International Journal of Agriculture and Allied Sciences July-December 9(2), 14-20, 2024
ISSN 2583-6336, NAAS Rated2.47: Peer Reviewed

Conference issue: Ecological Impact on Agriculture, Business and Technology

ENHANCING SUSTAINABLE AGRICULTURE PRACTICES THROUGH INDIGENOUS TECHNICAL KNOWLEDGE AND USES OF ORGANIC FORMULATIONS IN JHARKHAND, INDIA

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ABSTRACT: In pursuit of sustainable agriculture practices, Indigenous technical knowledge and uses of Organic Formulations have emerged as indispensable tools. This abstract explores the efficacy of various indigenous technical knowledge and biofertilizer techniques in fostering sustainable agricultural practices amide of climate change scenario. Beginning with use of Organic Formulations like Beejamrit, Jivamritam, along with the agricultural good practice and indigenous technical knowledge like seed sorting, the process involves meticulous selection of seeds, Subsequent seed treatment with beejamrit, a potent mixture of beneficial microorganisms, enhances seed germination rates and boosts plant immunity against pathogens. DSR and Line transplantation, a practice promoting optimal spacing and nutrient utilization, further optimizes crop productivity while minimizing resource wastage. The integration of Jivamritam, a nutrient-rich bio remediates, enriches soil health, fostering a balanced microbial ecosystem crucial for sustained agricultural productivity. Additionally, the incorporation of crop rotation practice with cereals and legume crops facilitates nitrogen fixation, reducing dependency on synthetic fertilizers and mitigating climate change impacts on marginalised farmers.This study underscores the pivotal role of agriculture good practices and Organic Formulations in augmenting sustainable agriculture practices, from seed selection to crop cultivation. The study has been done in the Ranchi District of Jharkhand in Paddy (*Oryza sativa*) field. By harnessing the synergistic benefits of agriculture good practice and uses of organic formulations, farmers can achieve heightened productivity while preserving ecological integrity, thus paving the way for a more sustainable agricultural future.

Key Words: Seed Sorting, Seed Treatment, Bijamritam, Line Transplantation, Jivamritam Application.

In recent years, the global agricultural sector has faced escalating challenges driven by factors such as climate change, dwindling natural resources, and population growth. In regions like Jharkhand, India, these challenges are particularly acute, threatening food security and livelihoods. In response, there's a growing recognition of the need to transition towards more sustainable agricultural practices that mitigate environmental degradation while ensuring long-term productivity.

Due to climate change effect, the precipitation distribution spatially & over the period changes may lead to Land degradation, soil erosion, and water scarcity, severe droughts in some places and water logging and salinity in other places to became waste land, low production in agriculture and allied activity.

Climate change and drought effect: Jharkhand has recently witnessed adversities due to previous COVID-19 situation, disruptions to supply chains, depressed demand for certain commodities and reduced prices, non-availability of cash for investments by households, and human morbidity and mortality etc.

Drought situation in Jharkhand in various years: Based on the climate change situation Drought is prominent in the Jharkhand due to long dry spell, erratic rainfall, early withdraw of monsoon etc. Based on the previous experience in every 3 to 5 years drought is observed in state.

Table-1: Year wise Districts of Jharkhand under drought condition

Year	**Districts under Drought condition**
2001-02	11
2002-03	22
2003-04	15
2004-05	22
2005-06	22
2008-09	4
2009-10	24
2010-11	12
2015-16	21
2019-20	0
2020-21	4
2021-22	22
2022-23	24
Source:- Jharkhand (imd.gov.in)	

Jharkhand, India, characterized by its diverse agro-climatic zones, faces recurring issues such as soil degradation, low crop yields, and nutrient deficiency. Agriculture is vital source to the economy, yet smallholder farmers grapple with soil erosion, declining soil fertility, and unpredictable weather patterns. In the region, the overreliance on chemical fertilizers has exacerbated these problems, leading to adverse environmental impacts, and diminishing returns for farmers.

This drought situation severely impacts the agriculture and allied activities by decrease in crop yields, shift planting seasons, trigger pest outbreaks, harm on agriculture and livestock systems, lead to food shortages, shortage of fodder for livestock, fisheries etc.

Against this backdrop, the use of Indigenous Agriculture techniques and Organic Formulations offers a sustainable alternative that aligns with the principles of agroecology and ecological balance. By harnessing the natural processes of nitrogen fixation, nutrient cycling, and biological pest control, Organic Formulations can rejuvenate degraded soils, improve crop resilience to climate stress, and enhance overall farm productivity. Moreover, the adoption of Organic Formulations presents an opportunity to reduce the reliance on expensive chemical inputs, thus improving the economic viability of farming operations for smallholders.

In this context, this paper aims to explore the potential of agriculture good practices and uses of organic formulations in enhancing sustainable agriculture in Jharkhand, India. By examining the current agricultural landscape, identifying challenges, and highlighting the initiatives taken at the farm level, this paper seeks to underscore the importance of integrating Organic Formulations into farming systems. Through knowledge sharing, capacity building, and policy support, the widespread adoption of agriculture good practices and uses of Organic Formulations can contribute to resilient, environmentally-friendly agricultural systems that benefit farmers, communities, and the planet alike.

RESEARCH METHODOLOGY: Field experimentation was conducted in Jaradih Village of Tamar block of Ranchi district. The Farmers were mobilised and trained in Agricultural technology intervention and Organic Formulation. Among all the 90 farmers 40 farmers were opted for DSR method whereas 50 farmers were opted for Nursery preparation and Line transplantation method.

Agriculture Technology Intervention:

Selection of Seed Variety: - For paddy cultivation usually farmers are using hybrid seeds, these are vigour in nature and extract more nutrients for production, the selection of drought tolerant variety like Sahbhagi Dhaan is the suitable solution for the marginalised farmers. Sahbhagi Dhan (IR74371-70-1-1) is a conventionally bred, drought-tolerant rice variety identified in 2009 by the Central Variety Release Committee (CVRC) and released for cultivation in India, in 2010. It was introduced under direct seeded upland conditions for the states of Odisha and Chhattisgarh as well as Jharkhand and transplanted lowland conditions in the state of Tamil Nadu. The same cultivar has also been released in Bangladesh (as 'BRRI Dhan 56') and in Nepal (as 'Sookha Dhan 3') (Mandal et al. 2009; Dar et al. 2012; Dobermann 2012; Anantha et al. 2016; Basu 2016.

Seed Sorting: Seed sorting is the process of sorting the paddy seed through Brine water solution. Brine water solution is the solution of high concentration of salt prepared at the rate of 80 gram salt per litter of water. In this process brine water solution has been prepared (O'Brien, T.F., Bommaraju, T.V., Hine, F. (2005)) by mixing salt in the water for checking the concentration of salt farmer can use the fresh egg, when the fresh egg start floating on the water the mixture is prepared. In this solution paddy seeds need to dip, the damaged and pathogen infected seeds start floating in the solution, all these floating seeds need to discarded and the pure seeds which are settled at the bottom of solution need to be washed by clean water 2-3 times. By this process farmers can get 99% genetic pure seeds and avoid the seed borne pathogens in their fields.

Seed treatment with Beejamrti: Seed treatment is the process of treating the seeds for preventing seed born diseases. For these processes usually chemical fungicides especially Carbendazim were used. In vedic era Beejamrit were used for the treatment of seeds. The term Beejamrit refers to Beej (meaning seed) dipped into Amrit (meaning Divine water). It can be made at the farm level with all available organic input basically made up of cow dung and cow urine. The mixture is further kept overnight with forest or bund soils and with lime (Sreenivasa et al. 2009 ;). This organic formulation is widely recommended in seed treatment to protect seeds from pathogens. In addition, Beejamrit has been reported to keep the young roots and rootlets away from disease-causing microbes and is so classified as an organic pesticide (Sreenivasa et al. 2009). Apart from its plausible role as a seed protectant, this organic tonic is also recommended as a foliar spray on the agricultural farm, particularly for vegetables and fruit crops (Chadha et al. 2012). It was reported earlier that the Beejamrit formulation is a consortium of different types of microflorae, including several plant growth-promoting bacteria that are capable of producing plant growth regulators. It further suggests that the microbes in

Beejamrit may have a direct role in antimicrobial activities as well as their role as a bio-stimulant (Sreenivasa et al. 2009).

Formulation and Application of Beejamrit

Beejamrit formulation:-

Uses :- Seed Treatment

Required material for Formulation :-

- Cow urine - 5 Litters
- Cow dung - 5 kg
- Lime- 50 Gram
- Field soil - 250 Gram
- Water- 20 Litter
- Drum/Bucket for container

Process of Formulation :-

- Take 20 litter of water in a container.
- Hang 5 kg cow dung in cotton cloth in water for overnight.
- Take 50 gram lime and keep it in water for over night.
- In morning squeeze the cow dung along with the cotton cloth for 3-4 time to extract all the nutrients and discard the remaining material.
- Mix the lime water, Cow urine and field soil in the container
- Keep the Mixture for over night.

Seed treatment process:-

- This solution is enough for 100 kg of Seeds.
- For seed treatment keep the sorted seed in the solution for 5-10 minutes.
- For Small seeds like vegetables, use 50 ml of Beejamrit on the seed and mix it well by hand.
- Keep the treated seed in shad for 6-7 hours for drying.

Source: - Farmers field level preparation

DSR technique of paddy cultivation: - In Jharkhand, paddy is monocropping in most of the area, farmers cultivate paddy through broadcasting method, The most common methods of rice crop establishment are direct sowing (dry direct seeding and wet direct seeding) and transplanting (Kumar et al. 2015 a, b; Chatterjee et al. 2016; Kumar et al. 2016e). Presently, in direct seeded rice (DSR) is gaining momentum due to labour shortage during peak season of transplanting and availability of water for short periods (Kumar et al. 2016c,d; Kumar et al. 2015a, b; Singh et al. 2017; Prakash et al. 2014). Direct seeding involves sowing of pre-germinated seeds in wet (saturated) puddled/ dry soils. According to Lafitte et al. (2002), concept of DSR comprises of use of rice varieties, which are nutrient-responsive and well adapted to aerobic soils with yield potential of 70-80% of high-input flooded rice.

Line Transplantation method of paddy cultivation-

Line transplantation of paddy refers to a method of planting paddy (rice) in which seedlings are transplanted in straight rows or lines in a well-prepared field. This method is widely practiced in many parts of the world, particularly in Asian countries where rice cultivation is common. For Line transplantation method of Paddy cultivation, Seedling preparation were done in raised bed Nursery.

For the preparation of Paddy seedings, seeds were sorted by Brine water solution and treated with Bijamrit first sown in seedbeds or nurseries. These seedbeds are usually prepared on fertile soil with adequate water supply. The seeds germinated and grow into young seedlings in the seedbeds. Seedlings were allowed to grow for about 3-4 weeks until they reach a certain height and have developed a good root system. During the seedling preparation Bijamrit were sprayed on the Seed bed for the better growth and minimising disease and pest infestation.

Meanwhile, the main paddy field where the seedlings was transplanted were prepared. This involved ploughing, levelling, and flooding the field to create a suitable environment for the rice plants to grow. Once the seedlings were ready, they were carefully uprooted from the seedbeds and dipped into Bijamrit for 10-15 minutes and then transplanted into the flooded paddy field. At the time of transplantation 2-3 seedlings were transplanted in straight rows or lines with the help of thin rope, at the time of transplantation the row-to-row distance were kept at 25 Centimetres, to facilitate easier management and better spacing between plants. Line transplantation of paddy offers several advantages over other planting methods, including better weed control,

efficient water and nutrient utilization, and higher yields per unit area. However, it requires more labor and careful management compared to direct seeding methods.

Intercultural practices

Weeding: The **w**eeding is an essential cultural practice in paddy cultivation that involves the removal of unwanted plants known as weeds from the paddy fields. Weeds compete with the paddy crop for resources such as water, nutrients, and sunlight, thereby reducing crop yields. Effective weed management is crucial for maintaining optimal paddy crop growth and maximizing yields. In Jharkhand Manual Weeding practice was very common; the entire manual weeding process is generally done by the women, so this practice induced the drudgery of women. Manual weeding involves physically removing weeds by hand, it almost took 15-20 person days to weed 1 hectare of paddy field. So mostly all the field of paddy got one time of weeding after 30-45 DAS (Days after sowing). Whereas application of Cono-Weeder (for wet land) and Dry weeder for Dry land after 20 DAS and 45 DAS reduce the drudgery of women and induce the productivity in both DSR and Line transplantation method of paddy cultivation.

Effective weed management is essential for maximizing paddy crop yields and reducing yield losses due to weed competition. Farmers often employ a combination of these weed control methods to achieve optimal weed control while minimizing labour, costs, and environmental impact.

Formulation and Application of Jivamrit: -

In interculture operation in paddy Jeevamrit were used after weeding of 20 DAS and 45 DAS. Jeevamrit is a liquid bio-fertilizer derived from the cow dung and cow urine, it has gained recognition in natural farming as a potential solution for both nutrient supply and pest management. Its application in paddy fields can offer numerous benefits. Jeevamrit serves as a rich source of nutrients essential for plant growth. The organic matter, microorganisms, and nutrients present in Jeevamrit enhance soil fertility, promoting healthier plant growth and higher yields in paddy fields. The microbial diversity in Jeevamrit aids in improving soil structure and texture. It enhances soil moisture retention, a critical factor in paddy cultivation. This leads to better aeration and nutrient uptake by rice plants, contributing to overall soil health. Microbial composition helps in suppressing harmful pests and diseases in paddy fields. The beneficial microorganisms present in Jeevamrit create an ecological balance, reducing the incidence of pests and diseases naturally. This minimizes the need for chemical pesticides, making it an environmentally friendly option. Jeevamrit aligns with the principles of sustainable agriculture by utilizing locally available resources, such as cow dung and urine. Its use promotes the recycling of organic waste, contributing to the circular economy and reducing dependency on external inputs. Jeevamrit offers a cost-effective alternative to synthetic fertilizers and pesticides. *Palekar, 2009* claim that the dung and urine of one Indian cow can support the organic cultivation of 12 hectares further underscores and its economic viability.

Jivamrita formulation:-

Uses :- Inoculums for Soil

Required material for Formulation :-

- Cow urine - 10 Litters
- Cow dung - 10 kg
- Pluses flour - 2 KG
- Jaggary - 2 Kg
- Field soil - 2 Kg
- Water - 200 Litter
- Drum/Bucket for container

Process of Formulation :-

- Take 200 litter of water in a container.
- Mix all the ingredients in the water and keep it for two days in the shadow area.
- Cover it with the jute bag.
- Stier it well once in a day

Application process: -

- This solution is enough for 1 acre of land.
- Apply this Jeevamrit in the field at the time of field preparation and after 1 st and 2 nd weeding.
- It is estimated that for better production 1600 letter of jeevamrit should be used for 1 Hectare of land per year.

Source:- Farmers filed level preparation

Bird Perchers: - In Jharkhand tribal farmers used their indigenous technical knowledge and keep the branches of KARAM (colloquially Karma) tree in their paddy field, they worship the tree and they believe these branches will provide security to their crops from the diseases and pest attack. This technology was used for calling the birds and the branches were used as bird perchers. These birds feed on the pest and insects of the field and crops remains unaffected. In the absence of tree branches these bird perches are made of sticks and are used in the field to avoid pest and insect infestation, 8 to 10 bird perches is sufficient for 1 acre of paddy field. These bird perchers were installed after 30-40 DAS, and were removed from the field after grain feeling.

Yellow Stickers: Yellow stickers with glue or grease were used for the small sucker insects. The small insects especially sucker insects attracted towards these yellow stickers and get stuck on this. These yellow stickers were very effective to control the brown plant hopper, (*Nilaparvata lugens)* a vector for viral diseases like Rice Grassy Stunt in paddy, Rice grassy stunt virus affects rice crops in areas where continuous all-year around rice growing is practiced. These yellow stickers were used 8-10 per acres.

Crop rotation: Crop rotation has been a longstanding practice in traditional farming, serving as a valuable tool for weed management and optimum utilisation of moisture. By alternating crops with different life cycles, farmers can disrupt weed growth patterns and reduce their prevalence in fields. Research conducted by *Watanabe et al. in 1998* demonstrated the efficacy of rice-mung bean rotation in controlling weedy rice. They found that volunteer rice seedlings struggled to survive in mung bean fields, thereby reducing the population of weedy rice. This highlights the importance of strategic crop rotations in traditional farming practices for effective weed management and sustainable agriculture. In the field we demonstrated the cultivation of Chick Pea after harvesting of paddy. These practices ensured the good production of chick pea as well as the paddy production as it required less irrigation and enhance the nitrogen fixing bacteria (*Rhizobium)* in the soil.

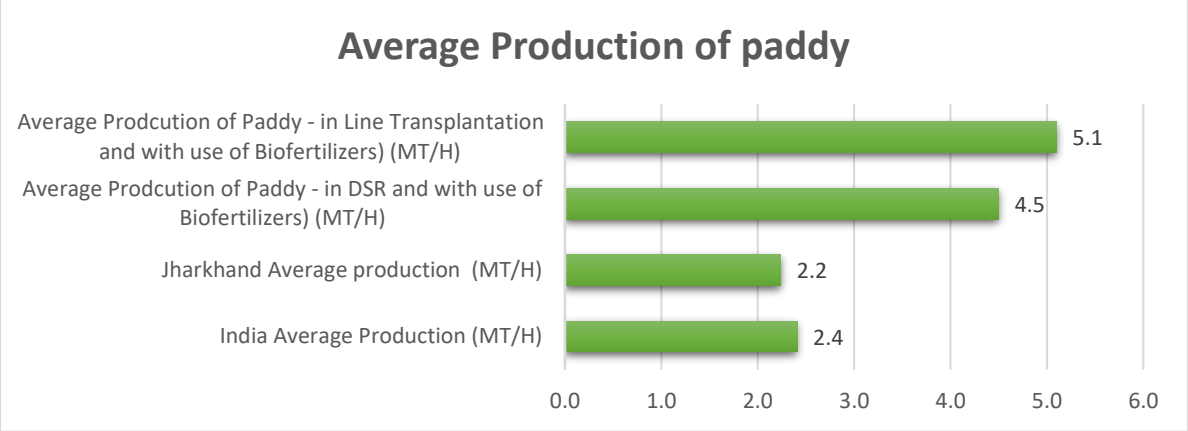
Table-2: Comparative Yield Analysis of Sahbhagi paddy

		Year 2019	
Particulars	**Yield of Paddy - Broadcasted and without use of Bio fertilizers**	**Yield of Paddy - DSR and with use of Bio fertilizers**	**Yield of Paddy - Line Transplantation and with use of Bio fertilizers**
Average No of Trellis	13	18	24
Average No of Grains/panicle	120	160	180
Average production/ sq. meter (g)	190	380	450
Average production (MT/H)	1.9	3.8	4.5
		Year 2020	
Particulars	**Yield of Paddy - Broadcasted and without use of Biofertilizers)**	**Yield of Paddy - DSR and with use of Biofertilizers)**	**Yield of Paddy Line Transplantation and with use of Biofertilizers)**
Average No of Trellis	12	21	32
Average No of Grains/panicle	145	185	210
Average production per sq. meter (In Grams)	220	390	490
Average production (MT/H)	2.2	3.9	4.9

Cont.....		Year 2021	
Particulars	**Yield of Paddy - Broadcasted and without use of Biofertilizers)**	**Yield of Paddy - DSR and with use of Biofertilizers)**	**Yield of Paddy - Line Transplantation and with use of Biofertilizers)**
Average No of Trellis	16	34	45
Average No of Grains/panicle	140	230	260
Average production per sq. meter (In Grams)	220	450	510
Average production (MT/H)	2.2	4.5	5.1

Source: Field data taken from Jharkhand Tribal Development Society (2019,2020,2021)- Government of Jharkhand

Table-3: Average Production of Sahbhagi paddy compared to Jharkhand and National Average: -



Source: - National and Jharkhand Average production data are taken from Agricultural-Statistics-at-a-Glance-2022

RESULTS AND DISCUSSION

The integration of indigenous technical knowledge and uses of organic formulations like Beejamrit and Jeevamrit in agriculture practices holds immense potential for enhancing crop production and sustainability. In the data it is clear that the selection of drought resilient variety of paddy, Seed sorting, Seed treatment and uses of organic formulation enhance the production of paddy even in the climate change condition. The production of Sahbhagi paddy were calculated 5.1 MT/H which is nearly double the average production paddy production of Jharkhand and higher than the nation average. The indigenous technical knowledge have long been embedded in the cultural fabric of communities, offering a wealth of knowledge that can be harnessed to address contemporary agricultural challenges. Firstly, indigenous technical knowledge, passed down through generations, is deeply rooted in the local ecosystem. This knowledge encompasses a wide range of practices, from soil management techniques to crop rotation strategies, tailored specifically to the region's climatic conditions, soil types, and crop varieties. By incorporating such practices into modern agricultural systems, farmers can leverage centuries of wisdom to enhance resilience against climate change, pests, and diseases. Secondly, the use of organic formulations aligns with the growing global demand for sustainable and environmentally friendly agricultural practices. Organic inputs, derived from natural sources such as compost, biofertilizers, and botanical extracts, offer a viable alternative to chemical fertilizers and pesticides. Not only do they reduce reliance on synthetic inputs, but they also promote soil health, biodiversity, and long-term productivity. In Jharkhand, where many farmers are smallholders with limited resources, organic formulations present a cost-effective and accessible means of improving agricultural productivity while minimizing environmental impact. Furthermore, the adoption of indigenous knowledge and organic formulations can contribute to socio-economic development in rural communities. By empowering local farmers to become self-reliant in managing their resources and reducing input costs, these practices can enhance livelihoods and foster community resilience.

In conclusion, the integration of indigenous technical knowledge and uses of organic formulations represents a promising approach to enhancing sustainable agriculture. By

drawing on traditional wisdom and leveraging natural inputs, farmers can cultivate resilient, environmentally friendly, and economically viable farming systems. However, realizing the full potential of these practices requires concerted efforts from various stakeholders, including policymakers, researchers, extension agents, and farmers themselves.

To support widespread adoption, initiatives should focus on knowledge dissemination, capacity building, and infrastructure development tailored to the local context. This may involve establishing demonstration plots, organizing training programs, providing access to quality inputs, and creating markets for organic produce. Additionally, policies that incentivize Natural farming and promote equitable access to resources can help overcome barriers to adoption and ensure the sustainability of agricultural systems in the long term.

Ultimately, by embracing indigenous knowledge and organic formulations in Agriculture, India not only address the challenges of food security, climate change, and rural development but also pave the way for a more resilient and sustainable agricultural future.

Acknowledgement: - The site and Production data were jointly visited and verified by Dr. V. P. Singh - Technical Advisor, IFAD, and Ms Julita Tithio, District Program Manager- JTELP- JTDS.

Reference:

1. Anantha, M. S., D. Patel, M. Quintana, P. Swain, J. L. Dwivedi, R. O. Torres, S. B. Verulkar, M. Variar, N. P. Mandal, A. Kumar, and A. Henry. 2016. Trait Combinations that Improve Rice Yield under Drought: Sahbhagi Dhan and New Drought-Tolerant Varieties in South Asia. Crop Science 56(1):408–421. https://doi.org/10.2135/cropsci2015.06.0344.
2. Sreenivasa MN, Naik N, Bhat SN (2009) Beejamrutha: A source for beneficial bacteria. Karnataka J Agric Sci 22(5):1038–1040
3. Chadha S, Rameshwar, Ashlesha, Saini JP, Paul YS (2012) Vedic Krishi: Sustainable livelihood option for small and marginal farmers. Indian J Tradit Know 11(3):480–486
4. Mandal, N. P., P. K. Sinha, M. Variar, V. D. Shukla, P. Perraju, A. Mehta, A. R. Pathak, J. L. Dwivedi, Dar, M. H., S. Singh, N. W. Zaidi, and S. Shukla. 2012. Sahbhagi Dhan: Science's Answer to Drought Problems. STRASA News 5(3–4):1–3.
5. Dobermann, A. 2012. Transformative Technologies. Retrieved from http://irri.org/blogs/achim-dobermann-s-blog/transformative-technologies.
6. O'Brien, T.F., Bommaraju, T.V., Hine, F. (2005). Brine Preparation and Treatment. In: Handbook of Chlor-Alkali Technology. Springer, Boston, MA. https://doi.org/10.1007/0-306-48624-5_7
7. Lafitte HR, Courtois B and Arraudeau M 2002. Genetic improvement of rice in aerobic systems: Progress from yield to genes. Field Crops Research 75:171- 190
8. Kumar R, Kumar M, Kumar A and Pandey A 2015a. Productivity, profitability, nutrient uptake and soil health as influenced by establishment methods and nutrient management practices in transplanted rice (Oryza sativa) under hill ecosystem of North East India. Indian Journal of Agricultural Sciences 85 (5):634-639
9. Kumar A, Nayak AK, Mohanty S and Das BS 2016c. Greenhouse gas emission from directseeded paddy fields under differentsoil water potentialsin Eastern India.Agriculture Environment and Ecosystems 228: 111-12
10. KumarR,Chatterjee D, DekaBC, Kumar M, KuotsuR,Ao M and Ngachan SV 2016a. Weed management practices in upland direct seeded jhum rice under the Eastern Himalayas. Research on Crops. 17 (2): 199-204.doi:10.5958/2348-7542.2016.00035.
11. Prakash C, Koli NR, Shivran RK, Sharma JC and Kumar R 2014. Response of nitrogen levels and weed management practices on productivity of rice under aerobic condition. Bioinfolet 11 (1A): 145-148
12. Singh SK, Abraham T, Singh AK, Kumar S and Kumar R 2017. Response of crop establishment methods and split application of nitrogen on productivity of rice. Environment & Ecology 35 (2A): 859-862
13. Watanabe H, Vaughan DAand Tomooka N 1998. Weedy rice complexes: Case study form Malaysia, Vietnamand Suriname. Paper presented at the Int. symposium on wild and weedy rice in agro-ecosystems, 10- 11Aug., 1998, HoChi MinchCity, Vietnam
14. Palekar, S. 2009. How to Practice Natural Farming? All India Pingalwara Charitable Society. pp 22–27.