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# ASSESSMENT OF ORGANIC AND NATURALFARMING PRACTICES ON QUALITY PARAMETERS OF *JOHA* RICE AND SOIL MICROBIAL BIOMASS CARBON (SMBC) IN SOIL UNDER CULTIVATION

**Saurav Kumar Dutta[1*], Hridesh Harsha Sarma[1], Ranjit Kumar Saud[2], Milon Jyoti Konwar[3], Bhabesh Gogoi[4], Kalyan Pathak[1], Santanu Kaushik Borah[5] an dSupahi Mahanta[6]**

[1]Department of Agronomy, Assam Agricultural University, Jorhat-785013, Assam, India.
[2]Associate Director of Extension Education, Assam Agricultural University, Jorhat-785013, Assam.
[3] AAU-Assam Rice Research Institute, Jorhat, Assam.
[4] AICRP on IFS under ICAR-IIFSR, Jorhat-785013, Assam.
[5]Krishi Vigyan Kendra, Kokrajhar, Assam.
[6]Department of Agricultural Statistics, Assam Agricultural University, Jorhat-785013, Assam.
*Corresponding author E-mail:duttasaurav57@gmail.com
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**ABSTRACT**

A field experiment was conducted at AAU-Assam Rice Research Institute, in Titabar (situated at 26°43' N latitude, 94°12' E longitudes and at an altitude of 86.6 m above msl), Jorhat, Assam during *sali* season of 2022. The aim of the experiment was to study the effect of organic and naturalfarming practices on quality parameters of *bokuljoha* variety of rice as well as to check its impact on soil microbial biomass carbonin soil under cultivation. The experimental design was randomized block design (RBD) with three replications. Total of eight treatments were taken in the experiment. Results revealed that (T8) application of vermicompost (1 t/ha), mixed inocula of *Azospirillumam azonense* A-10 and *Bacillus megaterium* P-5 (4kg/ha), rock phosphate (10 kg $P_2O_5$) recorded the highest protein content of grain (9.44%), whereas (T7) *azolla* as dual crop (400 kg/ha) + biofertilizers (*Azospirillum*, PSB and KSB mix as seedling root dip) (4 kg/ha) was at par (9.19%). Very strong aroma (++++) was recorded for both the treatments. Enriched compost (5 t/ha) + vermicompost (5 t/ha) ($T_6$) produced the greatest SMBC concentration (420.92 µg/gm), which was at par with enriched compost (5 t/ha) (T4) (419.13 µg/gm). The lowest value for all the parameters was observed in the control treatment.

***Key words***: Aroma, azolla, *beejamrit*, natural farming, protein

## Introduction

Rice plays a significant role in the daily diet of approximately one-third of the global population. In Asia alone, a substantial portion of people rely on rice and its derivatives for 60 to 70 percent of their daily calorie intake. As of 2021, the global rice cultivation spanned approximately 165.2 million hectares. India holds the top position in terms of rice cultivation area with 45 million hectares and ranks second in production, yielding 122 million tons in the 2020-21 periods. During the fiscal year 2022, the rice yield in India was estimated to be around 2.8 metric ton/ha. Rice cultivation in India occurs across various agroecological settings, heavily reliant on the distribution of monsoon rains. In Assam, rice holds paramount importance, covering 2.54 million hectares of the state's total cultivated land area of 4.16 million hectares and contributing to 96% of the state's overall food grain production. Assam is renowned for its extensive genetic diversity in rice varieties, including aromatic types like *Joha*, waxy types like *Bora*, semi-waxy like *Chokuwa*, and deep-water varieties like *Red Bao*. Among these, the aromatic *Joha* rice, distinguished by its unique fragrance, fine grains, superior cooking attributes, and exceptional taste, holds a prominent position. Assam cultivates various Joha rice varieties such as *Keteki Joha*, *Kola Joha*, *Tulsi Joha*, and *BokulJoha*. As chemical farming's negative impacts become more apparent, organic farming is increasingly favoured for its sustainable practices. Assam, recognizing the need to safeguard crops, soil, and ecosystems from the detrimental effects of inorganic farming, is taking proactive steps. Alongside organic farming, there is a growing interest in natural farming, a concept currently in the spotlight among agriculturists and scientific researchers. Natural farming in the Indian subcontinent traces its roots to ancient Vedic farming practices dating back to 1800-1500 BCE. Central to this method is the *Desi* cow, reminiscent of its pivotal role in *Vedic* agriculture. Modern natural farming incorporates elements like *jeevamrit* and *beejamrit*, utilizing cow dung and urine. Treating seeds with these formulations before planting reflects echoes of *vedic* agricultural traditions. Top of Form Bottom of Form According to IFOAM, organic farming is founded on ecological principles, emphasizing natural processes and cycles. Therefore, organic farming represents a holistic approach to agriculture, prioritizing long-term environmental sustainability and responsible food production practices (Seufert, 2012). Meanwhile, in developing nations, organic farming promotes sustainable resource utilization and increased crop yields without excessive reliance on costly external inputs, while also safeguarding the environment and biodiversity. Realizing this potential requires greater political commitment and investment in research (Stockdale *et al.*, 2001). Conventional agriculture, which heavily depends on chemical fertilizers for increased yields, leads to environmental degradation. As a result, there's a rising trend towards adopting organic and natural farming techniques to mitigate adverse environmental effects. Promoting the adoption of organic farming techniques is crucial, especially in the cultivation of Joha rice, as it not only provides a reliable nutritional source but also safeguards soil health and ensures the enduring sustainability of soil resources (Dutta *et al.*, 2024). Thus, this study aimed to systematically collect empirical data on cultivating *BokulJoha* variety of rice using organic and natural farming techniques, focusing on quality parameters of rice and soil microbial biomass carbon in soil.

## Materials and Methods

A field experiment was conducted at Agronomy research farm, Assam Agricultural University-Assam Rice Research Institute-, located at Titabar, Jorhat, India inthe *kharif* season of 2022-2023. The mean weekly maximum and minimum temperatures fluctuated between 25.71 to 35.19°C and 8.6 to 25.09°C, respectively during the cropping season, while bright sunshine hours ranged from 0.61 to 8.24 (hours/day). The soil type was characterized as clay loam with pH value of 5.63, organic carbon content was recorded to be 8.40, initial available nitrogen was 284.12 kg ha $^{-1}$, available $P_2O_5$ at 22.52 kg ha$^{-1}$ where as available $K_2O$ content was 127.43 kg ha$^{-1}$. The design of the experiment was randomized block design (RBD) with three replications. Eight treatments in total were taken for the experiment which was as follows: $T_1$ [Absolute control], $T_2$ [(Natural farming, *Beejamrit* as root dip treatment (3%) (100 L ha$^{-1}$) + *Jeevamrit* as spray (3%) (100 L ha$^{-1}$) + *Ghanajeevamrit* as soil treatment at 100 kg (Jeevamrit and *Ghanajeevamrit* at 30, 60 and 90 DAT)], $T_3$ [(Enriched compost (5 t ha$^{-1}$) + Biofertilizer (*Azospirillum*, PSB as seedling root dip) (4 kg ha$^{-1}$)], $T_4$ [Enriched compost (5 t ha$^{-1}$)], $T_5$ [Vermicompost (5 t ha$^{-1}$)], T6 [Enriched compost (2.5 t ha$^{-1}$) + Vermicompost (2.5 t ha$^{-1}$)], $T_7$ [Fresh *azolla* as dual crop (400 kg ha$^{-1}$) + Biofertilizers (*Azospirillum*, PSB and KSB mix as seedling root dip) (4 kg ha$^{-1}$)] and $T_8$ [Vermicompost (1 t ha$^{-1}$), mixed inocula of *Azospirillumamazonense* A-10 and *Bacillus megaterium* P-5 (4kg ha$^{-1}$), rock phosphate (10 kg $P_2O_5$ ha$^{-1}$)]. *BokulJoha* was taken as the rice variety with seed rate of 45 kg/ha. Transplanting of seedlings was done after 30 days after sowing with spacing of 20 × 15 cm with 2-3 seedlings per hill. Hand weeding was done to control weeds as and when required. The organic manures and fertilizers were incorporated 2 weeks before transplantation as per the treatment requirement. For the natural farming treatments, *beejamrita* was applied to the seeds before sowing, while *jeevamrita* and *ghanajeevamrita* were used as sprays during the growth period. *Azolla* was applied at a rate of 400 kg/ha (grown as dual crop) for plot T7 for each replication, two weeks prior to transplantation. The seedlings were extracted from the soil a day prior to transplantation, and each biofertilizer was applied at a rate of 4 kg/ha as a root immersion treatment for the seedlings in each treatment. The aroma of rice was assessed qualitatively following the method outlined by Sood and Siddiq (1978). Amylose content was determined by Starch-iodine colorimetry as proposed by McCready and Hassid (1943). The percent protein content in grain was calculated by multiplying the percentage of nitrogen content with 6.25 (Piper, 1966). Soil organic carbon was estimated using the wet digestion method described by Walkley and Black (1934) and soil microbial biomass carbon (SMBC) was estimated by fumigation extraction method (Vance *et al.*, 1987). Data

**Table 1:** Effect of organic and natural inputs on the quality parameters of rice.

| Treatments | Protein (%) | Amylose (%) | Aroma (+) |
|---|---|---|---|
| $T_1$: Absolute Control | 7.01 | 20.61 | ++ |
| $T_2$: NF, *Beejamrit* as root dip treatment (3%) (100 L ha$^{-1}$) + *Jeevamrit* as spray (3%) (100 L ha$^{-1}$) + *Ghanajeevamrit* as soil treatment at 100 kg (*Jeevamrit* and *Ghanajeevamrit* at 30, 60 and 90 DAT) | 8.44 | 20.90 | +++ |
| $T_3$: Enriched compost (5 t ha$^{-1}$) + Biofertilizer (*Azospirillum*, PSB as seedling root dip) (4 kg ha$^{-1}$) | 8.88 | 21.55 | +++ |
| $T_4$: Enriched compost (5 t ha$^{-1}$) | 8.50 | 20.40 | +++ |
| $T_5$: Vermicompost (5 t ha$^{-1}$) | 8.56 | 20.70 | +++ |
| $T_6$: Enriched compost (2.5 t ha$^{-1}$) + Vermicompost (2.5 t ha$^{-1}$) | 8.75 | 21.20 | +++ |
| $T_7$: Fresh *azolla* as dual crop (400 kg ha$^{-1}$) + Biofertilizers (*Azospirillum*, PSB and KSB mix as seedling root dip) (4 kg ha$^{-1}$) | 9.19 | 21.83 | ++++ |
| $T_8$: Vermicompost (1 t ha$^{-1}$), mixed inocula of *Azospirillumamazonense* A-10 and *Bacillus megaterium* P-5 (4 kg ha$^{-1}$), rock phosphate (10 kg $P_2O_5$) | 9.44 | 21.88 | ++++ |
| Sem (±) | 0.10 | 0.21 | - |
| CD (p=5%) | 0.32 | NS | - |

Here, NF=Natural Farming,DAT = Days After Transplanting,T= Treatment, KSB=Potassium Solubilizing Bacteria and PSB = Phosphate Solubilizing Bacteria

related to the experiment were analysed by ANOVA and the significance was determined by using Fisher's least significance difference (p = 0.05%).

## Results and Discussion

The information revealed a sizable variance in the protein composition of grains. Vermicompost (1 t/ha), mixed inocula of *Azospirillumamazonense* A-10 and *Bacillus megaterium* P-5 (4kg/ha), rock phosphate (10 kg $P_2O_5$) had the highest protein content of grain (9.44%), whereas *azolla* as dual crop (400 kg/ha) + biofertilizers (*Azospirillum*, PSB and KSB mix as seedling root dip) (4 kg/ha) was at par (9.19%). The aroma of rice under different treatments was recorded. It was measured by quantitative method. Very strong aroma (++++) was found in vermicompost (1 t/ha), mixed inocula of *Azospirillumamazonense* A-10 and *Bacillus megaterium* P-5 (4kg/ha), rock phosphate (10 kg $P_2O_5$), *azolla* as dual crop (400 kg/ha) + biofertilizers (*Azospirillum*, PSB and KSB mix as seedling root dip) (4 kg/ha), whereas weak aroma (++) was found in control. The variation in the chemical composition of rice seed may be due to differential release of nutrients from organic sources. Such results were earlier reported by Balamurali (2006), Bora *et al*., (2014), Hemalatha *et al*., (2000), Rajapriya (2005) and Sihi *et al*., (2012). The amylose content is in accordance with Borkakati *et al*.,

**Table 2:** Effect on organic carbon and soil microbial biomass carbon (SMBC) in soil.

| Treatments | Organic Carbon (g) | SMBC (µg/g) | SMBC % of OC |
|---|---|---|---|
| $T_1$: Absolute Control | 8.0 | 311.22 | 3.88 |
| $T_2$: NF, *Beejamrit* as root dip treatment (3%) (100 L ha$^{-1}$) + *Jeevamrit* as spray (3%) (100 L ha$^{-1}$) + *Ghanajeevamrit* as soil treatment at 100 kg (*Jeevamrit* and *Ghanajeevamrit* at 30, 60 and 90 DAT) | 8.3 | 332.12 | 4.12 |
| $T_3$: Enriched compost (5 t ha$^{-1}$) + Biofertilizer (*Azospirillum*, PSB as seedling root dip) (4 kg ha$^{-1}$) | 8.4 | 411.34 | 4.89 |
| $T_4$: Enriched compost (5 t ha$^{-1}$) | 8.5 | 419.13 | 4.93 |
| $T_5$: Vermicompost (5 t ha$^{-1}$) | 8.8 | 410.13 | 4.83 |
| $T_6$: Enriched compost (2.5 t ha$^{-1}$) + Vermicompost (2.5 t ha$^{-1}$) | 8.7 | 420.92 | 4.66 |
| $T_7$: Fresh *azolla* as dual crop (400 kg ha$^{-1}$) + Biofertilizers (*Azospirillum*, PSB and KSB mix as seedling root dip) (4 kg ha$^{-1}$) | 8.3 | 356.11 | 4.29 |
| $T_8$: Vermicompost (1 t ha$^{-1}$), mixed inocula of *Azospirillumamazonense* A-10 and *Bacillus megaterium* P-5 (4 kg ha$^{-1}$), rock phosphate (10 kg $P_2O_5$) | 8.2 | 348.43 | 4.24 |
| Sem (±) | 0.82 | 1.71 | - |
| CD (p=5%) | NS | 5.19 | - |

Here, NF=Natural Farming,DAT = Days After Transplanting,T= Treatment, KSB=Potassium Solubilizing Bacteria and PSB = Phosphate Solubilizing Bacteria

(2013), Das *et al.,* (2018) and Gogoi *et al.,* (2020). Evaluating quality based on taste can be challenging since individuals have diverse preferences, habits, and perceptions. However, there are indications suggesting that organically cultivated items contain higher levels of essential minerals and vitamins while having fewer harmful substances like nitrates and heavy metal. (Yadav and Bihari, 2006).

The organic carbon content was found to be non-significant among all the treatments. These could be the result of the organic matter taking time to build up; therefore, the OC content might not vary significantly in a year. Enriched compost (5 t/ha) + vermicompost (5 t/ha) produced the greatest SMBC concentration (420.92 µg/gm), which was at par with enriched compost (5 t/ha) (419.13 µg/gm). The control had the lowest SMBC content (311.22 µg/gm). Along with the SMBC as a percentage of the organic carbon is also presented and in all the plots the SMBC was found to be constituting between 1-5 % of the organic carbon. The findings of the recent study indicate that utilizing natural and organic nutrient sources boosts soil microbial and enzymatic activity. Compared to control areas, soils treated with organic methods exhibited higher biological properties. These improvements are likely linked to the application of organic nutrient sources, which directly impact the soil's biological characteristics, thus enhancing organic carbon and SMBC in the soil. These enriched biological qualities in the soil are presumably a result of the absence of chemical fertilizers for over five years. In a long-term organic farming experiment, a consistent increase in the microbial population of actinomycetes, bacteria, fungi, and blue-green algae (BGA) was observed over time due to the application of organic amendments, accompanied by significant enhancements in dehydrogenase enzyme activity. Soil organic carbon content was also found to be significantly increased due to organic farming which ultimately provided the bio-platform for the organisms to perform at their full potentiality. Similar findings were recorded by Padmanabhan *et al.,* (2014), Singh and Dhar (2011) and Yadav *et al*., (2013).

## Conclusion

The treatment of vermicompost (1 t/ha), mixed inocula of *Azospirillumamazonense* A-10 and *Bacillus megaterium* P-5 (4kg/ha), rock phosphate (10 kg $P_2O_5$) has the ability to enrich and enhance the protein and aroma content in *BokulJoha*. Meanwhile, the treatments enriched compost (5 t/ha) + vermicompost (5 t/ha) and enriched compost (5 t/ha), respectively can effectively increase soil microbial biomass carbon under the same variety. Thus, application of organic inputs can enhance the overall quality parameters of *joha* rice while maintain optimum organic nutrients in the soil, conserving soil vitality, nurturing soil microbes, and fostering the enduring sustainability of soil reservoirs, contributing to the long-term viability and resilience of our soil resources.

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