1. New York Times headlined on June 26, 2018, 'Bringing farming back to nature' and critically pointed out the catastrophe in farming if nature is ignored

   (Ref: Moss D, Bittman M. Bringing Farming Back to Nature, New York Times; 26th June, 2018. Accessed on 14th December, 2019 Available:https://www.nytimes.com/2018/06/26/opinion/farming-organic-nature movement.html)

   ZBNF can be a promising option under uncertainty of weather. It is an extreme form of low external input sustainable agriculture (LEISA), where all the inputs are locally (on farm) available and output of one farming system is mostly used as input in other farming system.

   (Ref: Saikat Biswas 1Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal **Zero Budget Natural Farming in India: Aiming Back to the Basics, International Journal of Environment and Climate Change 10(9): 38-52, 2020)**

2. The word zero budgets mean no credit or no expenses, without any credit and without spending any money on purchased agricultural inputs. Another term natural farming is a method of chemical-free agriculture drawing from traditional Indian practices. In other sense, natural farming shows the importance of the synergistic effect of both plant and animal products on crop establishment, to build soil fertility and microorganisms **(Ref:** Smith, J., Yeluripati, J., Smith, P., & Nayak, DR. (2020). Potential yield challenges to scale-up of zero budget natural farming. *Nature sustainability*, Analysis: 1-6.

3. **Beejamrutha: A source for beneficial bacteria:** Use of Beejamrutha, a mix of cow dung, cow urine, water, lime and a handful of soil has been given importance in sustainable agriculture since age old days. It is also one such

organic product helpful for the plant growth. The beneficial microorganisms present in beejamrutha are known to protect the crop from harmful soil-borne and seed-borne pathogens. Bacteria were isolated from beejamrutha and tested for their beneficial traits. These isolates were capable of N2 -fixation, Psolubilization and IAA, GA production in addition to suppression of Sclerotium.

(**Ref:** M. N. SREENIVASA, NAGARAJ NAIK AND S. N. BHAT, Institute of Organic Farming, University of Agricultural Sciences, Dharwad-58005, Karnataka, India. Karnataka J. Agric. Sci., 22 (5) (1038-1040): 2009)

4. Natural farming is working with nature produced good food, and keeping healthy over selves, it is also known as do-nothing farming because the farmer is considered as a facilitator and the real work can be done by nature. No-tillage, no chemical fertilizer, no pesticides in this farming.

- **Natural farming** is an ecological farming approach established by **MASANOBU FUKUOKA** (1913–2008), a Japanese farmer and philosopher, introduced in his 1975 book ***The One-Straw Revolution***. 1st time in *Japan, M Fukuoka* started work on natural farming, and his results showed that yields from natural farming are similar to chemical farming but without soil erosion also maintains soil fertility for a longer time.

(**Ref: Devarinti, S.R. (2016). Natural Farming: Eco-Friendly and Sustainable?.** ***Agro technology*****, *5*(2), 1-3.)**

- Prime Minister Narendra Modi recently told the UN conference on desertification that, in the future, India will focus on ZBNF

(**Ref:** *The Hindu, 2019; GEF, 2019 :* Addressing the 14th Conference of Parties (COP14) to the United Nations Convention to Combat Desertification (UNCCD) on Monday, Prime Minister Narendra Modi mentioned that India was “focusing on Zero Budget Natural Farming (ZBNF)”.)

5. Bijamrita and other organic treatments were easy to prepare made from locally available ingredients were useful to increase seed germination percentage of *Arachishypogaea* L. (Ground nut), *Glycine max* (L.)Merr.(Soybean), *Vignaaconitifolia* (Jacq.)Marechal (Moth bean) and *Vignaradiata*. (L.) R. Wilczek. (Green gram). Root, shoot and total seedling length was also increased when seeds were treated with organic liquid formulations.When compared different concentrations of Bijamrita; 100% Bijamrita showed high germination percentage, seedling growth and Seed Vigour Index.

(Ref: Naikwade Pratap Vyankatrao, 2019: Effect of Bijamrita and other organic liquid treatments on seed germination and seedling growth of legume crops Online International Interdisciplinary Research Journal, {Bi-Monthly}, ISSN 2249-9598, Volume-09, Issue-03, May- June 2019 Issue)

6. Maximum CFUs of bacteria, fungi, actinomycets, N-fixers and P-solubilizers were present in beejamrutha on the day of preparation and later on there was sharp decline in their number as the days elapsed and maximum CFUs of bacteria (623), fungi (22) actinomycets (2), N-fixers (71) and P-solublisers (52) were recorded on the day of preparation of beejamrutha and thereafter, it decreased progressively and it was minimum on 7th day after preparation. And it was also noticed that the higher colony forming units (CFU) in Jeevamrutha were recorded between 9th to 12th days after preparation. In the preparations, higher number of bacterial CFUs viz., Azatobacter sp., Bacillus sp., Beijerinckia sp., Chromatium sp., Chromobacterium sp., Pseudomonas sp., Rhodomicrobium sp., Serretia sp., Xanthomons sp., were recorded.

The different fungi observed were: Aspergillus sp., Fusarium sp., Penicillium sp., Trichoderma sp., isolated P-solubilisers fungi like - Aspergillus sp.,

Penicillium sp., Bacteria like- Bacillus sp., Pseudomonas sp., and N-fixers like Bacteria - Azatobacter sp., A.chroococcum, Bacillus sp., Beijerinckia sp., Actinomycetes - Streptomyces sp. It clearly indicates that the jeevamrutha is enriched consortia of native soil micro organisms. The preparation would give best results if it is used between 9th to 12th days after preparation

(Ref: N. Devakumar , Shubha s, S.B. Gouder , G.G.E.Rao 2014, Microbial analytical studies of traditional organic preparations beejamrutha and jeevamrutha ; Proceedings of the 4th ISOFAR Scientific Conference. 'Building Organic Bridges', at the Organic World Congress 2014, 13-15 Oct., Istanbul, Turkey

7. Jeevamrutham is the rich source of the beneficial micro-organism such as nitrogen fixing and phosphate solubilizing bacteria. From the study it was found that Jeevamrutham is efficiently used between 8th and 12th days of preparation.Addition of such organic liquid manure would help to improve efficient microbial consortia thereby increasing NPK content and plant growth promoting factors.The use of Jeevamrutham is the best alternative to chemical fertilizer and our bioenhancer could be potent source to improve soil fertility,crop productivity and quality.

   (Ref: Kulkarni and Gargelwar 2019 Production and microbial analysis of Jeevamrutham for Nitrogen fixers and Phosphate solubilizers in the rural area from Maharashtra, IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 12, Issue 8 Ser. I (August 2019), PP 85-92 www.iosrjournals.org)

8. ***The seed treatments with bijamrit, bavistin and untreated control were studied for seed germination and seedling growth behaviour:***

- The bijamrita treated seeds resulted in seed germination percentage of maize (93%) whereas finger millet (77%), however, germination varied from 77 to 93% in maize and 61-77% in finger millet respectively. The result of higher seed germination percentage in bijamrita treated seeds might be due to the presence of useful bacteria in bijamrita, which may produces Indole Acetic Acid (IAA) and Gibberellic Acid (GA)
- The maximum shoot and seedling length, fresh weight were observed in bijamrita (T2) treated seeds followed by bavistin (T1) and least in untreated seeds as control (T0).
- The maximum shoot length (47.72 cm) of maize was found in bijamrita treated seeds and found significantly higher in comparison to other treatments. Similarly, significantly highest shoot length was observed in bijamrita treated seeds of finger millet (9.35 cm) also.
- Shoot length was found significantly higher in the seeds treated with bijamrita as compared to chemical and control which may be due to the production of IAA and GA by the bacteria present in bijamrita that could have stimulated seedling length compared to chemical and control

(Ref: B. K. JHA*, OMKAR KUMAR, S. K. NAIK, P. K. SARKAR & R. SHINDE, 2020, COMPARATIVE PERFORMANCE OF SEED TREATMENT BY BIJAMRITA AND BAVISTIN ON SEEDLING GROWTH OF MAIZE (*Zea mays* L.) AND FINGER MILLET (*Eleusine coracana* L. International Journal of Agriculture , Science and Research (IJASR) , ISSN (P): 2250–0057; ISSN (E): 2321–0087 , Vol. 10, Issue 6, Dec 2020, 119-128)

9. Cows of cross bred and indigenous/ desi breeds were fed similar feed for 21 days, and thereafter, dung was collected for 6 days and analyzed for the organic and mineral content as shown in Table 2

TABLE 2: Comparison between Gomeya (cow dung) of Indian indigenous cow and cross bred cow.

Contents	Percentage
Organic matter	Similar
Nitrogen	Similar
Manganese	Similar
Calcium	10.8% higher in Indigenous cow
Phosphorus	8.0% higher in Indigenous cow
Zinc	84.1% higher in Indigenous cow
Copper	21.7% higher in Indigenous cow

(Ref: A. K. Garg and V.Mudgal, "Organic and mineral composition of *Gomeya* (cow dung) from Desi and crossbred cows—a comparative study," *International Journal of Cow Science*, vol. 3, no. 1-2, 2007.)

10. The use of cow urine is known for a long time in India. Cow urine has been described as a liquid with innumerable therapeutic values, capable of curing several incurable diseases in human beings and plants. It has been considered that cow urine is very useful in agricultural operations as a bio fertilizer and bio pesticide (Dharma *et al.,* 2005). It is rich source of macro, micronutrients and has disinfectant and prophylactic properties thus purify the atmosphere and improve soil fertility (**Pathak and Ram, 2013**). Cow urine therefore, could be an effective tool to address multi nutrient deficiencies in most of soils in the country.

Cow urine

• It contains 95 % water, 2.5 % urea, 2.5 % others (mineral salts, hormones and enzymes)

• It contains amino acids, cytokinins, lactone, which play important role in immunity enhancement

• Cow urine has antibacterial, antifungal, antiviral properties; hence it is most effective secretion of animal origin with innumerable therapeutic values

• The uric acid in the urine acts as fertilizer and hormone

• Cow urine contains copper, which transformed into gold in human body. Gold has power to destroy all diseases and is an antidote

• It contains iron, calcium, phosphorus, carbonic acid, potash and lactase and 24 types of salts

• The medicines made from the cow urine are used to cure several diseases

• It is disinfectant and prophylactic and purifies and improves soil fertility

• In organic farming, cow urine is used for preparation of number of bio enhancers and bio-pesticides, which are effective in improving soil fertility, quick decomposition of organic wastes and management of large number of pests and diseases in varied group

(Ref: Pathak, R.K. and Ram, R.A. 2013. Bio-enhancers: A potential tool to improve soil fertility, plant health in organic production of horticultural crops. Progressive Horticulture, 45(2): 237-254.)

11. Significantly high soil organic carbon (0.58%), available nitrogen (272.4 kg/ha), phosphorus (23.5 kg/ha) and potassium (199.9 kg/ha) were obtained with the application of FYM 12.5 t/ha+cattle urine at 34300 l/ha as compared to control (Veeresha *et al.,* 2014). soil microbial population viz., bacteria (47.0 × 105 cfu / g), fungi (34.6 × 104 cfu /g) and actinomycetes (40.0 × 103 cfu / g) as compared to control

Ref: Veeresha, Sharanappa, Gopakkali, P. 2014. Effect of organic production practices on yield and soil health of irrigated maize (*Zea mays* L.) as influenced by various levels of FYM and cattle urine application. *Environ. Ecol.,* 32(2A): 627-630.

12. Antifungal activity of three different concentrations (5, 10, and 15%) of cow urine against three fungal pathogens (Fusarium oxysporum, Rhizoctonia solani, and Sclerotium rolfsii) isolated from infected plants of Methi and Bhindi that showed symptoms of damping off and wilting disease by poison food technique. The extent of growth of test fungi in plates poisoned with cow urine was lesser when compared with the control plates. Among these concentrations cow urine at 15% concentration was most effective. When the three fungal organisms were compared, maximum growth suppression was observed in Fusarium oxysporum (78.57%) at 15% concentration of cow urine followed by Rhizoctonia solani (78.37%) and Sclerotium rolfsii (73.84%). Finally we concluded that the cow urine has antifungal activities and the inhibitory activity can be used in the control of fungi. The nutritional effect of cow urine on plant growth was also tested with Trigonella foenum-graecum (Methi) and Abelmoschus esculentus (Bhindi) plants and the chlorophyll and protein content was also estimated.

(Ref: Savita Jandaik, Preeti Thakur, and Vikas Kumar, (Shoolini University of Biotechnology and Management Sciences, Solan, Himachal Pradesh) 2015 Efficacy of Cow Urine as Plant Growth Enhancer and Antifungal Agent. Advances in Agriculture Volume 2015, Article ID 620368, 7 pages.

13. The biochemical contents of the plants increased with cow urine application. Therefore the use of cow urine provides better alternative to synthetic chemicals which are expensive and pose potential danger to the farmers, marketers, consumers, and environment. Application of cow urine has been reported to have a favorable impact, for enhancing productivity of different crops viz., mustard, maize and rice etc. Further research is required to prove its qualities and benefits

(**Ref:** Swati Swayamprabha Pradhan, Sudhanshu Verma, Sneha Kumari and Yashwant Singh, 2018, Bio-efficacy of cow urine on crop production: A review IJCS 2018; 6(3): 298-301)

14. Management of brown spot disease in rice (Helminthosporium oryzae) by spraying of cow urine

Rice (Oryza sativa) is one of the most important food grain crops and used as second most important cereal crop in the world after wheat crop. The majority of the rice-wheat areas are in the Indo-Gangetic plain which run from the North to East across the northern India. Among the different diseases of rice, Brown spot disease is also an important calprit for low yield of the crop. This field experiment was performed at Kharif during the year of 2015-16 at Agri Farm, IAS, BHU, Varanasi to assess the effect of cow urine spray on the suppression of Brown spot of rice. The experiment was conducted with three replication under the split plot design where Fertility levels (60% RDF, 80% RDF and 100% RDF) were kept under main plots and Cow urine spray (Control, 50%, 75% and 100% concentrations) were kept under subplots. The recommended dose of fertilizer (RDF) was 120-60-60-25 Kg N-P2O5-K2O-ZnSO4 ha. The varying fertility levels were unable to show the suppression of the brown spot disease whereas the varying concentrations of cow urine spray showed positive impact on that disease suppression. The 100% cow urine spray was able to minimize the brown spot score where as the control treatment exhibited maximum disease score. So, Cow urine as a bio-fungicide is able to reduce Brown spot infestation.

(Ref: R. Sadhukhan, J. Bohra, V. Pal , 2018, Biology International Journal of Chemical Studies)

15. Bioremediation of environment pollutants

Removal of chromium from aqueous solution using dry cow dung powder

Dry cow dung powder has recently been used as a source of adsorption for the removal of chromium from aqueous solution and achieved 73.8 % removal of chromium (Mohan and Gupta 2014*)*.

(Ref: Lekshmi Mohan and Divanshu Gupta, 2014: Study on removal of chromium from aqueous solution using dry cow dung powder Journal of Chemical and Pharmaceutical Research, 2014, 6(6):1066—1070)

16. Agriastra: It effectively controls the pests like Leaf Roller, Stem Borer, Fruit borer, Pod borer

Brahmastra: It is most effective against all of the sucking pests, pod borer, fruit borer, etc.

Neemastra: Mainly controls sucking pests & Mealy Bug.

Pest Repellants

The following leaves help repel insect pests:

1. Leaves that cattle don't eat. For eg. *Adusi and Nagod*
2. Stems that secrete milky sap when broken. For eg. *Aakado and Datturo*
3. Leaves that taste bitter. For eg. Neem, aloe vera
4. Leaves that taste salty. For eg. *Ratanjot*
5. Seeds that taste bitter or salty. For eg. Seeds of neem, custard apple

(Ref: **South Asia Conference on 'Outstanding Organic Agriculture Techniques' Bengaluru, India. 10-11 September 2009 Crop Production and Plant Protection in Organic Farming** By S. R. Sundararaman)

For rice pests

Vitex leaf extract (5%), *Lantana camara* leaf + *Tulsi* leaf extract (5%), *Nerium* + *Ipomoea* leaf extract (5%), *Agave* leaf flesh extract + kerosene (2.5%), *Jatropha* leaf extract + cow urine (5%), *Adathoda* leaf extract + cow dung slurry (2%), rice bran + kerosene, and *Brammathandu* leaf extract + toddy (3%)

For groundnut pests

Vitex leaf extract (5%), lemongrass +*tulsi* leaf extract (5%), garlic + kerosene + chilli fruit extract (2%), *Agave* leaf flesh extract (2.5%), *Eucalyptus* leaf extract (5%), fenugreek + betel vine + onion + butter milk + castor oil (3%), and tobacco leaf extract (5%).

For pulses pests

Vitex leaf extract (5%), *Datura* leaf extract (3%), sweetflag leaf and rhizome extract (2.5%), chilli + garlic + kerosene (2%), *Neem* oil + Vetiver extract (4%), fenugreek + betel vine + onion + butter milk + castor oil (3%), and *Brammathandu* leaf extract (5%).

For vegetable pests

Vitex leaf extract (5%), *Agave* leaf flesh extract (5%), *Jatropha* leaf extract (5%), Anna leaf + *Aduthina palai* leaf extract (3%), *Aloe vera* flesh + turmeric + chilli powder (2.5%), *Calotropis* leaf extract + garlic + onion + chilli powder (3%), and *Nerium* leaf extract (5%).

Tribal pest control practices of Tamil Nadu for sustainable agriculture

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