allied activities for income generation. Farmers mostly prefer the traditional methods of cultivation with low input application. Pulse is an important leguminous crop widely grown and consumed in India and it accounts for 6-7% of the total food grain production of the country. [12] Approximately 84 % area of the NE region having acidic soil due to high rainfall and forest land which causes the reduction of crop yield. Besides that deficiencies of phosphorus, calcium, magnesium, molybdenum and toxicities of aluminium and iron in the acidic soils is found in this area (Sanjay-Swami and Yadav, 2021). However, the inappropriate manner of soil nutrient management also a cause of low productivity of crops in this area (Bordoloi, 2021 a) in Rajma (*Phaseolus vulgaris* L.) The Rajma is a very good source of protein and its efficacy of biological nitrogen fixation plays a vital role in sustainable agriculture by enriching the soil nutrient status. Pulse productivity depends mainly on

appropriate nutrient management practices. Application of lime with improved soil management methods can increase the productivity of pulse crop (Bordoloi, 2021 d). Thus an experiment was carried out at Tirap District of Arunachal Pradesh in the year 2019-20 to test the effect of lime and organic nutrients management on productivity enhancement of Rajma (*Phaseolus vulgaris* L.) .

MATERIALS AND METHODS

To check the efficacy of organic sources of nutrients along with lime a trial was conducted at three villages of Tirap District of Arunachal Pradesh during the year 2019-20 for soil acidity management and for yield improvement of Rajma (*Phaseolus vulgaris* L.). In Rabi season of cropping calendar (November month); trial was conducted on variety Chitra. The each plot area was 1000 m^2. Before the ploughing of plot, light irrigation done in each plots to maintain the soil moisture. After that thorough ploughing @ 03 times were adopted for better tilth conditions. The seeds of rajma (Variety- Chitra) were sown @ 40 cm x 15 cm spacing; under 2 cm depth.

Total 03 treatments were adopted; as per following details-

T_1: Lime @ 350 kg/ ha + Farm yard manure (FYM) @ 4 t/ha + Neem cake @ 300 kg/ha + vermicompost @ 4 t/ha +Azospirillum 10 kg/ha.

T_2: FYM @ 4 t/ha + Neem cake @ 300 kg/ha + vermicompost @ 4 t/ha + Azospirillum 10 kg/ha.

T_3: (Farmers' Practice) -FYM + N: P_2O_5: K_2O:: 40:20:15 kg/ha (imbalance doses of fertilizers).

The FYM, neem cake and vermicompost were applied in field during last ploughing moreover lime applied during sowing time in furrows. The seeds of rajma were treated in slurry of azospillum (400 gm spirillum dissolved in 500 ml of water @ 10 kg seeds) for 30 minutes and dried in shed for proper inoculation around the seed.

The randomized block design was applied with five treatments. The total cost of cultivation (Rs), gross return (Rs), net return (Rs) and benefit Cost ratio were also analyzed as per the data of yield attributes and expenses occurred during the trial. In addition, the soil samples were also taken and examined before to the program's adoption and after crop harvest too. The standard statistical software was used to analyze the data and detailed statistics were included for interpretation.

Treatments	Seed Yields (q/ha)	% increase over control	Cost of Cultivation (Rs)	Gross return (Rs/ha)	Net return (Rs/ha)	B:C Ratio
T_1	10.2	43.66	46,176	1,53,000	106,824	2.31

T_2	9.3	30.98	43,880	1,39,500	95,620	2.17
T_3 (Farmer practices)	7.1	00.00	32,426	92,300	59,874	1.84
	CD (p d" 0.05): 7.09					

Table-1. Yield and Economics of Rajma Crop

Table-2. Impact of Lime and Organic Nutrients in Arunachal's Acid Soils

Treatments	**pH**		**Organic C (kg/ha)**		**% Increase**	**Available N (kg/ha)**		**% Increase**	**Available P (kg/ha)**		**% Increase**	**Available K (kg/ha)**		**% Increase**
	B	A	B	A		B	A		B	A		B	A	
T_1	4.48	5.12	0.88	1.18	25.42	279	356	21.62	19.76	26.42	25.20	28.32	39.31	27.95
T_2	4.27	4.89	0.76	0.94	19.14	308	374	17.64	18.31	22.36	19.93	34.21	43.67	21.66
T_3 (local)	4.90	5.22	1.02	1.26	19.04	320	338	05.32	22.74	26.21	13.62	32.86	40.21	18.27
CD (pd" 0.05)		0.06		0.07			7.82			2.48			1.63	
B denotes before starting of trial A denotes after harvesting of trial														

RESULTS AND DISCUSSION

Seed yield and Economics:

The data from Table 1, clearly showing that T_1 (Lime @ 350 kg/ ha + Farm yard manure (FYM) @ 4 t/ha + Neem cake @ 300 kg/ha + vermicompost @ 4 t/ha + Azospirillum 10 kg/ha) resulted significantly higher yield (10.2 q/ha), gross return (Rs 1,53,000/), net return (Rs 106,824) and B:C ratio (2.31), followed by T_2 (FYM @ 4 t/ha + Neem cake @ 300 kg/ha + vermicompost @ 4 t/ha + Azospirillum 10 kg/ha), 9.3 q, Rs. 1,39,500/, Rs 95,620 and 2.17 respectively. Meanwhile T_3: local resulted poorest in all aspect viz. 7.1 q, Rs 92,300/, Rs 59,874 and 1.84 respectively. The T_1 yield was 43.66 % superior in compared to local. This ultimately proved the signifince of lime in acidic soil management. The T_2 yielded lesser than T_1 (only 30.98 % higher yield over T_3/local), means nutrient management can improved the yield of Rajma but lime application is a pivotal factor as special concern of north- eastern's acidic soil. The numerous researchers (Das *et al*,2011, Datt *et al*, 2013 etc.) have proved that lime balanced the soil pH reaction by which availability of nutrients in soil increased. Thus higher availability of nutrients to plants resulted higher yield and other yield attributing parameters too (Maier *et al*, 2011).

So many researchers from North- east region have reported that improved technology significantly has increased the yield of pulse crops. Sanjay-Swami (2021) also reported that managing soil fertility in north-eastern region's acidic initial stages improved pulse crop yields. The average cost of inputs/goods during the demonstration year was used to calculate economics.

Under T_1, maximum cost of cultivation (Rs 46,176) was recorded while T_2 cultivation cost was moderate/lesser than T_1 (Rs 43,880); while T_3/local's cost of cultivation was minimum (Rs 32,426). The T_1 resulted maximum cost of cultivation due to maximum input's cost while T_2's cost was moderate due to none adopting of lime (Bordoloi, *et al* 2021d).

Soil Fertility Status

Before the program implementation and after completion of the trials the soil fertility were assessed. It was found that the soil at the experimental site is acidic and contains a significant concentration of organic matter (Table-2). T_1 has substantially greater levels of organic carbon (1.18 kg/ha as compared 0.88 kg/ha before the programme), available nitrogen (356 kg/ha as compared 279 kg/ha), available phosphorus (26.42 kg/ha as compared 19.76 kg/ha) and available potassium (39.31 kg/ha as compared 28.32 kg/ha).

The T_2 also resulted good result among all parameters but that was lower than T_1, viz. organic carbon (0.94 kg/ha as compared 0.76 kg/ha before the programme), available nitrogen (374 kg/ha as compared 308 kg/ha), available phosphorus (22.36 kg/ha as compared 18.31 kg/ha) and available potassium (43.67 kg/ha as compared 34.21 kg/ha).

The T_3 (Farmers practice) resulted the poorest result among all parameters due to not application of lime, biofertilizers etc. viz. organic carbon (1.26 kg/ha as compared 1.02 kg/ha before the programme), available nitrogen (338 kg/ha as compared 320 kg/ha), available phosphorus (26.21 kg/ha as compared 22.74 kg/ha) and available potassium (40.21 kg/ha as compared 32.86 kg/ha).

As per the finding point of view, T_1 resulted 25.42% more organic carbon after the trial, followed by T_2 (19.14 %) while T_3/local resulted minimum (19.04 %). Similarly available N was 21.62 % higher followed by T_2 (17.64) while T_3/local resulted minimum (5.32% higher). The available Phosphorus (P) was 25.20 % higher followed by T_2 (19.93) while T_3 was 13.62 % only. And the available potassium (K) was 27.95% followed by T_2 (21.66 %) while T_3 resulted the poorest (18.77 %).

So, the results proved that lime and biofertlizers improves the soil pH which positively co-related to soil fertility. The improved soil fertility in favour of maximum yield of rajma . Similar results when combining lime with organic and inorganic fertilizers to increase agricultural yield have also been reported by other researchers (Barcchiya*et al*. 2017, Ramana *et al*. 2010, Manivannan *et al*, 2009, Nawalgatti, *et al, 2009*).

CONCLUSION

The farmers of Tirap's district as well as NE region grow rajma in addition to grains, vegetables etc. The farmers of North East India will benefit greatly from the horizontal spread of appropriate organic farming technologies, which will increase agricultural yield in the area. The Treatment-1 with impressive B: C ratio proved the economic viability of new technology adoption for the socio - economic development of this area at the farmer's field. To enhance the life of the farming community in this region, successful organic farming with high crop output will require more research as well as technical, financial support from government agencies.

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