International Journal of Statistics and Applied Mathematics

ISSN: 2456-1452
Maths 2023; SP-8(5): 995-1000

https://www.mathsjournal.com
Received: 20-08-2023
Accepted: 25-09-2023

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A review: integrated use of inorganic fertilizer & organic matter on soil fertility under Rice (*Oryza sativa* L.) crop

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Abstract
Present Reviews are entitled that "A Review on Integrated use of chemical fertilizer & Organic manure on soil fertility under Rice (*Oryza sativa* L.) Crop". Entitled review are based on uses of various sources of inorganic as well as organic matter on fertility status of rice crop. Rice (*Oryza sativa* L.) is the supreme food for more than 65 percent of the population as well as generates live security to 70 percent of Indian people. Rice is grown in almost all state of India but its cultivation is mainly concentrated is river valleys and low-land sea areas in India. Andhra Pradesh, Madhya Pradesh, Utter Pradesh lead in the area. West Bengal (15.10%), Utter Pradesh (11.99%) and Punjab (11.33%) have the highest share in rice production. Kumar *et al.* (2012) revealed that the apply of Nitrogen, Phosphorus and organic matter significantly stimulates the no. of tillers, plant height and yield of rice over control. The highest yield of rice was obtained in 100% NP+GM (6.42 t ha^{-1}) than 100% NP (5.31 t ha^{-1}) and 100% NP +wheat residue (6.02 t ha^{-1}) treatment. (Javier *et al.*, 2004). Continuous treatments of organic matter like Form Yard Manure, Phosphorus Solubilizing Bacteria and Blue Green Algae on rice field resulting subtle yield and lower Nitrogen and Potassium content at the middle tillering stage of rice plant. Hence it is concluded that combined interaction was found that Inorganic fertilizers and organic matter can improve the soil health, Yield & Quality products.

Keywords: Rice (*Oryza sativa* L.), organic matter, chemical fertilizer, NPKS, Amit Singh N.K Singh, FYM, Integrated etc

Introduction
Rice (*Oryza sativa* L.) is the supreme food for more than 65.00 percent of the population as well as generates live security to 70.00 percent of Indian people. (Kulkarni *et al.*, 2015) [16]. India has largest farm area (43.9) million ha^{-1} followed by china (30.30 mha), Indonesia (13.80 mha), Bangladesh (11.30 mha) and Vietnam (7.86 mha) and production of rice
107.5 MT and per unit production of rice 3576 kilogram/hectare 2015-16. (Food and agricultural organization, STAT 2016). With the increasing demand, future prospectives for rice production is to be 172-188 MT with an average per unit production of 4050 kilogram/hectare by the year 2020 (Mishra *et al.*, 2006) [17]. Rice is grown in almost all state of India but its cultivation is mainly occurs is river bank, estuaries & lower sea areas in India. Andhra Pradesh, Bihar, Madhya Pradesh, Utter pradesh lead in the area. West Bengal (15.10%), Utter Pradesh (11.99%) and Punjab (11.33%) have the highest share in rice production (Directorate of economics and statistics DAC and FW).
Rice is primarily a high energy food. it is good source of Carbohydrates (80g), suger (0.12g), dietary fiber (1.3g), fat (o.66g), protein (7.12g) in per 100g of grain (USDA Nutrient data base, (2015).
Oryza is grow in various conditions and production, but submerged in water is the most common method used worldwide. Rice is the only cereal crop that can grow for long periods of time in standing water, 57% of rice is grown on irrigated land, 25% on rainfed lowland, 10% on the upland, 6% in deep water, and 2% in tidal wetland.

As the land area decreasing with time, increasing land use intensity inadequate and imbalanced use of chemical fertilizers with little or no use of organic manure have caused severe fertility deterioration resulting in stagnating or even declining crop productivity (Shormy *et al*., 2013) [18]. Integrated use of inorganic fertilizers, bio-fertilizers and farmyard manure seem to be the practicable alternative to the present malady of unsustainable agriculture. Farmyard manure is easily available, cheap, proven source of nutrition to agricultural crops and has been used by the far48mers traditionally. Blue green algae has vital role in soil fertility improvement and consequently increasing growth and yield as a natural fertilizer (Song *et al*., 2005) [19]. Phosphate solubilizing bacteria (PSB) has the capacity to solubilize and mineralize the residual or fixed phosphorous, increases phosphorus availability in the soil.

Integrating nutrient management (INM) aims for efficient and judicious use of all the major source of plant nutrients in an integrated manner (Farouue and Takeya, 2007) [12]. on the other hand, continuous supply of organic fertilizer such as FYM, PSB and BGA on rice field resulting low yield and low N and K content at the mid tillering stage of rice plant (Javier *et al*., 2004) [15]. Combined use of organic manure and inorganic fertilizer help in maintaining yield stability through correction of marginal deficiencies of secondary and micronutrients, enhancing efficiency of applied nutrients and providing favorable soil physical condition. (Gill and Walia 2014) [20].

Continuous use of inorganic fertilizers leads to deterioration in soil chemical, physical, and biological properties, and soil health. The negative impacts of chemical fertilizers, coupled with escalating prices, have led to growing interests in the use of organic fertilizers as a source of nutrients. Organic materials such as FYM have traditionally been used by rice farmers. FYM supplies all major nutrients (N, P, K, Ca, Mg, S,) necessary for plant growth, as well as micronutrients (Fe, Mn, Cu and Zn).

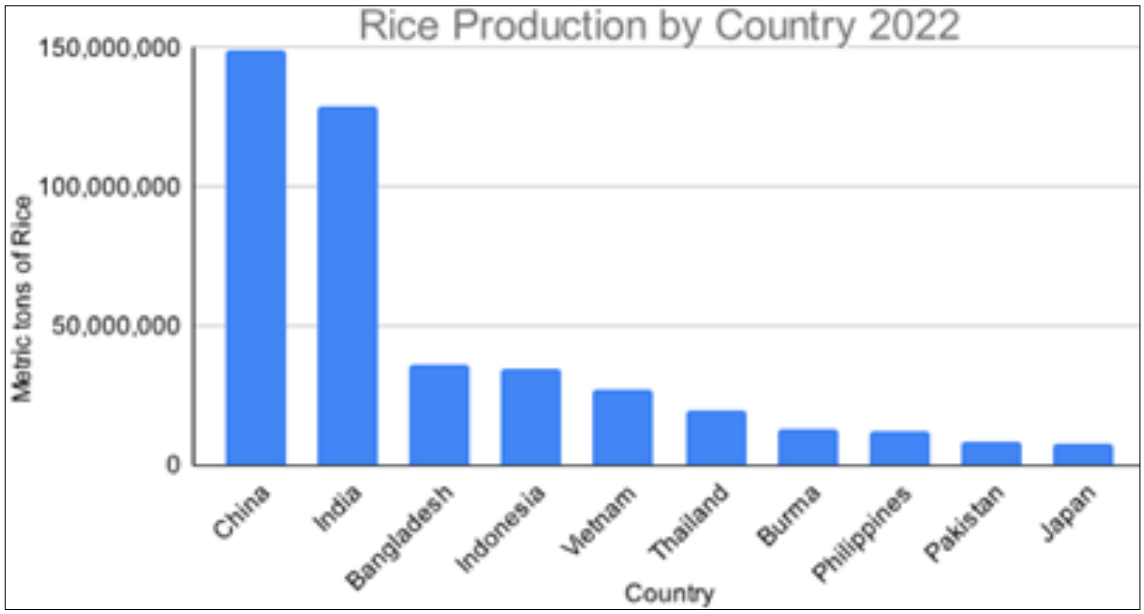

Fig 1: Shows the rice production by country in 2022

Effect of Integrated use of chemical fertilizer on soil fertility under Rice (*Oryza sativa* L.) crop

Kumar *et al*. (2007) [21] studied the effect of organic manures and chemical fertilizers in rice during the rainy and winter seasons of 2003-04 and 2004-05 with rice-wheat cropping system Incorporation of organic manures (FYM, poultry manure and FYM + poultry manure) significantly recorded higher crop growth, yield and yield attributes of rice as compared to control Organic manures increased the mean grain yield of rice by 16.1 to 18.8% over control. However, farm yard manure, poultry manure and FYM + poultry manure produced growth and yield of rice at par. Kumar *et al.* (2012) [12] reported that the application of N, P and organic sources significantly increased the no. of tillers, plant height and yield of rice over control. The maximum yield of rice was obtained in 100% NP+GM (6.42 t ha^{-1}) than 100% NP (5.31 t ha^{-1}) and 100% NP +wheat residue (6.02 t ha^{-1}) treatment. The 100% recommended NP with organic sources (FYM, PM, GM, and WR) recorded higher N uptake by 29.2, 29.4, 37.3 and 18.4%, respectively as compared to 100% recommended NP. The use of organic manure decreased soil pH and its combined use with fertilizers was significantly reflected in the buildup of available N, P, K, organic carbon and DTPA– extractable Fe and Mn content of the soil. Singh *et al.* (2001) [22] reported that the combined application of organic and inorganic N sustained the productivity, even at lower level of N application. The results indicated that without proper K fertilization, depletion of K may affect the sustainability of the rice-wheat system. Regression equations developed over the years revealed that incorporation of 5t FYM/6 t GM saved 70-80 kg N ha^{-1} y^{-1} without any adverse effect on productivity of rice-wheat system and the soil health. Dwivedi *et al.* (2002) [23] studied on maize for yield, quality and nutrient uptake by maize (*Zea mays* L). Application of S up to 30 kg ha^{-1} enhanced the average grain yield of maize by 22 per cent over control. The applicationof Zn up to 5 kg ha^{-1} increased the maize grain yield by 19 per cent over control.

Table 1: Shows the rice production by country

Country	Tonnes Rice Produced (2019)	% of Total
China	211.4M	28.0%
India	177.6M	23.5%
Indonesia	54.6M	7.2%
Bangladesh	54.6M	7.2%
Vietnam	43.4M	5.7%
Thailand	28.3M	3.7%
Myanmar	26.3M	3.5%
Philippines	18.8M	2.5%
Pakistan	11.1M	1.5%
Brazil	10.4M	1.4%
Others	119.0M	15.8%
Total	**755.5M**	**100.0%**

Begum *et al*. (2007) [24] carried out an investigation to assess the influence of integrated nutrient management on dynamics of nitrogen (N) and phosphorus (P) in soil under a wheat-mung bean-maize cropping system. Eight treatments *viz*. fertilizers applied at 50, 75 and 100% of the recommended dose (N120P60K60), N120only, P60only, FYM (@ 5 t ha-1) applied alone, and in combination with 50 and 75% recommended NPK were applied to wheat. These treatments were compared with no-fertilizer & manure control. Mung bean was grown following wheat without any fertilizer or manure application. It was allowed to grow till maturity, and after two pickings, the stover was incorporated into the soil. Zero, 50 and 75% of the recommended dose of fertilizer (N120 P60 K60) were applied to maize.

Kumar and Singh (2010) [25] reported that the combined application of 100% NPK + green gram + 5.0 t FYM each year gave significantly higher available N, P, K and higher content of DTPA-extractable Zn, Fe, Mn and Cu in post-harvest soil at the end of six years cycle. The DTPA-extractable Zn was found to be higher in the treatment combination of 100% NPK + 10 kg Zn ha^{-1} for each of the 5 crops. It is concluded that integrated application of 100% NPK + green gram + 5.0 t FYM was the most effective treatment in meeting the micronutrient requirements of rice and wheat crops. Vimera *et al.* (2012) [26] reported that the integrated application of chemical fertilizers, organic manures and biofertilizers significantly increased yield and quality characters as compared to control. Yaduvanshi *et al.* (2013) [27] reported that the effect of inorganic fertilizers alone and in combination with organic manures for soil organic carbon (SOC), bulk density, available soil N, P, K and yields of rice and wheat grown on a reclaimed sodic soil after twelve years (1994-95 to 2005-06). The SOC increased in plots receiving N120 P26 K42 plus green manure (GM) and N120 P26 K42 plus farmyard manure (FYM) by 28 and 23% over the initial value but decreased by 31 and 24% in unfertilized and N120 P26 K42 treated plots, respectively. Application of NPK and its combination with GM and FYM increased rice yields significantly. Applying inorganic fertilizers in rice resulted in nearly similar nitrogen use efficiency (NUE) values when compared to their combined application with organic manures. The NUE increases in wheat due to the residual effect of organic manures in addition to the inorganic fertilizers.

Kharche *et al*. (2013) [37] carried out to study the long-term effect of integrated nutrient management on properties of Vertisol under sorghum-wheat cropping system at the combination of NPK fertilizers with organics *viz*., farmyard manure (FYM), wheat straw and green manure, 100% organics and unfertilized control laid out in randomized block design with four replications. Soil physical properties were improved due to continuous application of chemical fertilizers in conjunction with organics over only chemical fertilizers. The integrated use of nutrient sources was beneficial to enhance soil properties by increasing labile soil C fractions and maintained the crop yields year after year while only chemical fertilizers showed decline in yield.

Chesti *et al.* (2015) [9] studied that the effect of integrated application of inorganic and organic sources on soil properties, yield and nutrient uptake by rice in intermediate zone of Jammu and Kashmir. Three years of conjoint use of 10 t FYM ha^{-1} with 100% NPK significantly improved the organic carbon and available N, P and K contents over the chemical fertilizers alone. Significantly higher grain yield of 5.36 t ha^{-1} and total NPK uptake by rice with the application of 100% NPK+10 t FYM ha^{-1} as compared to the grain yield of 4.96 t ha^{-1} and total NPK uptake (86.5, 18.1 and 96.8 kg ha^{-1}, respectively) with the 100% NPK alone.

Effect of Integrated use of Organic manure on soil fertility under Rice (*Oryza sativa* L.) crop

Patidar *et al*. (2002) [29] reported that the Application of 10 tonnes/ha FYM and nitrogen and phosphorus fertilizer up to 75% of recommended level significantly enhanced grain and fodder yields of sorghum. Azospirillum alone and in combination with phosphate-solubilizing bacteria increased sorghum yield by 6–7%. Both available P and N status in soil after sorghum harvest were improved with FYM application, while fertility levels and PSB inoculation increased only P status of soil after sorghum harvest over the control. Sahu *et al*. (2015) [30] Results revealed that the treatment STCR dose with 5 t FYM for YT 50 q ha-1 (T10) was found to be significantly superior not only over control (T1) but also over rest of the treatments in increasing the plant height, dry matter, total and effective tillers of rice. Singh *et al.* (2014) [31]. Combined use of FYM @ 5 t ha-1+BGA significantly superior over BGA or FYM alone. Cropping. Significant increase in rice yield were noticed in treatments with paddy straw as source of nitrogen (25 to 50%). Higher maize yield was observed in treatments with both organic and inorganic fertilizers in kharif followed by 100 per cent NPK in summer season, thus showing the beneficial effect of organic sources

of nutrients on the succeeding crop and improving the soil fertility levels. Singh *et al.* (2014) [31] conducted a field experiment during 2010 to evaluate the effect of NPK levels, BGA and FYM on growth and yield of rice HUBR-2-1. The application of NPK @ 100% RDF (i.e. 120-60-60 kg/ha) produced significantly better growth, yield attributes, grain and straw yield than its lower levels. Combined use of FYM @ 5 t ha-1+ BGA proved significantly superior over BGA or FYM alone. Chesti *et al.* (2015) [9] studied that the effect of integrated application of inorganic and organic sources on soil properties, yield and nutrient uptake by rice in intermediate zone of Jammu and Kashmir. Three years of conjoint use of 10 t FYM ha^{-1} with 100% NPK significantly improved the organic carbon and available N, P and K contents over the chemical fertilizers alone. Significantly higher grain yield of 5.36 t ha^{-1} and total NPK uptake by rice (96.3, 20.4 and 109.5 kg ha^{-1}, respectively) with the application of 100% NPK+10 t FYM ha^{-1} as compared to the grain yield of 4.96 t ha^{-1} and total NPK uptake (86.5, 18.1 and 96.8 kg ha^{-1}, respectively) 100% NPK alone. Satyanarayana *et al.* (2002) [32] resulted that the application of farmyard manure at 10 t ha−1 increased grain yield of rice by 25% compared to no farmyard manure control. Similar observations were also made on straw yield, tiller number, filled grains per panicle, and 1000-grain weight. There were significant interactions between farmyard manure and inorganic fertilizer treatments. The beneficial effects of application of farmyard manure were not enhanced at increased rates of application of inorganic fertilizers. The increased grain yield was due mainly to increased nutrient uptake and number of tillers, filled grains per panicle and 1000-grain weight. Duhan *et al.* (2002) [33] reported that the rice yield and uptake of nutrients increased significantly with increasing N levels. Moreover, application of N along with GM (green manuring) showed additive effect on these parameters. Under all GM treatments, the yield and uptake were always higher with 120 kg N ha^{-1} than with the lower levels of N. The effect of different green manures (GM) on rice yields and nutrient uptake was in order: sun hemp > moong > dhaincha.

Ghose *et al.* (2003) [13] study effect of conjoint use of farmyard manure and nitrogen on rice-wheat system in mid-hill soils of Uttaranchal. An application of 20 kg N/ha along with 15 tonnes FYM/ha to rice gave the highest grain yield of rice as well as wheat, besides led to build-up of total N in soil. Bhoite *et al.* (2005) [6] Application of 50% recommended dose and 50% N through green-manure to rice with 100% recommended dose of fertilizers to wheat crop resulted in significantly higher system productivity and benefit soil fertility than that of all those treatments, in which, green-manure was not used. The application of 50% recommended dose and 50% N through green-manure to rice gave significantly higher net returns and benefit: cost ratio, irrespective of fertilizer level applied to wheat. Singh *et al.* (2008) [34] reported that the treatments consisted of FYM, vermicompost, green manure, Azotobacter, phosphate solubilizing bacteria (PSB), blue-green algae (BGA), rice residue incorporation and NPK fertilizers. Significantly higher yields to the tune of 4.3 t ha^{-1} for rice and 4.0 t ha^{-1} for wheat were recorded when rice-wheat were grown after green manuring of dhaincha in-situ or application of FYM (10 t ha^{-1} $year^{-1}$) or vermicompost (5 t ha^{-1} $year^{-1}$) in kharif season along with reduced quantity of fertilizers per hectare per crop (30–90 kg N, 13–20 kg P and 37 kg K) accompanied by microbial cultures (Azotobacter, BGA & PSB) as compared to the yield (4.0 – 4.1 t ha^{-1}) with recommended dose of NPK (120-26-50) per hectare per crop. Reduction to the tune of 25% in recommended dose of N, P and K fertilizers (30 kg N, 6.5 kg P and 13 kg Kg ha^{-1} $crop^{-1}$) could be made with the application of FYM or vermicompost, green manuring alone without decrease in yield of rice and wheat. Quantity of N and P fertilizers could be further reduced to half of the recommended dose (i.e. 60 kg N and 13 kg P ha^{-1} $crop^{-1}$) with the application of Azotobacter and PSB along with FYM or vermicompost or green manuring.

Vikram *et al*. (2008) [35] studied that the Inoculation of green gram seeds with PSBV-14 recorded the highest nodule number, nodule dry weight, shoot dry matter and total dry matter in green gram plants 45 days after sowing. Similarly, treatment receiving the inoculation of PSBV-13 recorded the highest root length, root dry matter, P content and P uptake in root and shoot in green gram plants. Majority of PSB isolates tested in the present study were able to improve the growth parameters of green gram significantly compared to rock phosphate control and single super phosphate control. Prasad *et al*. (2010) [36] conducted an experiment on Grain yield of maize, wheat and the system under 50% N through FYM + 50% through chemical fertilizers was significantly higher than that under 100% chemical fertilizers applied to both the crops and was on par with 25% N through FYM and 75% through inorganic source. Maximum N, P and K uptake values were recorded when 50% N was substituted by FYM in maize (114.6, 23.9 and 125.5 kg ha^{-1}) and wheat (99.7, 18.1 and 89.8 kg ha^{-1}) and maize-wheat system (214.3, 42.0 and 215.3 kg ha^{-1}) followed by 25% N through FYM and remaining through inorganic source and minimum in control.

Conclusion and Future work

Present Reviews are entitled that "A Review on Integrated use of chemical fertilizer & Organic manure on soil fertility under Rice (*Oryza sativa* L.) Crop" Presented review are revealed that separately result was found that chemical fertilizers, minimize the yields & quality of product as well as cause toxic effect on food grain and soil mass. Current effect also affect soil health, microbial Biomass and physiochemical property of soil. use of chemical fertilizers with little or no use of organic manure have caused severe fertility deterioration resulting in stagnating or even declining crop productivity (Shormy *et al*., 2013) [18].

Effect of uses different dosses of various organic sources i.e FYM, Vermicompost, Biofertilizers can improve the soil health as well as physical, chemical & biological properties. FYM & Blue green algae has vital role in soil fertility improvement and consequently increasing growth and yield as a natural fertilizer (Song *et al*., 2005) [19]. It is also decreasing yield parameters because of increase H^{+} ions in soil mass. continuous application of organic fertilizer such as FYM, PSB and BGA on rice field resulting low yield and low N and K content at the mid tillering stage of rice plant (Javier *et al*., 2004) [15].

It is concluded that combined interaction was found that chemical fertilizers and organic manure can improve the soil health, Yield & Quality parameters.

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