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Yield and quality of rice as influenced by nutrient management interventions in rice: No till ragi cropping system

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Abstract

The field experiment was conducted during *kharif* 2017 and 2018 on sandy loam soil of the Agricultural College Farm, Bapatla with following treatments T₁: 100% RDF (100-60-40 kg N-P-K ha⁻¹); T₂: 100% RDF+ Soil application of ZnSO₄ @ 50 kg ha⁻¹; T₃: 125% RDF+ Soil application of ZnSO₄ @ 50 kg ha⁻¹; T₄: 75% RDF+ Poultry manure @ 0.82 t ha⁻¹ + Soil application of ZnSO₄ @ 50 kg ha⁻¹; T₅: 75% RDF+ FYM @ 5.0 t ha⁻¹ + Soil application of ZnSO₄ @ 50 kg ha⁻¹; T₆: 50% RDF+ Poultry manure @ 1.6 t ha⁻¹+ Soil application of ZnSO₄ @ 50 kg ha⁻¹ and T₇: 50% RDF+ FYM @ 10 t ha⁻¹+ Soil application of ZnSO₄ @ 50 kg ha⁻¹. The experiment was laid out in Randomized Block Design and replicated thrice among all the treatments, T₇ recorded highest grain yield (5343, 5465 and 5404 kg ha⁻¹) in both the years and in pooled data. All the quality parameters viz., protein, amylase, amylopectin content, head rice recovery, milling percent, water uptake and volume expansion ratio were said to be non significant in both the years of study because these quality parameters are highly governed by genes. To study the influence of organic manures on quality parameters, this experiment needs to be continued on the same site for more years.

Keywords: Rice, yield, protein, amylopectin content, amylase content, volume expansion ratio, water uptake

Introduction

Rice (*Oryza sativa* L.) is the most important cereal crop in the world and is the staple food of over half the world's population. Finger millet (*Eleusine coracana* L.) is an important dry land millet crop and ranks third in importance among millets in India, after sorghum and pearl millet. Ragi is being a C₄ plant, it has higher productivity among the small millets. It is a supplemental food for diabetic patients instead of regular food item like rice as it can reduce sugar levels in blood and urine because it has low glycemic index. In India, it is grown in an area of 43.9 m ha with a production of 99.24 m t and productivity of 2494 kg ha⁻¹. In Andhra Pradesh, it is grown in an area of 2.152 m ha with a production of 8.05 m t and productivity of 3741 kg ha⁻¹. (Ministry of Agriculture, Govt of India, 2018-19) [4]. In intensive cropping systems, maintenance of soil fertility is the major criteria to sustain the crop yields for longer period of time as these systems, deplete substantial amount of nutrients from the soil throughout year. The main principle of maintaining the soil fertility status is to annually replenish those nutrients which are removed by the crops from the field. For maintaining fertility status of soil on a long run, we should dependent on the different nutrient sources rather than chemical fertilizers alone. Whereas, integration of chemical fertilizers with organic manures (INM) is one of the best management practices to maintain the soil fertility on a long run to achieve sustainable crop yields with less environmental pollution to the ecosystem. Organic manures improve the soil physical, biological, and chemical properties. These increases the water holding capacity of soil, enabling the plant roots to have better access to available nutrients. Organic materials are also known to increase the diversity in a microbial population. These are essential to transform fertilizer materials into available form for plant's use and to rejuvenate soil. Organic manures serve as supplement to inorganic fertilizers because they contain both micro and macro nutrients.

Material and methods

A field experiment entitled "Nutrient Management Interventions in Rice- Ragi Sequence" was conducted during *kharif* and *rabi* seasons of 2017-18 and 2018-19 on sandy loam soil of the Agricultural College Farm, Bapatla with following treatments T₁ : 100% RDF (100-60-40 kg N-P-K ha⁻¹) ; T₂: 100% RDF+ Soil application of ZnSO₄ @ 50 kg ha⁻¹ ; T₃: 125% RDF+ Soil application of ZnSO₄ @ 50 kg ha⁻¹; T₄: 75% RDF+ Poultry manure @ 0.82 t ha⁻¹ + Soil application of ZnSO₄ @ 50 kg ha⁻¹; T₅: 75% RDF+ FYM @ 5.0 t ha⁻¹ + Soil application of ZnSO₄ @ 50 kg ha⁻¹; T₆: 50% RDF+ Poultry manure @ 1.6 t ha⁻¹+ Soil application of ZnSO₄ @ 50kg ha⁻¹ and T₇: 50% RDF+ FYM @ 10 t ha⁻¹+ Soil application of ZnSO₄ @ 50 kg ha⁻¹. The experiment was laid out in Randomized Block Design and replicated thrice during *kharif* rice and in *rabi* each *kharif* treatment was sub divided into four sub treatments and hence, The split plot design was adopted. The treatments include S₁: No fertilizer, S₂: 100% RDF, S₃: 75% RDF and S₄: 50% RDF. The soil was sandy loam in texture, slightly alkaline in reaction, low in organic carbon, available nitrogen and available phosphorus and medium in available potassium. BPT 5204 and Sri Chaitanya are the rice and ragi varieties respectively used in this trial.

Grain yield (kg ha⁻¹)

The harvested crop from the net plot area was threshed and dried. After cleaning, the dried produce was weighed. The grain yield from five tagged hills was also included in respect of net plot yield and expressed as yield in kg ha⁻¹.

Quality Parameters

Protein Content

The protein content of grain was estimated by multiplying the nitrogen content with the factor 6.25 (Bandyopadhyay and Roy, 1992)^[1] and expressed as percentage.

$$\text{Protein content(\%)} = \text{Total N content (\%)} \times 6.25$$

Milling Per cent

The hulled brown rice was subjected to milling for 90 seconds i.e., 5 per cent milling in Satake grain testing mill and calculated the milling percentage using the following formula (Chauhan *et al.*, 1994)^[2].

$$\text{Milling percentage} = \frac{\text{Total weight of milled rice (g)}}{\text{Total weight of rough rice (g)}} \times 100$$

Head Rice Recovery (%)

Head rice obtained after milling was weighed and the head rice recovery was calculated by using the formula as suggested by Bandyopadhyay and Roy (1992)^[1].

$$\text{Head rice recovery (\%)} = \frac{\text{Weight of whole polished grain (g)}}{\text{Weight of paddy (g)}} \times 100$$

Amylose Content

Amylose, a linear fraction of starch has a major influence on cooking and eating quality characteristics of rice. It also plays an important role in determining the texture of cooked rice. Grain amylose content was estimated as per the procedure as described by Sadasivam and Manickam (1992)^[8] and expressed as percentage.

Amylopectin content

Amylopectin content was calculated using the following equation explained by Torruco-Uco *et al.* (2006)^[10]. The average

amylose content value was taken for the calculation.

$$\text{Amylopectin} = (100 - \text{Amylose \%})$$

Cooking quality characteristics

Water Uptake

Two grams of the milled rice was soaked for thirty minutes in a test tube by adding 10 ml of water. Then, it was boiled for 45 minutes at 77°C- 80°C in a constant temperature on water bath. Two test tubes were kept with 10 ml of water as a control along with the samples in the water bath. Immediately, the tubes were placed in a beaker containing cold water for cooling. The supernatant water in the test tube was poured into graduated cylinder after cooling and the water level was noted (DRR, 2014)^[3].

$$\text{Water uptake} = \frac{100}{2} \times \text{Actual water absorbed}$$

Volume Expansion Ratio

Volume expansion ratio was determined as suggested by Verghese (1950)^[12] and modified by Murthy (1965)^[5] by using the following formula.

$$\text{Volume expansion} = \frac{\text{Increase in volume after cooking (X - 50)}}{\text{Increase in volume before cooking (Y - 50)}}$$

Five grams of rice sample was soaked in 15ml of water for 5 minutes in a 50 ml graduated centrifuge tube. The volume of water was recorded after adding rice samples (Y-15). Rice cooked for 20 minutes in water bath was dipped in 100ml measuring cylinder (X) containing 50 ml water. The volume raised was recorded (X-50) and was computed by using the above formula. The data were statistically analyzed following the analysis of variance method as described by Panse and Sukhatme (1978)^[6].

Results and Discussion

Grain yield (kg ha⁻¹)

Grain yield of rice in both the years of study showed significant differences among the imposed treatments. During first year of study, significantly the highest grain yield (5343 kg ha⁻¹) was recorded with the 50% recommended dose of inorganic fertilizers + FYM 10 t ha⁻¹ + ZnSO₄ @ 50 kg ha⁻¹ (T₇) over the other treatments but it was found statistically at par with 125 % RDF + ZnSO₄ @ 50 kg ha⁻¹ i.e. T₃ (4881 kg ha⁻¹) which was significantly superior to the remaining treatments. The remaining treatments (T₁, T₂, T₄, T₅ and T₆) remained at par with one another this was noticed in the first year of study.

In the second year also, significantly the highest grain yield was recorded with T₇ (50% RDF+ FYM 10 t ha⁻¹ + ZnSO₄ @ 50 kg ha⁻¹) i.e. 5465 kg ha⁻¹ followed by T₃ (125% RDF + ZnSO₄ @ 50 kg ha⁻¹) i.e. 5021 kg ha⁻¹. Treatment T₃ was found on par with T₄, T₅ and T₆ however, it was significantly superior to the T₁ and T₂.

Combined application of organics and inorganics to the rice crop leads to improved overall growth of the crop in terms of drymatter production, morphological and photosynthetic components along with nutrient accumulation. This shows greater availability of nutrients and metabolites for growth and development of reproductive structures, which ultimately might have led to realization of higher productivity of individual plant. The increased availability of nutrients and photosynthates might have enhanced the yield attributes. The

highest grain yield in T₇ might be due to improvement in yield attributing characters i.e. number of productive tillers, test weight and number of filled grains per panicle which were recorded with this treatment comparatively T₃ and other

treatments in the study. These results are in complete agreement with the findings of Trivedi *et al.* (2016)^[11], Premalatha and Angadi (2017)^[7] and Singh and Singh (2018)^[9] who reported similar findings.

Table 1: Grain yield (kg ha⁻¹) at harvest of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled Data
T ₁ : 100% RDF (100-60-40 kg NPK ha ⁻¹)	4036	4165	4100
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	4162	4299	4230
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	4881	5021	4951
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	4253	4416	4334
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	4319	4500	4409
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	4360	4595	4477
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	5343	5465	5404
S.Em ±	173.1	118.9	146
CD (P=0.05)	519.0	356.8	437.9
CV (%)	8.6	10.4	9.5

Protein Content (%)

The protein content of rice grain furnished in table 2 revealed that the fertilizer doses and organic manures did not significantly affect the rice protein content. Numerically highest protein content in rice grain was recorded with T₇ (50

RDF + FYM @ 10 t ha⁻¹ + ZnSO₄ @ 50 kg ha⁻¹) i.e. 6.5 % and lowest was recorded with 100 % RDF (6.4 %). Similar trend was observed in both the years of study and in pooled data.

Table 2: Protein content in rice (%) of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ : 100% RDF (100-60-40 kg NPK ha ⁻¹)	6.4	6.5	6.4
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	6.4	6.5	6.4
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	6.5	6.6	6.5
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	6.4	6.5	6.4
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	6.4	6.5	6.4
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	6.4	6.5	6.4
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	6.5	6.7	6.6
S.Em ±	0.10	0.11	0.10
CD (P=0.05)	NS	NS	NS
CV (%)	3.7	3.9	3.8

Amylose content (%)

The data on amylose content of rice grain furnished in table 3

revealed that the fertilizer doses and organic manures did not significantly affect the rice amylose content.

Table 3: Amylose content in rice (%) of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ : 100% RDF (100-60-40 kg NPK ha ⁻¹)	20.8	21.1	21.0
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	21.0	21.2	21.1
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	21.8	22.0	22.0
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	21.1	21.9	21.5
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	21.7	22.0	21.8
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	21.5	21.9	21.7
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	21.7	22.0	21.8
S.Em ±	0.44	0.32	0.38
CD (P=0.05)	NS	NS	NS
CV (%)	4.6	3.3	3.9

Amylopectin Content (%)

The data on amylose pectin content of rice grain presented in

table 4 revealed that the fertilizer doses and organic manures did not significantly affect the rice amylose pectin content.

Table 4: Amylopectin content in rice (%) of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ : 100% RDF (100-60-40 kg NPK ha ⁻¹)	77.7	78.0	77.8
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	78.0	79.4	78.7
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	79.1	79.6	79.2
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	76.8	78.1	77.4
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	77.6	78.4	78.0
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	76.9	78.2	77.5
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	79.3	79.8	79.5
S.Em ±	1.08	0.56	0.82

CD (P=0.05)	NS	NS	NS
CV (%)	3.0	4.8	3.9

Cooking quality parameters (Volume expansion ratio, water uptake in ml)

Data on cooking quality parameters were not significantly affected with treatments in both the years of study and the

data are presented in table 5 and 6 revealed that the fertilizer doses and organic manures did not significantly affect the rice amylose pectin content.

Table 5: Volume expansion ratio of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ :100% RDF (100-60-40 kg NPK ha ⁻¹)	3.3	3.3	3.3
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	3.3	3.4	3.3
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	3.3	3.4	3.3
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	3.2	3.4	3.3
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	3.2	3.3	3.2
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	3.2	3.3	3.2
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	3.3	3.4	3.3
S.Em ±	0.04	0.04	0.04
CD (P=0.05)	NS	NS	NS
CV (%)	4.8	3.9	4.3

Table 6: Water uptake of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ :100% RDF (100-60-40 kg NPK ha ⁻¹)	137.6	138.3	137.9
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	138.3	139.3	138.8
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	140.3	143.6	141.9
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	134.3	135.6	134.9
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	135.0	137.6	136.3
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	137.6	138.6	138.1
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	140.0	142.3	141.1
S.Em ±	2.80	2.78	2.79
CD (P=0.05)	NS	NS	NS
CV (%)	4.6	4.4	4.5

Milling quality parameters (hulling, milling and head rice recovery %)

Among the treatments there was no significant variation in milling quality parameters i.e. hulling, milling and head rice recovery percent (Table 7, 8 and 9)

Highest hulling (77.6 and 78.2 %), milling (69.1 and 69.3 %)

and head rice recovery (58 and 59 %) was recorded with the application of 50 RDF + FYM @ 10 t ha⁻¹ + ZnSO₄ @ 50 kg ha⁻¹ and lowest hulling (75.6 and 76.4 %), milling (67.6 and 68 %) and head rice recovery (56.3 and 57 %) was recorded with 100 % RDF in both the years of investigation.

Table 7: Hulling percent (%) of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ :100% RDF (100-60-40 kg NPK ha ⁻¹)	75.6	76.4	76.0
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	76.6	77.1	76.8
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	77.6	77.6	77.6
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	76.3	76.6	76.4
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	76.8	77.5	77.1
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	76.0	77.0	76.5
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	77.6	78.2	77.9
S.Em ±	0.80	0.70	0.75
CD (P=0.05)	NS	NS	NS
CV (%)	3.9	4.2	4.0

Table 8: Milling percent (%) of *kharif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ :100% RDF (100-60-40 kg NPK ha ⁻¹)	67.6	68.0	67.8
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	68.3	68.3	68.3
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	69.1	69.1	69.1
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	67.5	68.0	67.7
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	67.3	68.3	67.8
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	68.0	68.1	68.0
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	69.1	69.3	69.2
S.Em ±	0.69	0.49	0.59
CD (P=0.05)	NS	NS	NS
CV (%)	4.8	3.0	3.9

Table 9: Head rice recovery of *khariif* rice as influenced by nutrient management interventions

Treatment	2017	2018	Pooled data
T ₁ : 100% RDF (100-60-40 kg NPK ha ⁻¹)	56.3	57.0	56.6
T ₂ : 100% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	57.0	57.5	57.2
T ₃ : 125% RDF+ ZnSO ₄ @ 50 kg ha ⁻¹	57.3	58.7	58.0
T ₄ : 75% RDF+ PM @ 0.82 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	56.6	57.3	56.9
T ₅ : 75% RDF+ FYM @ 5.0 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	56.6	57.6	57.1
T ₆ : 50% RDF+ PM @ 1.6 t ha ⁻¹ + ZnSO ₄ @ 50kg ha ⁻¹	56.8	57.9	57.3
T ₇ : 50% RDF+ FYM @ 10 t ha ⁻¹ + ZnSO ₄ @ 50 kg ha ⁻¹	58.0	59.0	58.5
S.Em ±	0.74	0.89	0.81
CD (P=0.05)	NS	NS	NS
CV (%)	4.0	4.6	4.3

Conclusion

Overall it can be concluded that, the maximum grain yield of rice was recorded with the application of 50 RDF + FYM @ 10 t ha⁻¹ + ZnSO₄ @ 50 kg ha⁻¹ in both the years of study. In all the quality parameters of rice is concern, numerically highest was recorded with T₇ treatment. Quality parameters are highly governed by genes. To study the influence of organic manures on quality parameters, this experiment needs to be continued on the same site for more years.

References

1. Bandyopadhyay S, Roy NC. Rice Process Technology. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi, 1992.
2. Chauhan JS, Chauhan VS, Lodha SB. Studies on milling quality components of upland rice. *Oryza*. 1994; 31:50-52.
3. Directorate of Rice Research, Hyderabad. Laboratory Manual on Rice Grain Quality Procedures, 2014.
4. Ministry of Agriculture, Government of India. 2018-19. www.indiastat.com.
5. Murty PS. Spikelet sterility in relation to nitrogen and carbohydrate contents in rice. *Indian Journal of Plant Physiology*. 1965; 25:40-58.
6. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. Indian Council of Agricultural Research, New Delhi, 1978, 145-152.
7. Premalatha BR, Angadi VV. Influence of integrated nutrient management and Leaf Color Chart (LCC) based nitrogen management in rice (*Oryza sativa* L.) yield and yield attributes, nitrogen uptake and soil available nitrogen status. *Environment and Ecology*. 2017; 35(3B):2012-2020.
8. Sadasivam S, Manickam A. Biochemical methods for Agricultural Sciences. Wiley Eastern Limited. New Delhi, 1992, 10-11.
9. Singh B, Singh AP. Response of wheat (*Triticum aestivum* L.) to FYM and phosphorus application in alluvial soil. *International Journal of Current Microbiology and Applied Sciences*. 2018; 7(6):418-423.
10. Torruco-Uco JG, Chel-Guerrero LA, Betancur-Ancona D. Isolation and molecular characterization of Makal (*Xanthosoma yucatanensis*) starch. *Starch - Stärke*. 2006; 58(6):300-307.
11. Trivedi VK, Dimree S, Pathak RK, Tripathi M. To study the effect of integrated nutrient management of rice (*Oryza Sativa* L.) in central plain zone of U.P. *International Journal of Technical Research and Applications*. 2016; 4(4):108-112.
12. Verghese EJ. Standard procedure for cooking rice for experimental purposes. *Madras Agricultural Journal*. 1950; 36(6):217-221.