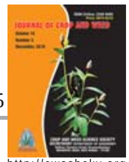
Journal of Crop and Weed, 16(1): 162-166 (2020)

ISSN- O : 2349 9400 ; P : 0974 6315



http://cwssbckv.org
www.cropandweed.com

Influence of liming to green manure crop and different sources of phosphorus in lowland rice of Odisha

K. KUSUMAVATHI, S. SARKAR, D. SETHI AND A. K. MOHAPATRA

Orissa University of Agriculture and Technology,
Bhubaneswar, Odisha -751003

Received : 03.01.2020 ; Revised : 26.02.2020 ; Accepted : 01.03.2020

DOI: https://doi.org/10.22271/09746315.2020.v16.i1.1288

ABSTRACT

An experiment was carried out to study the impact of liming to green manure crop and different sources of phosphorus in lowland rice of Odisha consisting of STBF (Soil test based fertilizer) 100 kg N + 40 kg P_2O_5 + 50 kg K_2O ha^{-1}, STBF + green manuring with Sesbania and STBF + green manuring with Sesbania + liming @ 0.2 LR to green manure crop as main plots, three sources of fertilizers in sub plots such as urea + SSP + MOP, DAP as basal and urea as top dressing + MOP, urea as basal and DAP as top dressing + MOP and replicated thrice following the split plot design. The highest yield of grain (4.85 t ha^{-1}) and straw (6.39 t ha^{-1}) were recorded in STBF + green manuring with Sesbania + liming @ 0.2 LR to green manure crop along with DAP as basal and urea as top dressing + MOP treatment due to the highest (341.16) number of effective tillers per m^2 and the lowest nutrient uptake by weeds as liming is an effective ameliorative practice that integrated in the acid soil management program to raise and maintain a near neutral pH range for optimal crop growth and yield potential.

Keywords: Grain yield, liming, lowland rice, soil test based fertilizer

Food grain production in sufficient quantity and quality for escalating population without degrading the soil productivity, quality and fertility and is one of the major challenges in the current agriculture scenario. The enhancement in rice productivity would go a long way in meeting the country's food requirements. The rice is a major cereal crop, contributes about 40 per cent of total food grain production and staple food for more than 50 per cent of the world's population. It plays an important role in food security and livelihood for almost every household. In Odisha the total productivity of rice during 2017- 18 (MAFW, GOI) was 1739 kg ha^{-1} where as in India was 2576 kg ha^{-1}. Rice is generally grown by transplanting seedlings into puddled soil and field kept inundated with water for most part of the growing season. The puddled soil ensures good crop establishment, weed control with standing water, and reduces deep-percolation losses. Singh *et al.*, 2016. Indiscriminate use of chemical fertilizers for increasing the crop yield elicited many problems such as increasing crop weed competition, reducing soil fertility and crop productivity unsustainable.

Weeds grow profusely in the rice fields, accumulate a large amount of biomass in a very short period, which hampers the growth of rice plants and reduce crop yields drastically. According to Manhas *et al*. (2012) uncontrolled weed growth caused 33-45 per cent reduction in grain yield of rice. Losses due to weeds are the foremost importance to be concentrated in rice production systems, as they interfere with all the activities involved in the field throughout crop growing period. The competition between crop and weed initiate when the supply of any of the growth factor is restricting and falls below the demand of both the crop and weed, when they grow in close vicinity. Weeds remove a large amount of nutrients from soil. An estimate shows that weeds can deprive the crops by 47% nitrogen, 42% phosphorus, 50% potassium, 39% calcium and 24% magnesium of their nutrient uptake as well as reduce the yield potential by accommodating number of crop pests (Balasubramaniyan and Palaniappan, 2001). The main aim of nutrient management with green manure crop sesbania is to enhance not only nutrient uptake and productivity but also to reduce weed growth. The present paper investigates on the importance of incorporating sesbania, liming to sesbania in fostering sustainability and moreover our results can support a choice for increasing rice productivity

MATERIALS AND METHODS

A field experiment was conducted at agronomy main research farm of Odisha University of Agriculture and Technology (OUAT), Bhubaneswar during *kharif* 2017. The experimental site was located in Agro-climatic zone of East and South Eastern plains zone of Orissa with latitude of 20°15′N, longitude of 85°52′E and altitude of 25.9 m above mean sea level (MSL). The experimental design was split plot consisting of three replications

Email : kusumavathi1994@gmail.com

along with three main plots (M_1 -STBF – Soil test based fertilizer 100 N + 40 P_2O_5 + 50 K_2O kg ha^{-1}, M_2 - STBF + green manuring with *Sesbania* and M_3 - STBF + green manuring with *Sesbania* + liming @ 0.2 LR to green manure crop) and three subplots (S_1 - urea + SSP + MOP, S_2 -DAP as basal and urea as top dressing + MOP, S_3-urea as basal and DAP as top dressing + MOP). The experiment was conducted on lowland rice where Naveen variety was grown as *kharif* crop. The composite soil samples from 0-15 cm layers were taken before primary tillage operations. The representative soil was air dried and preserved properly for physical and chemical analysis. The data related to the initial soil physic chemical status were presented in table 1.

Lime ($CaCO_3$) was applied to the field @ 0.2 LR (2.63 t ha^{-1}) before sowing of green manure crop *viz. Sesbania* for main plot treatment M_3. The green manure dhaincha *(Sesbania aculeata)*, seeds were broadcasted @ 25 kg ha^{-1} for main plot treatments M_2 and M_3. The entire plant of *Sesbania* has been incorporated by chopping into three pieces and incorporated at the age of 42 days after sowing with tractor drawn puddler. The field was left undisturbed for a period of two days for decomposition. The field was thoroughly levelled using bullock drawn wooden plank. The experimental field was divided into 27 plots having three replications, each containing three main plots and three sub plots with proper drainage facility. All the plots demarcated by 10 cm high ridges on all sides. The nutrients were applied in form of urea, SSP/DAP and MOP (as per STBF N: P_2O_5: K_2O - 100: 40: 50) kg ha^{-1} and gypsum @ 200 kg ha^{-1}.

All P was applied as per treatment. Nitrogen and potash were applied in three splits *viz.* 25% basal, 50% at active tillering stage and rest 25% at panicle initiation stage and gypsum was applied as basal as per the experimental plan. Twenty-five day's old seedlings were used for transplanting with a spacing of 25 x 10 cm in puddled soil in order to perform conoweeding operation and to maintain the required population in the main field. The plots were kept moist till panicle initiation stage by suitably maintaining the water level in the side channels of each bed. Thereafter a thin film of water was allowed to stand over the bed from panicle initiation stage to 10 days before the harvest of the rice crop. Excess rain water was drained out as and when required. Two hand weedings were done at 25 and 45 DAT of rice. Weed biomass was determined at 25 and 45 DAT from a randomly selected 1 m^2 quadrant in each plot. Weed samples were oven dried before weighing till the constant weight was achieved. These samples were taken up for nutrient analysis. The weeding was done at 35 DAT by conoweeder to reduce the weed population which favor root and plant growth and also maintain aerobic condition at soil of root zone. The rice crop was harvested close to the ground with the help of sickle at maturity.

RESULTS AND DISCUSSION

Influence of liming to green manure crop and different sources of phosphorus on weed flora in lowland rice.

The higher weed growth will absorb the nutrients from the soil, so that the growth of the rice plant will be disrupted. The C_4-type weeds have a very low efficiency of photosynthesis and wasteful in the water use, which causes weeds to absorb a lot of water and nutrients from the soil than rice plants. According to Caton *et al.* (2010) C_3-type weeds become protruding due to high speed of growth through vegetative propagation. Many ecological and crop production principles influence the type of weed flora and its intensity in rice fields. The rice crop is generally infested with a variety of weeds due to favorable agro-climatic condition for the growth of both, crops and weeds. Diversified weeds such as *Echinochloa colonum, E. crusgalli, Cyperus irria, C. rotundus, Altematheara sessilis, Digitaria* spp*, Phyllanthus niruri and Commlina communis* were the major weeds found in rice field.

Influence of liming to green manure crop and different sources of phosphorus on nutrient content of weeds at 25 and 45 DAT of lowland rice.

The nitrogen, phosphorus and potassium content of weeds was increased from 25 DAT to 45 DAT of rice with irrespective of all the treatments. The highest nitrogen, phosphorus and potassium content of weeds at 25 DAT (0.58, 0.32 and 1.82%) and 45 DAT (0.91, 0.41 and 2.01%) of rice was recorded in M_1S_1 treatment respectively. The lowest nitrogen and phosphorus content of weeds at 25 DAT (0.34 and 0.16%) and 45 DAT (0.61 and 0.25%) of rice was recorded in M_3S_2 treatment respectively.

The lowest potassium content of weeds was recorded in M_3S_3 treatment at 25 DAT (1.47%) of rice and in M_3S_2 treatment at 45 DAT (1.81%) of rice. The highest Ca and Mg content of weeds recorded in M_3S_1 treatment at 25 DAT (0.49 and 0.25%) and at 45 DAT of rice (0.52 and 0.23%) whereas the lowest Ca and Mg content of weeds recorded in M_1S_3 treatment at 25 DAT (0.36 and 0.17%) and at 45 DAT of rice (0.28 and 0.17%). The highest Sulphur content of weeds in M_2S_1 treatment at 25 and 45 DAT of rice was 0.25 and 0.43 per cent respectively. This could be due to better utilization of applied phosphorus through as SSP and application of

Table 1: Initial physico-chemical properties of experimental soil

Sl. No.	Parameter	Status	Methods employed
	Physical properties		
1.	Soil textural class	Sandy Loam Sand - 88% Silt - 4% Clay - 12%	Bouyoucos hydrometer method (Piper, 1950).
2.	BD (g cm^{-3})	1.59	Core sampler (Black *et al*., 1965)
3.	PD (g cm^{-3})	2.40	Pycnometer (Black *et al*., 1965)
4.	Porosity (%)	33.75	
5.	WHC (%)	34	Keen's box (Black *et al*., 1965)
	Chemical Properties		
6.	pH (1:2.5)	5.42	Digital pH meter (Jackson, 1973).
7.	EC (dSm^{-1})	0.13	Conductivity meter (Jackson, 1973).
8.	OC (g kg^{-1})	6.62 (Medium)	Walkley and Black (Jackson,1973)
9.	LR (t $CaCO_3$ ha^{-1})	2.63	Woodruff Buffer method
10.	Available N (kg ha^{-1})	253.5 (Low)	Alkaline potassium permanganate ($KMnO_4$) method (Subbiah and Asija, 1956)
11.	Olsen P (kg ha^{-1})	12 (Medium)	Olsen method (Jackson, 1973)
12.	Available K (kg ha^{-1})	59 (Low)	Flame photometer method(Jackson, 1973)
13.	Available S (kg ha^{-1})	11 (Low)	Monocalcium phosphate method
14.	Exch. Ca (meq/100g soil)	3.60 (Adequate)	EDTA (Versenate) complex metric titration
15.	Exch. Mg (meq/100g soil)	0.3 (Low)	EDTA (Versenate) complex metric titration

Table 2: Effect of liming to green manure crop and different sources of phosphorus on

Treatments	Nitrogen content		Phosphorus content		Potassium content		Calcium content		Magnesium content		Sulphur content	
	25 DAT	45 DAT	25 DAT	45 DAT	25 DAT	45 DAT	25 DAT	45 DAT	25 DAT	45 DAT	25 DAT	45 DAT
	Days After Transplanting											
M_1S_1	0.58	0.91	0.32	0.41	1.82	2.01	0.41	0.38	0.21	0.20	0.19	0.28
M_1S_2	0.53	0.86	0.28	0.35	1.75	1.96	0.38	0.36	0.18	0.18	0.12	0.28
M_1S_3	0.57	0.90	0.30	0.39	1.81	1.94	0.36	0.28	0.17	0.17	0.14	0.27
M_2S_1	0.50	0.83	0.29	0.36	1.69	1.91	0.44	0.44	0.23	0.22	0.25	0.43
M_2S_2	0.40	0.77	0.24	0.32	1.67	1.91	0.43	0.42	0.22	0.21	0.24	0.42
M_2S_3	0.46	0.81	0.27	0.34	1.64	1.92	0.42	0.41	0.21	0.18	0.22	0.37
M_3S_1	0.41	0.65	0.22	0.31	1.52	1.84	0.49	0.52	0.25	0.23	0.17	0.25
M_3S_2	0.34	0.61	0.16	0.25	1.52	1.81	0.44	0.44	0.23	0.21	0.15	0.20
M_3S_3	0.37	0.65	0.18	0.29	1.47	1.85	0.42	0.37	0.22	0.19	0.12	0.18
SEm (±)	**0.015**	**0.014**	**0.007**	**0.006**	**0.023**	**0.021**	**0.007**	**0.021**	**0.004**	**0.005**	**0.010**	**0.012**
LSD(0.05)	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**

lime provide favorable microclimate for the weeds to compete with rice crop for nutrients.

Influence of liming to green manure crop and different sources of phosphorus on nutrient uptake by weeds at 25 and 45 DAT in lowland rice

The highest Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca) and Magnesium (Mg) uptake of weeds at 25 DAT of rice recorded in M_1S_1 treatment was 2.93, 1.63, 9.14, 2.03 and 1.05 kg ha^{-1} respectively and at 45 DAT of rice recorded in the same treatment was 1.75, 0.80, 3.88, 0.75 and 0.39 kg ha^{-1} respectively. The lowest N, P, K, Ca and Mg uptake by weeds at 25 DAT of rice was recorded in M_3S_2 treatment was 0.39, 0.19, 1.77, 0.52 and 0.27 kg ha^{-1} respectively and at 45 DAT of rice recorded in M_3S_3 treatment was 0.49, 0.22, 1.42, 0.28

Table 3: Effect of liming to green manure crop and different sources of phosphorus on nutrient uptake (kg ha^{-1}) by weeds at 25 and 45 DAT of lowland rice.

Treatments	Nitrogen		Phosphorus		Potassium		Calcium		Magnesium		Sulphur	
	25	45	25	45	25	45	25	45	25	45	25	45
	Days After Transplanting											
M_1S_1	2.93	1.75	1.63	0.80	9.14	3.88	2.03	0.75	1.05	0.39	0.95	0.55
M_1S_2	1.20	0.98	0.64	0.40	3.98	2.23	0.86	0.41	0.42	0.21	0.28	0.32
M_1S_3	1.98	1.35	1.02	0.58	6.07	2.91	1.21	0.43	0.58	0.26	0.46	0.41
M_2S_1	1.06	1.25	0.60	0.54	3.57	2.86	0.93	0.66	0.48	0.33	0.54	0.64
M_2S_2	0.80	0.84	0.48	0.35	3.35	2.11	0.86	0.46	0.44	0.23	0.48	0.46
M_2S_3	1.40	0.97	0.82	0.41	4.97	2.31	1.27	0.50	0.63	0.22	0.66	0.44
M_3S_1	0.80	0.68	0.44	0.32	3.01	1.91	0.96	0.53	0.49	0.24	0.35	0.25
M_3S_2	0.39	0.61	0.19	0.25	1.77	1.81	0.52	0.44	0.27	0.21	0.17	0.20
M_3S_3	0.52	0.49	0.26	0.22	2.07	1.42	0.60	0.28	0.30	0.14	0.16	0.14
SEm (±)	**0.084**	**0.111**	**0.033**	**0.051**	**0.300**	**0.243**	**0.062**	**0.072**	**0.036**	**0.031**	**0.039**	**0.045**
LSD(0.05)	**0.260**	**NS**	**0.102**	**NS**	**0.925**	**NS**	**0.191**	**NS**	**0.112**	**NS**	**0.121**	**NS**

Table 4: Effect of liming to green manure crop and different sources of phosphorus on yield and yield attributes of lowland rice

Treatments	ET per m^2	Sterility (%)	Test weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
M_1S_1	284.52	13.80	22.05	3.25	5.12
M_1S_2	292.56	11.15	22.15	3.75	5.33
M_1S_3	289.56	12.14	21.89	3.48	5.14
M_2S_1	295.2	11.08	22.05	4.00	5.48
M_2S_2	315.72	10.11	22.16	4.52	6.13
M_2S_3	301.32	10.88	21.69	4.22	5.94
M_3S_1	300.36	11.07	22.19	4.03	5.86
M_3S_2	341.16	9.54	22.45	4.85	6.39
M_3S_3	304.92	10.27	22.27	4.37	6.21
SEm(±)	**4.267**	**0.25**	**0.310**	**0.039**	**0.065**
LSD(0.05)	**13.149**	**0.78**	**NS**	**0.120**	**0.201**

and 0.14 kg ha^{-1} respectively. The biomass weeds were recorded highest in M_1S_1 treatment than in all the treatments. This is due to the absence of liming and application of phosphorus through SSP. The correction of the soil pH by liming influences the bioavailability of plant nutrients and thereby providing favorable environment to increase the yield potential of the crops whereas the weeds can grow with irrespective of the situation. These findings corroborated with the findings of Karalic *et al.* (2013). The findings also prove that practice of green manuring not only increase the yield and maintain the soil fertility in the long run but also suppress the weeds.

The rice grain and straw yield recorded higher in M_3S_2 treatment (4.85 and 6.39 t ha^{-1}) than the other treatments due to the highest number of effective tillers per m^2 (341.16) and the lowest nutrient uptake by weeds. The lowest grain (3.25 t ha^{-1}) and straw (5.12 t ha^{-1}) yield was recorded in M_1S_1 treatment due to the lowest number of effective tillers per m^2 (284.52) and the highest nutrient uptake of weeds. The research findings prove the importance of green manuring and liming to green manure crop over Soil test based fertilizer in increasing the rice yields by reducing the weeds growth and neutralizing the soil pH which enhances the plant nutrient availability thus providing a favorable microclimate for rice.

It may be concluded from the above experiment that the lime application to acid soil elevate the soil pH and favours the desired growing environment for the microbes and crop plants, which also influences the nutrient availability and maintains soil health in long run.

ACKNOWLEDGEMENT

The author would like to thank to Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar for providing the financial assistance for both field experiment and laboratory facility.

REFERENCES

Balasubramanian, P. and Palaniappan, S.P. 2001. Principles and practices of Agronomy. Agrobios Publishing co. Pvt. Ltd., New Delhi: 306-364.

Black, C. A. (ed.) 1965. Method of Soil Analysis, Part 2, Chemical and Microbiological Properties, American Society of Agronomy, Inc, Publisher, Madison, Wisconsin USA.

Caton, B. P., Mortimer, M., Hill, J.E. and Johnson, E. 2010. A Practical Field Guide to Weeds of Rice in Asia.2nd edition. International Rice Research Institute. Los Banos.

Department of Agriculture, Cooperation and Farmers Welfare, Ministry of Agriculture and Farmers Welfare. 2017-18. Government of India, Krishi Bhawan, New Delhi.

Jackson, M.L. 1973 Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 498.

Karalić , K., Loncarić, Z., Popović, B., Zebec V. and Kerovec, D. 2013. Liming effect on soil heavy metals availability. Poljoprivreda, **19** (1): 59-64.

Krunoslav, K., Zdenko, L., Brigita, P. and Vladimir, I. 2013. Phosphorus and potassium availability change by liming of acid soils. IV International Symposium. Agrosym.

Manhas, S.S., Singh,G., Singh, D. and Khajuria, V. 2012. Effect of tank-mixed herbicides on weeds and transplanted rice (*Oryza sativa* L.). *An. Agril. Res*., **33** : 25-31.

Piper, C. 1950. Soil and Plant Analysis. International Public Inc., New York.

Priyanka, K., Tej, P. and Vimal Raj, Y. 2018. Weed Management in Transplanted Rice-A Review. *Int. J. Curr. Microbiol. Appl, Sci*., **7(4**): 1660-69.

Singh, V., Mangi, L. J., Zahoor, A.G., Bhagirath, S. and Chauhan Raj, K.G. 2016. Herbicide options for effective weed management in dry direct seeded rice under scented rice-wheat rotation of western Indo-Gangetic Plains. *Crop Prot.*, **81**: 168-76.

Subbiah, B.V. and Asija, G. L.1956. A rapid procedure for the determination of available nitrogen in soil, *Curr. Sci.* , **25**: 259-60.