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# Soil property dynamics under submerged paddy as affected by organic and inorganic nutrient sources

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**Abstract**
The present investigation entitled "Effect of different Nutrient sources on soil properties under submerged rice" was conducted at the experimental farm of department of Soil Science and Agricultural Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, during the *Kharif* season 2021-22. The field experiment was laid out in Factorial Randomized Block Design. The four levels of inorganic fertilizers application *viz*. N0-Absolute Control, N1- Recommended dose (100:50:50 N:P2O5:K2O kg ha$^{-1}$) through chemical fertilizer (Urea, SSP, MOP), N2- Recommended dose through Konkan Annapurna Briquette (KAB) and N3-Glyricidia @ 10 tonnes per hectare which were replicated three time to study the effect of different nutrient source on chemical properties and nutrient availability in soil. The initial experimental soil was strongly acidic in reaction and showed low electrical conductivity. The soil found very high in organic carbon whereas, available N was medium. The soil was medium in available P2O5, high in available K2O. The highest available nitrogen was recorded where 34:14:6 N:$P_2O_5$:$K_2O$ kg ha$^{-1}$ through Konkan Annapurna Briquette was applied. It was revealed from data that at Harvest, the maximum phosphorus (22.38 kg/ha) of soil was found in the treatment $N_1$ *i.e.* application of Recommended dose of fertilizer 100:50:50 N:$P_2O_5$:$K_2O$ kg ha$^{-1}$ found highest yield over rest of treatments. Among different nutrient source, It was observed that the application of recommended dose of fertilizer found significantly recorded the highest available potassium content (30 DAT and at Harvest). Based on the experimental findings, it could be concluded that, the recommended dose of fertilizer through chemicals followed by Konkan Annapurna Briquette can improve nutrient availability, thereby improving yield of the paddy under submerged condition in lateritic soil of Konkan region.

**Keywords:** Submerged rice, nutrient sources, soil chemical properties

## Introduction
India possesses a remarkable array of agro-climatic and socio-cultural conditions, making it the most populous nation globally, following China. Given the growing population and the availability of marginal areas for cultivation, research priorities must shift to focus on improving production through the use of available land resources. Rice is the staple food for more than 60 per cent of world's population and mainly in South-East Asia. About 90 per cent of rice grown in the world is produced and consumed in Asia. India is the second largest producer of rice in the world after China. In India, rice occupies the first position among the cereals in respect to both area and production. The area of 46.27 million hectares is under rice, with the production of 129.47 million tonnes and 35.25q ha$^{-1}$ productivity (Anonymous, 2022) [1]. In Maharashtra rice is cultivated in about 1.65 million hectares area with annual production of 3.59 tonnes with productive of 29.95 q ha$^{-1}$and in Konkan it occupies 0.39 M ha area with production of 2.90 MT and productivity of 25.54 q ha$^{-1}$ (Anonymous, 2022) [1]. An ample water supply is probably the greatest advantage of soil submergence for rice. Unstable production of rainfed lowland and upland rice crops is largely attributed to water shortages. Submergence creates a unique environment for rice's growth and nutrition. The root environment during submergence is characterized by a lack of oxygen and subsequent series of reductive changes; the exchange of gases between soil and air is markedly curtailed. Within a few hours after submergence, microorganisms use up the oxygen present in the water or trapped in the soil. To avoid suffocation of root tissues in submerged soils, the rice plant has developed special tissues

through which air is transported from shoot to root.

In submerged soils, ammonia is the major form of nitrogen available for rice. Although relatively low concentrations of ammonia are toxic to many upland crops, rice tolerates and uses ammonia efficiently at relatively high concentrations. An increase in the availability of phosphate is an obvious benefit of soil submergence. Thus, the application of phosphate is less vital to lowland rice than to upland rice and other upland crops. After the disappearance of the molecular oxygen, carbon dioxide and organic acid levels increase sharply. Nitrogen plays an important role in plant metabolism as it forms a basic component of amino acids, nucleic acids, chlorophyll, enzymes etc. Phosphorus is a constituent of sugar phosphates ADP, ATP etc, which play an important role in energy transformations and metabolic processes. Phosphorus deficiency and response to P application are most common in acid soils, especially in laterite and red soils. Potassium is essential in synthesis and translocation of carbohydrates from the tops to roots. The low use efficiency of N and P is because of various reasons such as volatilization, denitrification, surface runoff, leaching losses for nitrogen and fixation in soil for phosphorus. Broadcast application of nitrogen as urea resulted in an average 10 times higher amounts of ammonium N in flood water compared to deep placement of KAB briquettes (Kapoor *et al*. 2008) [12]. Deep placement of fertilizers reduces volatilization loss. Moreover, deep placement method of fertilizer application is environment friendly and will not decrease the normal fertility of land (BRRI, 2010) [5]. Incorporation of organic manures influences soil enzymatic activity either because of the composition of the added materials themselves or because they increase microbial activity of soil (Goyal *et al*., 1993) [7]. Organic material is used to prevent or improve the negative stresses effects in plants and yield decreasing. It is material to decrease soil salinity, increase the organic matter, improve the soil structure and increase water permeability by root developing in soil. It is one the best used fertilizers (Hassanpanah and Azimi, 2012) [8]. These organic sources influence availability of native nutrients. In absence of fertilizers crop entirely on the mineralization of organically bound nutrients. Organic manures increases yield of crop by supplying almost all nutrients in balanced quantities and prevent loss of nutrients.

For increasing productivity an economical fertilizer package need to be formulated which can provide all the essential elements through both organic and inorganic sources to got good quality, produce with higher production and maintaining soil fertility, keeping the production cost at sustainable level of an average farmer. By keeping all these views in front, the study entitled, “Effect of different Nutrient sources on soil properties under submerged rice” was under taken.

## Materials and Methods

The pot culture experiment was carried out at the experimental farm of department of Soil Science and Agricultural Chemistry, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, during the *Kharif* season 2021-22. Selection of the place for arranging the pot culture experiment was done on the basis of availability of resources like irrigation water, protection from the wild animals, suitability for the supervision and recording observations. The experimental site (*Konkan* region of Maharashtra state) is a long and narrow strip covering an area of 30,728 sq. km. It is located at $17^0$ 45' 02" North latitude and $73^0$ 10' 55" East longitude. The study area falls under 19.2 Agro-ecological sub-region (AESR) i.e., Central and South sahyadris region represented by hot moist sub humid to humid transitional ecological sub-region (ESR) with deep sandy loam to clayey red and lateritic soils, low to medium available water capacity (AWC) and length of growing period (LGP) being 210-270 days (Gajbhiye and Mandal, 2000) [6].

The mean annual rainfall is 3500 mm, of which about 90 per cent is received during the months of June to October. Generally total 95 to 100 rainy days are in the most of years. The hottest month is May with temperature above 33 $^0$C, while months of December and January are coldest with temperature below 16 $^0$C. The mean annual maximum and minimum temperature were 33.0 $^0$C and 15.0 $^0$C having 3530.1mm average rainfall with 94 rainy days during the year 2022. The maximum rainfall of 655.6 mm was recorded in July-August in thirty-two meteorological week, while the lowest rainfall of 2.6 mm was recorded in August in thirty five meteorological weeks. The total rainy days recorded during the cropping period were ninety-four.

For evaluating the initial status of soil, the composite soil sample was collected on 27$^{th}$ July 2022. The sample was air dried then crushed by the wooden mortar and pestle processed for removing the large gravels and stubbles passing through the 2 mm sieve. The sample was then analyzed for following properties (Table 1) with standard procedures.

**Table 1:** Initial properties of the experimental soil

| Sr. | Chemical Properties | Status |
|---|---|---|
| 1 | pH (1: 2.5) | 5.20 |
| 2 | Electrical conductivity (dSm$^{-1}$) | 0.161 |
| 3 | Organic Carbon (g kg$^{-1}$) | 1.17 |
| 4 | Available N (kg ha$^{-1}$) | 316.74 |
| 5 | Available $P_2O_5$ (kg ha$^{-1}$) | 6.668 |
| 6 | Available $K_2O$ (kg ha$^{-1}$) | 313.6 |

The soil used for the pot culture at initial stage was acidic in reaction and showed low electrical conductivity. The soil was found to be medium in available N while low in available $P_2O_5$ and high in organic carbon and $K_2O$.

### Experimental Details

The experiment comprised total sixteen treatments with three replications and laid out in Factorial Randomize Block Design. Rice (*Oryza sativa* L.) variety Karjat-3 was selected for the experiment during the *Kharif* season of the year, 2022-23

The trial consists of 4 total treatments were the nutrient sources which are described by the symbols below.

**Table 2:** Details of the treatments

| Symbols | Nutrient source |
|---|---|
| N0 | Control |
| N1 | Recommended dose (100:50:50 N:P2O5:K2O kg ha$^{-1}$) through chemical fertilizer (Urea, SSP, MOP) |
| N2 | Recommended dose through Konkan Annapurna Briquette (KAB) |
| $N_3$ | Glyricidia 10 tonnes per hectare |

Nutrient source

**Note**

1) $N_0$ consist application of vermicompost, $N_1$ consist application of 100:50:50 N:$P_2O_5$:$K_2O$ kg $ha^{-1}$ through chemical fertilizer i.e. Urea, SSP & MOP, $N_2$ comprising RDN through Konkan Annapurna Briquette i.e. one briquette at center of four rice hill (34:14:6 N:$P_2O_5$:$K_2O$), $N_3$ indicate Glyricidia 10 tonnes per hectare.
2) Application of vermicompost @ 3.5tonne $ha^{-1}$ prior to the puddling as a soil conditioner addition to nutrient source and mitigation source.

**Preparation of rectangular pot for growing rice**

The rectangular pot for the pot culture experiment made from the FRP fiber sheets. The sheets are molded in the size 0.54 x 0.36 m suitable for accommodate four rice hills having the area of 0.1933 $m^2$. The upper side of the chamber was molded with water fillable channel or notch 2.5 cm in diameter which can be filled with water and suitable for placing acrylic closed chamber which serve the effective seal and make leak proof.

**Filling of pots**

The rectangular pots were filled with the cultivable lateritic soil from the experimental location. Average 33-38 kg soil was filled in each pot.

**Arrangement of pots**

Pots were arranged in the uniform rows and columns according to the different treatments and became suitable for the sampling of gas and soil.

**Preparation of the rice Seedlings**

Rice seeds of variety karjat-3 was sown on the prepared bed and grown for 21days until it become ready for transplanting.

**Application of fertilizers, briquette, and Glyricidia**

**a. Fertilizer application**

The recommended dose of fertilizer that is 100: 50: 50 N: P2O5: K2O kg $ha^{-1}$ was applied after puddling at the time of transplanting of rice seedling, in which nitrogen is applied in three splits and whole dose of phosphorus and potassium was applied at the time of transplanting. Nitrogen, phosphorus and potassium were applied in the form of urea, single super phosphate and muriate of potash respectively.

**b. Briquette application**

One Konkan Annapurna Briquette containing 34:14:6% N: P2O5: K2O, respectively was incorporated 7 - 8 cm deep in the soil. The briquette was applied manually in between four rice hills as per the recommendation given by the Dr. B. S. K. K. V, Dapoli. The briquettes were made by the Regional Agricultural Research Station, Karjat.

**c. Glyricidia application**

The fresh Glyricidia leaves collected and weight out as per treatment and which was applied as broadcasting in stagnant water of the pots @ 10 tonne $ha^{-1}$ over the after transplanting of the rice.

All the fertilizers and organic amendments used in the experiment were analyzed for determination of the nutrient contain, respectively. The nutrient content of the fertilizers and organic amendments used in the study are given in Table 4.

**Table 3:** Nutrient content of the fertilizers and organic manures used in the study

| Sr. No. | Fertilizers and organic manures | Nutrient content (%) | | | | |
|---|---|---|---|---|---|---|
| | | N | P2O5 | $K_2O$ | S | Si |
| 1. | Urea | 46.0 | - | - | - | - |
| 2. | Single super phosphate | - | 16 | - | 19 | - |
| 3. | Muriate of Potash | - | - | 59.7 | - | - |
| 4. | Vermicompost | 1.38 | 0.28 | 0.62 | - | - |
| 5. | Briquette | 34 | 14 | 6 | | |
| 6. | Gliricidiya | 3.8 | 0.32 | 1.8 | - | - |

**Transplanting of seedlings**

The transplanting was done in the rectangular pot an age 21 days old seedlings with spacing 20 x 15 cm. in such a way that total four rice hills became accommodate in one pot with leaving the extra space at the outer side.

**Water management**

As rice requires continuous submerged condition for its optimum growth 8 to 10 cm stagnant water was maintained continuous during all crop growth stages. When the crop reaches its grain filling-maturity stage the irrigation of the water was stopped.

**Harvesting**

The experimental crop was harvested when it became mature. The color of the leaves and straw became yellow to brown and it became dry. The proper filled grains showed the signs of maturity. The rice crop was then cut from the ground and the matured grains are then harvested separately. The grain and straw were dried in sunlight for 3 to 4 days and weigh after drying was recorded.

**Sampling techniques**

**Collection and preparation of soil samples**

The representative soil samples were collected from each pot from 0 to 15 cm depth at 30 DAT, 60 DAT and at harvest stage. The collected samples were air dried in shade and prepared as per quartering principle. Then the samples were crushed using the wooden mortar and pestle and passed through the 2 mm sieve. Further, the soil samples were stored in properly labeled polythene bags.

**Soil analysis**

**1. Soil properties**

The soil as well as gas samples were collected from each treatment at various crop growth stages and plant samples were collected at harvest for various nutrient analysis

**i) Soil reaction**

The pH of the soil was determined with pH meter having glass and calomel electrode using 1:2.5 of soil: water suspension ratio (Jackson, 1967) [9].

**ii) Electrical conductivity ($dSm^{-1}$)**

Electrical conductivity of the soil was determined using Systronic Conductivity Meter-306 with 1: 2.5 of soil: water suspension ratio (Jackson, 1973) [10].

**iii) Organic carbon (g $kg^{-1}$)**

Walkley and Black wet digestion method (Black, 1965) [3] was

used for determination of Organic carbon of the soil.

$$\text{Organic carbon (\%)} = \frac{\text{Blank reading} - \text{sample reading X N of } FeSO_4 \text{ X } 0.03\text{X } 100}{\text{Weight of soil}}$$

Where: 0.03= recovery factor of 77 per cent.

**2. Available macronutrients of the soil**

**i) Available nitrogen (kg ha$^{-1}$)**

Alkaline permanganate (0.32% $KMnO_4$) method used to estimate available nitrogen of the soil (Subbiah and Asija, 1965) [19].

$$\text{Available N (\%)} = \frac{(\text{sample reading} - \text{blank reading}) \text{ X N of } H_2SO_4 \text{ X } 0.014\text{X } 100}{\text{Weight of soil}}$$

Where: 0.014 = 1 ml of 1 N $H_2SO_4$

**ii) Available phosphorus (kg. ha$^{-1}$)**

Brays No. 1 method was followed as soil used in experiment is acidic soil. Available phosphorous from the soil extracted with dilute NH4F. Phosphorus in the extract was determined calorimetrically using Spectrophotometer at a wavelength of 660 nm, as outlined by Bray and Kurtz (1945) [4].

$$\text{Avail. } P_2O_5 \text{ (kg ha}^{-1}) = \frac{\text{Graph ppm x Vol. of extractant x Vol. made x 2 x}10^6 \text{ x } 2.29}{10^6 \text{ x Weight of soil x Aliquot taken}}$$

Where: 2 x $10^6$ = weight of one hectare of soil.
2.29 = conversion factor of P to $P_2O_5$

**iii) Available potassium (kg ha$^{-1}$)**

It was extracted with neutral normal Ammonium Acetate. Soil: extractant ratio was 1:5. The available potassium in extract was determined by using Flame Photometer as described by Jackson, 1973 [10].

$$\text{Avail. } K_2O \text{ (kg ha}^{-1}) = \frac{\text{Graph ppm x Vol. of extractant x 2 x } 10^6 \text{ x } 1.20}{10^6 \text{ x Weight of soil}}$$

Where: 2 x $10^6$ = weight of one hectare of soil.
1.20 = conversion factor of K to $K_2O$

**Statistical analysis**

The experimental data was analyzed statistically by the technique of Analysis of Variance as applicable to Factorial Randomized block design. The significance of treatment difference was tested by 'F' (Variance ratio) test. Critical difference (CD) at 4 per cent level of probability was worked out for comparison and statistical interpretation of the treatment means (Panse and Sukhatme,1967) [17] and data analysis software SAS 9.3, ICAR-11601386.

**Results and Discussion**

**1. Soil reaction (pH)**

Data related to the integrated effect of Nutrient source the Soil pH during 30 DAT were ranged from 5.82 to 5.26, effect of Nutrient source on the Soil pH during 60 DAT were ranged from 6.20 to 5.89 and effect of Nutrient source on the Soil pH during harvesting period were ranged from 6.67 to 6.07.

the result revealed that due to application of different nutrient source at 30 DAT, the maximum pH of soil (5.85) was found in the $N_2$ treatment receiving the Recommended dose of nutrient through Konkan Annapurna Briquette (KAB) which showed highest value over rest of treatment. It not showed significant results. It was revealed from data that at 60 DAT, the maximum pH (6.06) of rice was found in the treatment $N_2$ where the application Recommended dose of nutrient through Konkan Annapurna Briquette (KAB) found highest value over rest of treatments and it not showed significant results. It was revealed from data that at Harvest, the maximum pH (6.37) of rice was found in the treatment $N_3$ application of gliricidiya found highest value over rest of treatments. It not showed any significant result.

At early growth stages (30 DAT and 60 DAT) increment in the soil pH seen due to application of the Konkan Annapurna Briquette (KAB) and at harvest stage highest pH was seen due to the vermicompost and gliricidiya application. Mineral fertilizer causes rapid fluctuation in the soil pH while vermicompost and gliricidiya application gives the buffering capacity to soil due to the organic matter addition over long time. Increment in the soil pH might be due to the addition of the ions. Phytoremediation effect leads to increases the soil pH to neutralizing levels particularly in acid soil condition (Poonam and Kumar, 2019).

**2. Electrical conductivity**

Data related to the effect of Nutrient source on the Soil EC during 30 DAT were ranged from 0.37 to 0.10ds/m, effect of Nutrient source on the Soil EC during 60 DAT were ranged from 0.14 to 0.05ds/m and effect of Nutrient source on the Soil EC during harvest period were ranged from 0.09 to 0.05ds/m.

It was revealed from data that due to application of different nutrient source at 30 DAT, the maximum EC of soil (0.28ds/m) was found in the $N_2$ treatment receiving the Recommended dose of nutrient through Konkan Annapurna Briquette (KAB). It not showed significant results. It was revealed from data that at 60 DAT, the maximum EC (0.08ds/m) of soil was found in the treatment $N_2$ where the application Recommended dose of nutrient through Konkan Annapurna Briquette (KAB) found highest value over rest of treatments and it not showed significant results. It was revealed from data that at Harvest, the maximum EC (0.08ds/m) of soil was found in the treatment $N_1$ Recommended dose of fertilizer 100:50:50 N:$P_2O_5$:$K_2O$ kg ha$^{-1}$ found significantly superior over rest of treatments. Where nutrient source for treatment $N_2$ i.e., application Recommended dose of nutrient through Konkan Annapurna Briquette (KAB), $N_3$ application of gliricidiya and $N_0$ control was found to be at par with $N_1$.

Highest value of the electrical conductivity was found in the briquette application might be due to releasing mineral salt from the briquette and restricted leaching losses as crop is growing in the pot. Similar results were also reported by Tapkeer *et al*., 2017 [20]; observe that, increment in the electrical conductivity due to briquette application than the chemical fertilizer application.

Recently, singh *et al*. (2019) [18] observed that the application of 100% NPK along with crop residues was significantly improved in EC of soil over control in rice-wheat system. Pandey and kumar (2018) studied the application of FYM along with NPK through organic matter was significantly improved in EC of soil. Reduction of electrical conductivity in soil with the progress of crop growth and period of submergence was mainly due to various absorption and assimilation of nutrients by rice plant. These finding are similar to reported by Mangare (2002) [15].

**Table 4:** Effect of Organic and Inorganic Nutrient Sources on Soil reaction (pH) and Electrical conductivity

| Treatments | Soil pH | | | Electrical conductivity | | |
|---|---|---|---|---|---|---|
| | At 30 DAT | At 60 DAT | At Harvest | At 30 DAT | At 60 DAT | At Harvest |
| $N_0$ | 5.72 | 6 | 6.25 | 0.21 | 0.06 | 0.06 |
| $M_1$ | 5.83 | 6.04 | 6.33 | 0.12 | 0.07 | 0.08 |
| $M_2$ | 5.85 | 6.06 | 6.32 | 0.28 | 0.08 | 0.07 |
| $M_3$ | 5.73 | 5.98 | 6.37 | 0.11 | 0.06 | 0.06 |
| Mean | 5.78 | 6.01 | 6.32 | 0.18 | 0.07 | 0.07 |
| S.E.(m) ± | 0.02 | 0.13 | 0.1 | 0.06 | 0.01 | 0.01 |
| CD (P=0.05) | NS | NS | NS | NS | NS | 0.02 |

### 3. Organic carbon (g/kg)

Data related to the integrated effect of different Nutrient source on the Soil organic carbon during 30 DAT were ranged from 17.80 to 12.90g/kg, effect of different Nutrient source on the Soil organic carbon during 60 DAT were ranged from 18.30 to 10.90g/kg and effect of different Nutrient source on the Soil organic carbon during harvest period were ranged from 13.60 to 11.50 g/kg.

It was revealed from data that due to application of different nutrient source at 30 DAT, the maximum O.C of soil (15.53g/kg) was found in the $N_0$ treatment *i.e.* control. It not showed significant results. It was revealed from data that at 60 DAT, the maximum O.C (17.58) of soil was found in the treatment $N_0$ *i.e.*, control found significantly superior over rest of treatments. Where nutrient source for treatment $N_3$ application of gliricidiya was found to be at par with $N_0$ and It was revealed from data that at Harvest, the maximum O.C (12.95g/kg) of soil was found in the treatment $N_3$ i.e. application of gliricidiya found highest value over rest of treatments. It not showed any significant result.

Increase in organic carbon content may be due to incorporation of some portion of fresh root mass of rice in soil sample collected at harvest Mangare (2002) [15]. In general, organic carbon content of lateritic soil of konkan is very high range as per the classification of organic carbon proposed by bangar and zende (1978) [2]. It could be observed from the data that application of fertilizer doses showed increase in the soil organic carbon at every stage.

**Table 4:** Effect of Organic and Inorganic Nutrient Sources on Organic carbon (g/kg)

| Treatments | Organic carbon (g/kg) | | |
|---|---|---|---|
| | At 30 DAT | At 60 DAT | At Harvest |
| $N_0$ | 15.53 | 17.58 | 12.1 |
| $M_1$ | 14.3 | 11.68 | 12.83 |
| $M_2$ | 15.08 | 12.7 | 12.95 |
| $M_3$ | 14.08 | 15.28 | 12.93 |
| Mean | 14.74 | 14.31 | 12.70 |
| S.E.(m) ± | 0.6 | 1.39 | 0.34 |
| CD (P=0.05) | NS | 4.01 | NS |

### 4. Available nitrogen (kg/ha)

Data related to the integrated effect of of different Nutrient source on the Soil nitrogen during 30 DAT were ranged from 411.47 to 355.53kg/ha, effect of of different Nutrient source on the Soil nitrogen during 60 DAT were ranged from 392.00 to 315.69kg/ha and effect of different Nutrient source on the Soil nitrogen during harvesting period were ranged from 339.73 to 280.15kg/ha.

It was revealed from data that due to application of different nutrient source at 30 DAT, the maximum Nitrogen of soil (381.31kg) was found in the $N_3$ treatment *i.e.* application of gliricidiya. It not showed significant results, It was revealed from data that at 60 DAT, the maximum Nitrogen (357.24kg/ha) of soil was found in the treatment $N_2$ *i.e.* application of Recommended dose of nutrient through Konkan Annapurna Briquette (KAB) found significantly superior over rest of treatments. Where $N_1$ treatment receiving application Recommended dose of fertilizer 100:50:50 $N:P_2O_5:K_2O$ kg $ha^{-1}$ and application of $N_3$ treatment receiving Gliricidiya showing at par with $N_2$ and at Harvest, the maximum nitrogen (325.88kg/ha) of soil was found in the treatment $N_2$ *i.e.* application of Recommended dose of nutrient through Konkan Annapurna Briquette (KAB) found highest results over rest of treatments. It not showed any significant result.

Briquette release nitrogen slowly and steadily up to harvest stage of the rice hence found the highest available nitrogen by briquette application at harvest over chemical fertilizer. Similar findings were noticed by Kokare *et al.*, 2015 [13].

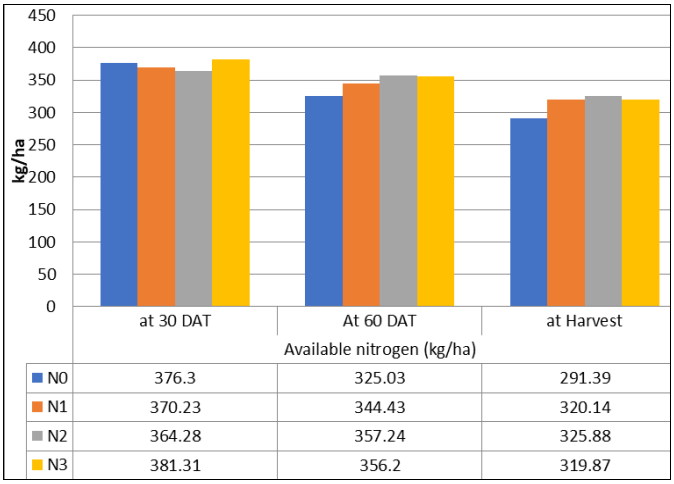



**Fig 1:** Effect of Organic and Inorganic Nutrient Sources on Available nitrogen (kg/ha)

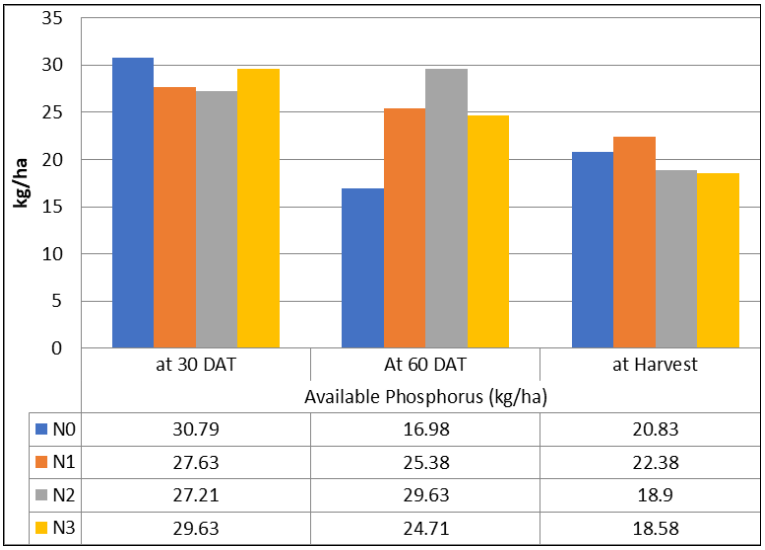
### 5. Available Phosphorus (kg/ha)

Data related to the effect of different Nutrient source on the Soil phosphorus during 30 DAT were ranged from 19.67 to 37.33 kg/ha, effect of different Nutrient source on the Soil phosphorus during 60 DAT were ranged from 12.50 to 31.33 kg/ha and effect of different Nutrient source on the Soil phosphorus during harvest period were ranged from 14.00 to 26.33 kg/ha.

It was revealed from data that due to application of different nutrient source at 30 DAT, the maximum phosphorus of soil (30.79 kg/ha) was found in the $N_0$ treatment *i.e.*, control. It not showed significant results, at 60 DAT, the maximum phosphorus (29.63 kg/ha) of soil was found in the treatment $N_2$ *i.e.*, Recommended dose of nutrient through Konkan Annapurna Briquette (KAB) found highest over rest of treatments, not shows significant results and the maximum phosphorus (22.38 kg/ha) of soil was found in the treatment $N_1$ *i.e.* application of Recommended dose of fertilizer 100:50:50 $N:P_2O_5:K_2O$ kg $ha^{-1}$

found highest yield over rest of treatments. It not showed any significant result.

It was noticed that the application of chemical fertilizer found to be highest available P might be due to the easy solubility of the phosphorus in water through Single super phosphate. Several workers reported an increase in p content of rice with the briquette application over broadcasting of recommended dose of fertilizer in lateritic soil of Konkan due to slow-release nature (Jagtap, 2014) [11].




Available Phosphorus (kg/ha)

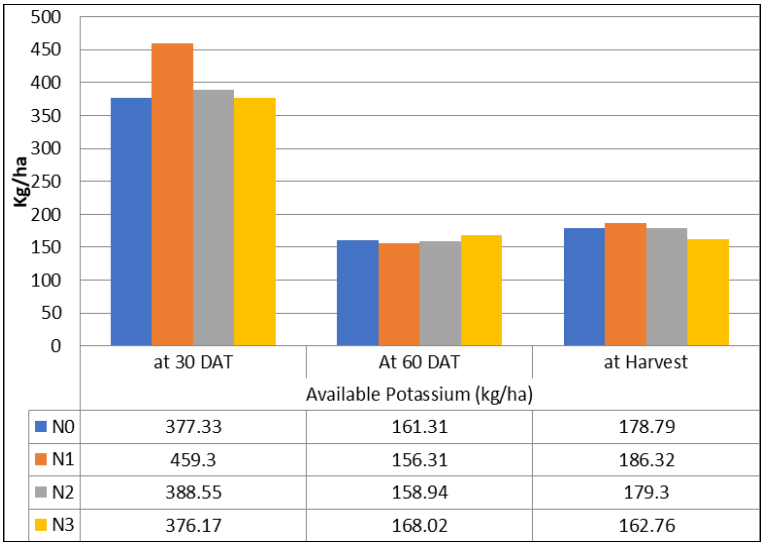
| | at 30 DAT | At 60 DAT | at Harvest |
|---|---|---|---|
| N0 | 30.79 | 16.98 | 20.83 |
| N1 | 27.63 | 25.38 | 22.38 |
| N2 | 27.21 | 29.63 | 18.9 |
| N3 | 29.63 | 24.71 | 18.58 |

**Fig 2:** Effect of Organic and Inorganic Nutrient Sources on Available Phosphorus (kg/ha)

**6. Available Potassium (kg/ha)**

Data related to the integrated effect of different Nutrient source on the Soil potassium during 30 DAT were ranged from 486.71 to 338.33 kg/ha, effect of different Nutrient source on the Soil potassium during 60 DAT were ranged from 186.74 to 148.06 kg/ha and effect of different Nutrient source on the Soil potassium during harvesting period were ranged from 196.30 to 156.95 kg/ha.

It was revealed from data that due to application of different nutrient source at 30 DAT, the maximum potassium of soil (459.30 kg/ha) was found in the $N_1$ treatment *i.e.* application of Recommended dose of fertilizer 100:50:50 N:$P_2O_5$:$K_2O$ kg $ha^{-1}$. It showed significant results, the maximum potassium (168.02 kg/ha) of soil was found in the treatment $N_3$ *i. e.* application of gliricidiya found highest value over rest of treatments. It not showed significant results. A study revealed that submergence at 60 DAT cause decrease water soluble potassium compered to control due to fixation (Leno *et al.*, 2019) [14]. And at Harvest, the maximum potassium (186.32kg/ha) of soil was found in the treatment $N_1$ *i.e.* application of Recommended dose of fertilizer 100:50:50 N:$P_2O_5$:$K_2O$ kg $ha^{-1}$ found highest value over rest of treatments. It not showed any significant result.




Available Potassium (kg/ha)

| | at 30 DAT | At 60 DAT | at Harvest |
|---|---|---|---|
| N0 | 377.33 | 161.31 | 178.79 |
| N1 | 459.3 | 156.31 | 186.32 |
| N2 | 388.55 | 158.94 | 179.3 |
| N3 | 376.17 | 168.02 | 162.76 |

**Fig 3:** Effect of Organic and Inorganic Nutrient Sources on Available Potassium (kg/ha)

The highest content of the available potassium was seen due to as the potassium was applied in the form of MOP it gets easily soluble and became available shortly. Potassium contents in the soil decreased progressively with the crop growth due to crop removal coupled with increased adsorption and reduced migration of potassium by the process of diffusion and mass flow resulting out of submergence.

**Conclusion**

The highest available nitrogen was recorded where 34:14:6% N:$P_2O_5$:$K_2O$ kg $ha^{-1}$ through Konkan Annapurna Briquette was applied. The application of recommended dose of fertilizer

significantly recorded the highest available potassium content (30 DAT) in soil. It could be concluded that, the recommended dose of fertilizer through chemicals followed by Konkan Annapurna Briquette can improve nutrient availability, thereby improving yield of the paddy under submerged condition in lateritic soil of Konkan region

**References**


1. Anonymous. National Oceanic and Atmospheric Administration (NOAA). Washington (DC): NOAA; 2022. www.noaa.com
2. Bangar AR, Zende GK. Soil testing: A new basis for efficient fertilizer use. J Maharashtra Agric Univ. 1978;3(2):81-84.
3. Black CA. Methods of soil analysis. Part I and Part II. Madison (WI): American Society of Agronomy; 1965. p. 1374-1375.
4. Bray RH, Kurtz LT. Determination of total, organic and available forms of phosphorus in soils. Soil Sci. 1945;59:39-45.
5. Bangladesh Rice Research Institute (BRRI). Annual report of soil and fertilizer management programme. Joydebpur (BD): BRRI; 2010. p. 15-20.
6. Gajbhiye KS, Mandal C. Agro-ecological zones, their soil resources and cropping systems. In: Status of farm mechanization in India. New Delhi: ICAR; 2000. p. 4.
7. Goyal S, Mishra MM, Dhankar SS, Kapoor KK, Batra R. Microbial biomass turnover and enzyme activities following application of farmyard manure to field soils with and without previous long-term applications. Biol Fertil Soils. 1993;15:60-64.
8. Hassanpanah D, Jafar A. Evaluation of “Out Salt” anti-stress material effects on mini-tuber production of potato cultivars under *in vivo* conditions. J Food Agric Environ. 2012;10(1):256-259.
9. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India; 1967.
10. Jackson ML. Soil chemical analysis. New Delhi: Prentice Hall of India; 1973. p. 219-221.
11. Jagtap DN, Pawar PB, Sutar MW, Jadhav MS, Pinjari SS. Response of rice to different fertilizer sources: A mini review. Farming Manag. 2018;3(2):146-152.
12. Kapoor V, Singh U, Patil SK, Magre H, Shrivastava LK, Mishra R, *et al*. Rice growth, grain yield and floodwater nutrient dynamics as affected by nutrient placement method and rate. Agron J. 2008;100:526-536.
13. Kokare VG, Kasture MC, Palsande VN, Mhalshi RM. Effect of different fertilizer briquettes and organic manures on yield, nutrient uptake and chemical properties of soil in chilli (*Capsicum annuum* L.) in lateritic soils of Konkan. Int J Agric Sci Res. 2015;5:13-18.
14. Leno N, Moossa PP. Dynamics of potassium fractions under submergence in sandy clay and loamy sand rice soils of Kerala. Int J Chem Stud. 2019;7(2):1492-1496.
15. Mangare B, Mamaril CP, Paterno ES, Sanchez PB, Badayos RB, Cruz PCS. Soil chemical and physical properties with rice straw management during fallow period. Philipp J Crop Sci. 2002;37:15-26.
16. Mikkelsen DS, De Datta SK, Obcemea WN. Ammonia volatilization losses from flooded rice soils. Soil Sci Soc Am J. 1978;42:725-730.
17. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research; 1967. p. 347.
18. Singh DK, Puniya R, Pandey PC, Bisht PS, Singh AP. Effect of long-term nutrient management practices on soil micronutrient concentrations and uptake under a rice-wheat cropping system. J Agric Sci. 2019;157(3):226-234.
19. Subbiah BV, Asija GL. A rapid procedure for the estimation of available nitrogen in soil. Curr Sci. 1965;25(8):259-260.
20. Tapkeer PB, Kasture MC, Kadu JB. Effect of different fertilizer briquettes on yield, nutrient uptake and soil fertility status of dolichos bean (*Dolichos lablab* L.) in lateritic soils of Konkan. Int Agric Biotechnol. 2017;3(5):262-265.