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ORIGINAL ARTICLE **OPEN ACCESS**

Seed quality of black gram seed under Integrated Nutrient Management practice

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ABSTRACT
A field experiment was conducted to assess the response of integrated nutrient management practices on seed quality attributes of black gram. The field was strongly acidic in reaction (pH 4.56). Experimental results revealed thatseed inoculated with Rhizobium coated with lime using sago (tapioca root extract) as sticker, applied with soil test based fertilizers and FYM @ 1 t ha^{-1}recorded highest protein content (32.05%) and mineral salt content in black gram seed producing at par result with soil applied with lime.
Keywords: *INM, Seed Quality, Black Gram*

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INTRODUCTION

India is one of the ancient countries in the world growing wide range of pulse crops as prime source of protein. Black gram is one of the most important pulse crop among the various grain legumes. According to Vavilov [3], it is native to India, belong to the family leguminaceae. It contains about 26 percent protein, 1.2 per cent fat and 56.6 per cent carbohydrates on dry weight basis and it is rich source of calcium and iron.

INM, which entails the maintenance of soil fertility to an optimum level for crop productivity to obtain the maximum benefit from all possible sources of plant nutrients – organics as well as inorganics – in an integrated manner [2,10], is an essential step to address the twin concerns of nutrient excess and nutrient depletion.

Integrated approach of nutrient supply by chemical fertilizers along with biofertilizers is gaining importance as this system not only reduces the use of excessive use of inorganic fertilizers, but sustaining thecrop productivity by improving soil health and is also an environment-friendly approach. Integration of inorganic fertilizers and biofertilizers resulted in better growth, yield and nutrient uptakes in black gram [6], green gram [9] and rice [5] as compared to sole application of inorganic fertilizers.

Liming ($CaCO_3$) is routinely used as long-term agricultural management practice to neutralize the acid produced in the soil and to overcome the problems associated with soil acidification. The pure liming material is costly, less available and not affordable by poor farmers.To reduce the amount of liming materials and getting almost similar effect of liming, coating of seeds of green gram with lime using gum acacia [8] and sago as stickers proved to be a better option for increasing productivity, grown in acid soils.

MATERIALS AND METHODS

The field experiment was conducted in the village Haripur of Khordha district during summer (January 2016-17). Haripur is situated at 20^0 07' 66" N latitude and 85^0 42' 81" E longitude. The soil of the experimental field comes under the soil order of *Alfisols.* Test crop Black gram with variety Prasad (B-3-888) and duration of 70 days was selected. The experiment was laid out with Randomized Block Design with six treatments and four replications.

Table 1 :Treatments and their details

Sl no	Abbreviated treatments	Treatment details
T_1	(-) R	Seed without *Rhizobium*, FYM application @ 3 t ha^{-1} and with soil test based fertilizers.
T_2	(+) R	Seed inoculated with *Rhizobium*, FYM @ 1 t ha^{-1}, and applied with soil test based fertilizers.
T_3	(-) R+ $LIME_{(SOIL)}$	T_1 + soil applied with lime @ 0.2 LR below the seed zone on the day of sowing of seeds mixed with FYM
T_4	(+) R+ $LIME_{(SOIL)}$	T_2 + soil applied with lime @ 0.2 LR below the seed zone on the day of sowing of seeds mixed with FYM
T_5	(-)R + $SEED_{(LIME)}$	Seed coated with lime using sago as sticker (no *Rhizobium* inoculation) applied with soil test based fertilizers and FYM @ 1 t ha^{-1}
T_6	(+) R+$SEED_{(LIME)}$	Seed inoculated with *Rhizobium* coated with lime using sago (tapioca root extract) as sticker, applied with soil test based fertilizers and FYM @ 1 t ha^{-1}

The seed samples were analyzed for N, P, K, Ca, Mg, S, Fe, Mn, Cu and Zn. The samples were analysed (except N) by taking 0.5mg materials digesting in di-acid mixture [HNO_3: $HClO_4$ (3:2)] by using standard analytical methods [4].Nitrogen was estimated by micro-kjeldhal method. [1].Crude seed protein was calculated by multiplying the total nitrogen content by 6.25.

Table 2 :Seed quality of black gram seed under Integrated Nutrient Management practice

Treatment	Protein (%)	Mineral content								
		(g kg^{-1})					(mg kg^{-1})			
		P	K	Ca	Mg	S	Fe	Mn	Cu	Zn
(-)R	25.70	2.9	12.4	2.6	1.9	0.6	261.3	295	6.0	24.2
(+)R	27.37	3.0	12.8	3.0	1.9	0.9	262.1	289	6.2	23.8
$LIME_{(SOIL)}$(-)R	29.28	3.5	13.0	4.1	1.5	0.8	293.2	239	6.0	23.1
$LIME_{(SOIL)}$(+)R	33.38	4.0	13.3	4.4	2.4	0.8	349.5	296	6.2	23.7
$SEED_{(LIME)}$(-)R	30.60	3.8	13.1	3.5	2.0	0.9	236	315	7.1	24.9
$SEED_{(LIME)}$(+)R	32.05	4.3	13.7	4.2	2.3	1	371.8	332	7.9	25.5
CD(0.05)	2.85	0.05	0.12	0.06	0.03	0.02	70.13	58.86	1.91	3.42
CV(%)	6.5	8.6	6.5	11.6	10.3	12.5	16.6	14.2	19.8	9.6

RESULTS AND DISCUSSION

The phosphorus salt in pulse seeds under the influence of INM differed significantly and increased positively with integration and varied between 2.9g kg^{-1} to 4.3g kg^{-1}.The potassium salt content in the seedsvaried widely between 12.4g kg^{-1} and 13.7g kg^{-1}.Lime coating of seeds integrated with seed inoculation with *Rhizobium* significantly improved the K content of seeds. The calcium and magnesium salt in the seed ranged from 2.6g kg^{-1} to 4.4g kg^{-1} and 1.9g kg^{-1} to 2.4g kg^{-1}, significantly influenced by *Rhizobium* seed inoculation, combined with lime coating of seeds or soil applied with lime. There was significant impact of treatments on sulphur content of seeds which ranged from 0.6 to 1g kg^{-1}, mostly influenced by *Rhizobium* seed inoculation, combined with lime coating of seeds. The significant higher micro nutrient content i.e. iron (15.77 mg kg^{-1}), manganese (13.43 mg kg^{-1}), copper (29.20 mg kg^{-1}), zinc (57.99 mg kg^{-1}) were recorded in Seed inoculated with *Rhizobium* coated with lime using sago as sticker, applied with soil test based fertilizers and FYM @ 1 t ha^{-1} as compared to other treatments.

Maximum protein content (33.38 %) was recorded in $SEED_{(LIME)}$(+)R compared to Seed without *Rhizobium*(25.70 %) (Table 2). Increase in protein content due to high uptake of nitrogen and phosphorous by slow and continuous supply through bio fertilizers. The results are in agreement with Mahesh babu *et al*. [7] in soybean where combined use of organic and inorganic fertilizers provided better seed quality parameters over control.

CONCLUSION

The study result indicated seed inoculated with *Rhizobium* coated with lime using sago (tapioca root extract) as sticker, applied with soil test based fertilizers and FYM @ 1 t ha^{-1} recorded highest seed quality parameters over other treatments. Here we also found that the lime coating of seed and soil applied with lime have at par effect on quality parameters of black gram seed. Hence, it can be concluded

that lime seed coating can be an alternative for acidic soil, where availability of pure liming material is a major constraint. Therefore conjunctive use of inorganic fertilizers,biofertilizer and lime under acidic condition may be suggested for higher seed quality parameters along with overall betterment of black gram.

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