CGES Newsletter

CLEAN AND GREEN ENVIRONMENTAL SOCIETY

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VISION

Clean and Green Environment for Healthy Life

MISSION

To Strive for A Clean and Healthy World

In This Issue

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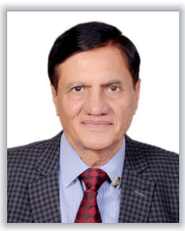
PRESIDENT'S MESSAGE



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Er. Sumer Agarwal
President, CGES
Chairman, Levana Group, Lucknow
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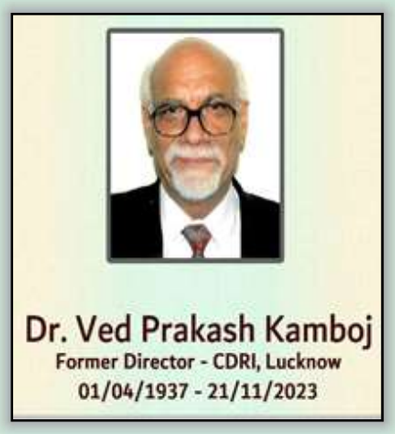
New CGES Members

Dr. B.K. Banerji, Former Chief Scientist, CSIR-NBRI, Lucknow, Prof. S.K. Tewari, Former Head of the Department of Agriculture Economics, Pant Nahar Agriculture and Technology University, Prof. Vidya Nath Jha, Former Professor of Botany, Mithila University, Darbhanga, Er. Shailendra Kumar Agarwal.

BOOK REVIEW



Dr Ved Prakash Kamboj, FNASc., FNA (1937 - 2023), former president of the National Science Academy of India (NASc; 2005–2006) and former director, CDRI and CSIR Emeritus Scientist, Central Drug Research Institute (CDRI). He left to heavenly on Nov. 21st 2023

He was the Advisor in Clean and Green Environmental Society

He authored or co-authored over 300 research papers and articles appearing in Indian and international journals. He has been instrumental in the development of a nonsteroidal once-a-week contraceptive pill, ormeloxifene.

Activities done during last 6 months by CGES

Celebrated Eighth Foundation Day on July 8 (Saturday), 2023 at 11.30 a.m. at CSIR-National Botanical Research Institute, Lucknow. Prof. Dhruv Sen Singh, Head, Geology Dept. University of Lucknow: delivered the Key Note Lecture on: "Environment and Sustainability of Planet Earth during Anthropocene". Dr. R.C. Chaudhury Chairman, Participatory Rural Development Foundation also delivered a Lecture on: "Story of Kala Namak Rice" Release of News Letter July 2023, and Foundation Day Address by Chief Guest: Dr. A. K. Shasany, Director, CSIR-NBRI. Newsletter of CGES was also released.

Oct. 7th 2023 (Saturday) at 10.00 a.m CGES in-colloboration with C.B. Gupta Agricl. P.G. College, Bakshi Ka Talab, Lucknow organized a Lecture on "Quality Management System: Importance and Strategic approaches "by Prof. V.P. Sharma Sr. Principal Scientist, CSIR-IITR, Lucknow.

Awareness program and establishment of "Jal Club" under the Akashvani "*BUNDON KI TUTE NA LADI*" series was done by CGES at four schools in Lucknow in Nov. and Dec. 2023.

A Fly Ash Story

Once, while enjoying dense green foliage of tree crowns above while strolling on a riverside hill, I suddenly felt like my feet were sinking ankle deep in loose ground below. Looking down, I realized that the gray-white dust covering the hill was a few inches deep, as the cause of losing my foothold. The dust was also sliding into the river water below. I stopped and returned to my lodge.

At dinnertime in the lodge, I narrated my experience to co-diners and questioned in a general way, if the ash menace can be stopped. A diner at my table, a senior official in local thermal power plant, declared, rather curtly, "If we don't want to see the ash, this city will remain in darkness forever." I kept quiet.

A couple of years later, two senior officials from an industry came to my office. One of them started, "We have recently started a power production industry a hundred kilometers north of Bombay. The locals are worried that emissions from our project will spoil their greenery, including the prized production of sapota."

I remembered that very much like 'Ratnagiri Alphonso mango', sapota from Dahanu-Gholwad belt is a world recognized GI (Geographical Identity) fruit.

"We have all the permissions to go ahead," he continued.

I wondered where I am in this picture! He continued, "Luckily, our coal contains very little sulphur, unlike European coal, so there is no worry about acid rains. On the other hand, our coal contains lots of solids, so that a large amount of ash is formed when we burn coal."

"Oh! So that's how I happened to walk on an ash hill on a riverside a couple of years back."

"That's it. We don't want anyone to walk on loose ash hill. We don't want loose ash floating on coastal breeze spoiling seaside walk in evenings. We want to do something about it."

"What is this meeting for?" I asked.

"We want you to visit our factory site and suggest measures to overcome the problems ash can create."

"How big an ash hill you are referring to?"

"Come to the site and see for yourself. But let me answer your question first, so that you will be prepared to absorb the significance of our problem." He pulled a diary from his pocket and started reading from a page opened before me, so I could read with him.

"Our factory produces 500 MW (megawatt) electric power every day. That level of power generation consumes 8040 tons of coal. The available average quality coal contains about 44% ash, which means that daily discharge of ash amounts to 3537 tons, of which 2830 tons is fly ash (at the rate of 80% of total ash)."

"OMG! All this ash emitting through the tall chimney must lead to darkening of sky there all day –"

"No, Sir. Fly ash is captured near the generator itself with ESP (Electrostatic Precipitator) of 99.8% efficiency and carried away in pipes, using water. Thus, every day, as much as 2824 tons of fly ash is piped away for storing in specially created lagoons."

"For storing so much fly ash every day, the lagoons must be very big?"

"Yes, eight lagoons as of now, each more than two hectares in spread, 1-1/2 meters deep, are planned; some have already started filling to capacity. Water that is used for carrying the ash from factory to lagoon, starts drying up in exposed sunny conditions and our problem starts."

"Problem?"

"Yes, once water in the slushy ash dries up, fly ash actually starts flying on air currents and creates danger of getting deposited on paddy fields, orchards, water bodies and structures in the vicinity." He resumed after a small pause. "And yes, your comment on dark skies was obvious – some fly ash goes as emission through chimney – about 5 + tons per day, along with flu gas."

"Flu gas?"

"While coal is burnt at high temperature, hot air containing oxides of sulfur, nitrogen, carbon etc. escape through chimney. These gases, as also particles of ash, land at a distance of about 10 times the height of the chimney (as per Gaussen's Model). Landing concentrations of these gases are within permissible levels as per rules. Dust in flue gas may be about 94 mg / cu meter, well within the permissible limit of 500 mg/cu meter."

After a small pause, he resumed, "We request you to do something by which the stored fly ash remains where deposited and not fly into air and move with air currents and cover green fields, orchards, etc."

The meeting ended after planning my site visit.

We selected a lagoon – two hectare area and one meter deep for stabilization of stored ash. Spreading sand or gravel as some recommend was expensive and would prove wasteful, if and when cement industry may require ash, as was being contemplated elsewhere. Plantation of trees is always recommended by nature lovers, but couldn't be considered seriously since ash contains absolutely no plant nutrients.

Small scale trials to grow grass on 1 to 5 sq. m. plots, using cow dung as source of plant nutrients and fresh water, were planned as first step. Grass growing naturally in the vicinity was carefully planted with minimal disturbance of surface ash. Periodic observations and recording of surviving tillers, number of internodes was done. It showed that the planted grass was still green at the end of one week, sprouted laterally in two weeks or so and spread enough to cover a sq. meter or so, within a month.

Large scale grass plantation was planned for the beginning of rainy season. All available cow dung from villages in the neighborhood was collected and local labor invited to do what they do best – Prepare cow dung suspensions, soak grass in it and sow in small patches across the lagoon. By the end of rainy season, entire surface of a 2 hectare lagoon was covered by a protective carpet of green grass.

The factory management was pleased, showed us some barren patches of land within and adjacent to factory premises. Some of the land was located on closed salt pans, obviously highly saline in nature. Basically using the same technique – use of cow dung, beginning of rainy season for plantation, but in place of hariyali grass (*Cynodon dactylon)* we opted for salinity-loving halophytes like 'machul' (*Suaeda fruticosa, Sesuvium portulacastrum)* were planted with good results, showing plant cover on salinity affected fly ash.

Note: The two selected pictures show fly ash as it lay before treatment started and after formation of grass cover in two rainy seasons.

Based on Reports submitted from time to time and discussions held with engineers and authorities of the Power Plant of B.S.E.S. Ltd., Mumbai.

Economic and Medicinal Significance of Makhana (*Euryale ferox* Salisb.)

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ABSTRACT

Makhana (*Euryale ferox* Salisb.) is an aquaphyte belonging to the family Euryalaceae/Nymphaeaceae . It is a rooted floating macrophyte that has gained much significance during recent decades. It has been recognized as a crop and a National Research Centre under ICAR set up has been established at Darbhanga. While it is grown as a crop in about ten districts of Mithila area in north Bihar , its wild populations are available in different states of northern India.It has good quality of protein and starch and is almost fatless. It is full of minerals. Recent years have witnessed its cultivation in arable plots with about 2 ft. water depth. Accordance of GI tag to the crop under the name of 'Mithila Makhana' has provided a boost to its cultivation and a volley of entrepreneurs have come forward to prepare edible items of various hues that could raise its marketing potentials. Two new varieties of the crop under the names of 'Swarn Vaidehi' and 'Sabour Makhana 1' have been developed. In addition to the edible perisperm, its seed coats and other vegetative parts have been found to have medicinal significance. Both State and Central governments are providing incentives to the farmers and processing entrepreneurs to promote the development of Makhana industry in traditional and non-traditional areas. The paper provides a review of its economic significance and medicinal properties of Makhana.

Makhana (*Euryale ferox* Salisb.) is an aquaphyte belonging to the family Euryalaceae/Nymphaeaceae . It is a rooted floating macrophyte that has gained much significance during recent decades. It has been recognized as a crop and a National Research Centre under ICAR set up has been established at Darbhanga. While it is grown as a crop in about ten districts of Mithila area in north Bihar , its wild populations are available in different states of northern India.It has good quality of protein and starch and is almost fatless. It is full of minerals. Recent years have witnessed its cultivation in arable plots with about 2 ft. water depth. Accordance of GI tag to the crop under the name of 'Mithila Makhana' has provided a boost to its cultivation and a volley of entrepreneurs have come forward to prepare edible items of various hues that could raise its marketing potentials.Of late , Makhana has come to light at a global level on account of discovery of a number of phytochemicals in the edible and other parts of plant. COVID-19 has led to its recognition as a promising immunostimulant. Recently it has achieved GI tagging under the name of Mithila Makhana. Its nutraceutical properties have triggered its cultivation in non-traditional water logged areas of other states as well including Uttar Pradesh , Chhattisgarh., West Bengal, Haryana etc. Wild populations of *E. ferox* are available in the northeastern states of Assam, Tripura, Manipur and the northwestern lakes of J & K and have also been reported from Japan, China, Korea etc. Fossils of *E.ferox* have also been reported from a number of European countries. Keeping in view the resolve of both central and state governments to increase the production of Makhana, Jeevika didis have been involved in its cultivation and processing. Two new varieties of the crop under the names of 'Swarn Vaidehi' and 'Sabour Makhana 1' have been developed. The two varieties have been further studied for their nutritional and other related characteristics (Kumar *et al* 2016, Gaurav *et al* 2021).In addition to the edible perisperm, its seed coats and other vegetative parts have been found to have medicinal significance. Both State and Central governments are providing incentives to the farmers and processing entrepreneurs to promote the development of Makhana industry in traditional and non-traditional areas.

It is considered a functional food owing to its various health benefits such as anti-diabetic, antihyperlipidemic, antifatigue, hepatoprotective, cardioprotective,

antimelanogenic etc. *E. ferox* has immense potential in both food and non food industries. Several patents have been obtained for developing wine from fox nut in countries like China, Korea etc.

NUTRITIONAL AND THERAPEUTIC VALUES

Perisperm in the seed of *E. ferox* is its edible part. Raw seed is converted into popped form through an arduous method of post-harvest processing. Makhana seed with moderate 10-12 percent protein content is known for its high essential amino acid index(EAAI) of about 90 percent. This makes it comparable to fish and mutton so far as the quality of protein is concerned. Raw seed powder is an essential ingredient of the baby foods in China with a dependable system of indigenous medicine. It has about 78 percent carbohydrate mainly (Table 1) in the form of starch of very minute dimension (i.e: 1 to 3 micron) . Properties of *E. ferox* starch have also ben investigated . Makhana pops have a good prospect of being exported to affluent countries where there is a large population of obese people who are in search of non-fat diets. It has only 0.1%fat content and is rich in minerals.

Table-1: Nutritional properties of the aquatic crop Makhana grown in north Bihar.

Parameters	**Content**
Seed Kernel	
Protein	9.7%
Carbohydrate	79%
Fat	0.1%
Iron	1.4 mg/100g
Calorific Value	
Raw seed Kernel	362 kcal/100g
Popped form	328 kcal/100g
Essential Amino Acid Index	
Raw seed kernel	93.63%
Popped form	89.95%
Biological Value	
Popped Form	55
Chemical Score (% Egg)	
Raw seed kernel	70%
Popped form	56.57%
Comparative values of (a) Leucine/Isoleucine	
Raw seed kernel	1.84
Popped form	1.99
(b) (Arginine+Lysine)/Proline	
Raw seed kernel	6.30
Popped form	4.74

Based on Jha *et al* (2018).

Ayurveda mentions it as spermatogenic and aphrodisiac. In Mithila (India), it is customary for a new bride's parents to send Makhana to the groom on the occasion of **Kojagara** festival (a marital ritual) . It is an integral component of a number of ethnic practices in Mithila and other parts of India. The raw seed of Makhana possesses a calorific value of 362 K cal/100gm as against 328 Kcal/100gm in its popped form. However , its biological value (B.V.) is low (around 55) which may be attributed to the high ratio of leucine to isoleucine amino acids in its seeds.

Wild populations of "Thangjing"(Manipuri vernacular of Makhana) are also available in Manipur lakes. *Meitei* tribals in the Manipur valley utilize several non-seed parts including young petiole, leaf ,fruit coat, placenta and also the young seeds for preparing vegetable dishes . No such practice of utilization of vegetative parts , however, exists in north Bihar.There is a need to adopt this practice in other Makhana growing area of the country as Makhana ponds do have an excessive no. of young plantlets that need to be thinned out to facilitate the maximum expansion of only the required no. of plants . The giant leaves occupies a large space. One single *E.ferox* plant,if allowed unhindered space , may develop as many as ten leaves at a time , including expanding, maturing and senescing leaves. Others have elaborated the cultivation and conservation practice as prevalent in Manipur. *E.ferox* growing in the north eastern state of Tripura has attracted scientific attention . Nath and Chakraborty (1985a.b) have investigated protein-quality and starch in Tripura population of *E.ferox*. Starch quality of *E.ferox* has been elaborately investigated by Zhang *et al* (2019),Yang *et al* (2021),Zhang L'*et al*(2022) etc. Tribals in Tripura use the aril of *E.ferox* over its raw seeds (embedded inside fruits) for the cure of gonorrhea,. A recent analysis has found this aril to be rich in micronutrients. They have also reported the ratio of K/Na in *E. ferox* aril to be 7.19 and this plays an important role in the prevention of hypertension and atherosclerosis.

Zhao *et al* (1989) attributed the medicinal properties in this plant to the presence of glucosylsterols as active components. Anti-oxidant activity of the plant products has been studied in correlation to its therapeutic properties including a reduction in the ischemic/reperfusion cardiac injury. Two new cerebrosidesand two new tocopherol trimers from the seed of this plant have been reported recently. Its extract has also been demonstrated as a potential chemotherapeutic agent against neuronal diseases. A recent study shows *E.ferox* as a proteinuria inhibitor of diabetic nephropathy. Its seed extract have been examined as potent scavenger as well as inhibitor of LDL oxidation which is attributed to ischemic heart problems.. Closely agreeing to this observation , extracts from seeds of this aquaphyte have been demonstrated as significantly hypoglycemic as well as hypolipidemic . The anti-oxidant effects of the extracts have been attributed to these effects in rats.

E . ferox seed coat : A repository of phytonutrients

Seed coat of *E. ferox* is simply used as fuel during its popping process. This is because the people are ignorant about its medicinal properties present in the seed coat. Recent investigations have revealed the presence of anti-oxidant and anti-bacterial components in the same (Kadu *et.al* 2021). Phytochemicals like alkaloids,phenols,glucosides,terpenoids, steroids and flavonoids have also been reported (Jiang *et al* 2023) from the *E.ferox* seed coat. The hard seed coat of *E. ferox* , that is generally used as fuel during Makhana popping , also comprises medicinal properties. A novel muco-adhesive biopolymer from *E.ferox* seed coat have been isolated and characterized which could be effective in drug delivery. A recent study in China has confirmed the hypoglycemic effect of triterpenoid-rich extract from *E.ferox* seed-shell on the normal and streptozotocin-induced diabetic mice . The hypoglycemic action was shown to occur through the regulation of glucose metabolism . In response to the treatment , the body weight of experimental animals was shown to return to normal levels. Morphology of the islets of the pancreatic cells also recovered , as expected. There was a reduction in the expression of the negative regulation protein PTP1B gene with a concomitant increase in the insulin receptor IRS-1 protein expression . Anti-oxidant properties in *E.ferox* seed shell make it effective in preserving the pork sausage . Phenolic extract from its seed coat has been found to have a significant anti-fatigue effect .

Other properties of *E.ferox*

A recent investigation on transcriptomic sequencing and analysis during growth of *E.ferox* seed and its development has revealed that the two vital differential genes PAL and P450 remain associated with phenylpropanoid biosynthesis. This indicates a relationship between morphological changes and accumulation of medicinal components in the plant.

Food technologists are now preparing nutri-bars for its possible use by the pregnant and lactating women. These are also consumed by women of child bearing potential who are on way to pregnancy . Nutri-bars are rich in vitamins that enhance the nutritional status of such women. The property of floatability of Makhana seed powder has been exploited as an effective drug delivery agent. Makhana powder obtained after crushing its pops keeps on floating over the water surface and mixes only after continued stiring. This property of *E.ferox* has been involved in developing a drug delivery system . Based on this concept , a recent work has led to development of a non-effervescent floating matrix tablet with *E. ferox* seed (Negi *et al* 2014). Yan *et al* (2019) were able to derive superlubricated nanoparticles for treatment of osteoarthritis based on the structure of *E.ferox* seed, that possess a slippery aril and a hard coat containing starchy kernel. This kernel has a novel superlubricated nanoparticle called MSNs-NH2 @PSPMK .This compound has been biomimicked and synthesized via a one step photopolymerisation method. Kapoor *et al* (2022) have provided an

Fig. 1

Fig.2

elaborate review earmarking Makhana as a superfood in view of its nutritional, pharmaceutical and economic significance.

Fig. 1. Shows habitat of *E. ferox*, also depicting integrated aquacultural method adopted by Makhana farmers to facilitate the cultivation of Makhana. Open space in the middle facilitates dissolution of atmospheric oxygen essential for culture fishes. Air breathing detritivorous fishes easily survive in this system.

Fig. 2. Shows a site of Makhana cultivation under *"Khet me Kheti"* (i.e., cultivation in arable plots with only 1.5 2 feet water) in Purnea district of Bihar depicting a semblance to climate resilient agriculture

E. ferox is considered to have a combination of both dicot and monocot characters that is of much evolutionary significance.

Fig. 3. shows the mature stage of Makhana crop under field condition. Mature upturned leaf shows intricate reticulate venation that is a dicot character. **Fig. 4.(a), 4(b)**. shows the incidence of sepal trimery as well as presence of fibrous roots in this plant that are monocot characters. Its flowers have four sepals as a normal dicot character. **Fig. 5(a)** shows the fruits of *E. ferox*

Fig. 3

Fig. 4(a)

Fig. 4(b)

Fig.5(a)

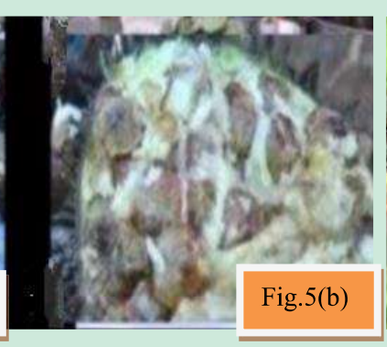

Fig.5(b)

Fig. 6

Fig. 7(a)

Fig.7(b)

Fig. 8

showing prickly spines stream all over. **Fig. 5(b)** shows the inner placental mass with seeds embedded inside. **Fig. 6**. shows the arillated seeds floating on the water surface after the natural dehiscence of the fruit inside water. In areas where the final harvest is not performed by the usual sweeping process , it is generally the angling method that is adopted for taking out the fruits from the water body. In this situation the harvester remains navigating over a boat. This method is generally adopted in Manipur lakes. **Fig. 7(a), 7(b)** show Makhana being distributed (in the first year of marriage) to the kin of the groom sent from the bride side on the occasion of **Kojagara** (Ashwin Poornima).Various items are being carved recently from the edible pops to enhance its marketing appeal. **Fig. 8.** shows these Makhana items in different tastes and flavours, obviously with a view to enhance its marketability.These items were on display at a stall raised recently in the Darbhanga collectorate premises.

Recent years have witnessed an increasing interest in Makhana (gorgon nut/ fox nut) at a global level. A number of references cited below deal with the economic and nutraceutical potentials of *E. ferox* (Ahmad, D et *al* 2015,2018; Baek *et al* 2015, Biswas *et al* 2016,2020; Devi *et al* 2020, Jha *et al* 1991 a,b, 2018; Kapoor *et al* 2018,2022; Kumar *et al* 2016, Kumar and Jena 2016, Liaquat *et al* 2022, Parray *et al* 2010, Paramanik *et al* 2013, Puri et *al* 2000, Row *et al* 2007, Song *et al* 2011, Vikram and Mishra 2021, Wu *et al* 2013,2022; Zhang *et al* 2022 etc.)

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ACC Producing Bacteria as Biofertilizers, Aiding Agriculture in Stressed Soil Environments

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Today we face a gigantic task of accomplishing food security and for that we need to increase crop production. Since agricultural land is a limited resource, if we can reclaim and use non-productive stressed land, it can be an additional asset. Moreover, for increasing productivity harmful chemicals are still being used in large quantities resulting in the search for better and sustainable alternatives.

Approximately 20% of the cultivable land is assessed to be under salinity stress and additionally there is a trend of increase in the salinity globally due to climate change. Salinity means the salt (mostly NaCl) concentration is high in soil and if it is exceeding 200 mM, it is deleterious to crops as most plants will not survive. Salinity affects the productivity of many crop plants. Salinity stress can cause severe dehydration in plant cells, causes osmotic stress and interrupts cellular homeostasis as well as many other physiological and biochemical processes. It may also lead to nutritional stress, reduction of cell division. Moreover, salinity stress generates reactive oxygen spesies (ROS), which includes, singlet oxygen (O_2), hydroxyl (OH^-), superoxide ($O2^{2-}$), and hydrogen peroxide (H_2O_2), which promote oxidative stress thereby damaging the cellular structures.

The zone surrounding plant roots harbours many soil microbes including bacteria, fungi, actinomycetes, protozoa and algae. This rhizosphere microbiome can be of fundamental support to the crops in acquiring various nutrients, resisting diseases, and tolerating various biotic and abiotic stresses. Thus, these Plant Growth-Promoting Rhizobacteria (PGPR), which can act as bio-fertilizers or bioprotectants, can be of great help in making agriculture sustainable by improving the fertility of soil. Some of them also have ability to increase the plant tolerance towards salinity stress and help them grow in adverse environmental conditions.

As a plant responds to environmental stress, it is known to produce ethylene. The gaseous hormone, ethylene is responsible for many functions in plants, including regulating and managing growth and development and taking part in systematic growth. It is present in these natural processes in plants, but, another peak of ethylene has been observed when the ethylene content of plant tissues growing under stress was analyzed, thereby operating or modulating plant responses to environmental stress. Almost every part of the plant suffers in from of chlorosis, senescence, abscission, and cell damage when it is exposed to this stress ethylene. 1-aminocyclopropane-1-carboxylic acid or ACC is a precursor in ethylene synthesis. Some microorganisms have an enzyme ACC deaminase (ACCD) and are capable of breaking down this ACC forming á-ketobutyrate and ammonia. Thus they can reduce the levels of stress induced ethylene and they do so without affecting plant physiology. It was observed that ACCD activity is comparatively common within the plant microbiome particularly in stressful environments. The enzyme is found to be present in many bacteria, fungi, and yeasts including *Rhizobium, Azospirillum, Pseudomonas, Arthrobacter* and *Bacillus*. These microorganisms especially bacteria are able to increase germination rate as well as growth and yield in many plants.

Bacillus pumilus and *Bacillus amyloliquefaciens* have been reported to *i*ncrease nitrate reductase activity and antioxidant genes in Rice. *Bacillus subtilis* can increase total soluble sugars and proline content which can enable wheat plants to survive salt stress. *Burkholdera cepacia* and *Enterobacter* sp. were able to reduce activities of antioxcident enzymes and increase gibberellins; enhance amino acids, suppress salicylic acid synthesis for stress tolerance in cucumber. In Red pepper plants, *Pseudomonas frederiksbergensis* also decreased the content of antioxidant enzymes present. In cotton also *Klebsiella oxytoca* was able to increase the

germination rate along with control in plant disease. Similarly, *Mesorhizobium cicero* in Chickpea and *Rhizobium* sp. in Mung bean, were not only able to increase stress tolerance but also increased nitrogen fixation and plant hormone regulation.

Mostly the bacteria are optimized for a single crop but now a days many are being tested for action in multiple crops. Alternatively, best ones are being tested together forming a consortia. These bacteria can be easily formulated as biofertilizers by mixing them with suitable solid materials as charcoal powder or talc. Even various agricultural wastes can be used as raw material. But before release it is determined that the biofertilizer production has followed the government BIS guidelines and the shelf life is good enough to get transported and reach the farmers. They can be easily mixed with soil or even seeds can be coated before sowing in fields.

Henceforth, the ACC deaminase producing PGPR strains which can mitigate oxidative stress induced damage caused by salt stress, can be used as biofertilizers. These efficient biofertilizers can promote plant growth even under saline stressed conditions, thereby increasing the crop yield of many plants organically and sustainably.

Chandra Shekhar Azad Bird Sanctuary: A Cradle for Invasive-Alien Species

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Wetlands are mainly a water-logged pond that is not deeper than six meters having areas of marsh, fen, peat land and bog. Wetlands may be natural or artificial, permanent or ephemeral which contain flowing or static as well as fresh or marine water (Ramsar convention 1971). Since the 1970s, when legislation and other regulations were implemented, wetlands and the subdiscipline of wetland ecology have emerged as a relatively new topic of study in the subject of ecology. The spread of non-native or alien or exotic species has emerged in recent years as one of the most serious threats to biodiversity, undermining the ecological integrity of many native habitats and pushing some rare species to the edge of extinction, second only to habitat loss (Reddy et al., 2009). Even now there is little attention has been paid on biological invasion in wetlands on global scale in general and regional or national level in particular.

Chandra Shekhar Azad Bird Sanctuary (CSA Bird Sanctuary) is well known for its floral and faunal diversity. Recently, Garg et al. (2015, 2018) reported 87 invasive species and a diversity of 243 vascular plants inside this sanctuary. In the present study, we collected 12 plants that were not earlier reported, of which 3 are invasive in nature, namely *Portulaca oleracea* (Tropical South America), *Cuscuta reflexa* (Mediterrean), and *Evolvulus nummularius* (Tropical America).

The spread of invasive plant species is known to be facilitated by migratory birds. They are not, nevertheless, the only cause of the spread of invasive plants. Natural disasters, human activity, and climate change are some of the ways that invasive plants can spread. Human activity is primarily responsible for the introduction of these invasive or alien species, either intentionally or accidentally. Invasive plant species like *Parthenium hysterophorus, Oxalis corniculata* and *Lantana camara* etc. are occupying a major area of agricultural landfills and natural environments, as per study conducted by the Institute of Forest Productivity, Ranchi. According to the recent studies, invasive species that have a strong resistance to warmth and spread across different landscapes will become more widespread as a result of climate change (Divakara et al. 2013). Most invasive plants develop quickly, get established and naturalized in their new habitat, eventually taking over and outcompeting the original flora. Certain species may be harmful, and their populations frequently explode to the point that they negatively affect native biodiversity, the ecosystem, the environment, the economy, and even human health (Garg & Joshi 2015).

Table-1: Physico-chemical properties of pond water inside CSA Bird Sanctuary

S. No.	Parameters	Pond water
1.	Colour	Colourless
2.	Odour	Odourless
3.	pH	7.84
4.	Temperature	22.5^{0}C
5.	TS	165mg
6.	TDS	129mg
7.	TSS	36mg
8.	BOD	2.60
9.	DO	7.2

Table-2: Physico-chemical properties of pond Soil inside CSA Bird Sanctuary

S. No.	Parameters	Soil
1.	Colour	Light brown
2.	pH	7.56
3.	Temperature	22^{0}C
4.	Moisture level	16.34%
5.	Water holding capacity	55%

The physico-chemical studies on soil and water of CSA Bird Sanctuary revealed that it has nutrient rich environment, neutral pH and favourable BOD value. So, water and soil make a suitable environment for growth of all type of plants, but these physical resources are mostly utilized by invasive plants for their own growth and negatively hamper the growth of other economic plants. This process also leads the extinction of several native species in that area. To protect the wetland from invasive species and conserve the diversity, some procedure may be useful like biological, chemical, cultural, mechanical, and physical methods. These methods are used according to the area and need. Under chemical methods, some weedicides and pesticides are used. Even with physical methods, individuals could pick up these invasive plants with their hands and protect the biodiversity.

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Application of Artificial Intelligence (AI) in Botanical Research

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In the recent years Artificial Intelligence (AI) has been making significant role in various fields such as, healthcare, finance, transportation, plant and their disease identification, horticulture, ecological or environmental and many more areas, One area that has been gaining attention in recent years is the application of AI in botanical studies. Different aspects of botanical studies

such as, understanding of biodiversity, agriculture and climate change, sustainable agriculture and conservation of plants.

The classical plant identification methods involving morphology, anatomy, cytology, palynology simultaneously replaced by modern plant identification after supplementation of molecular and biotechnological tools and techniques. After the advent of Artificial Inteligence, machine learning (MI) techniques replaced the traditional laboratory identification through molecular tools and techniques. In the recent decades, a lot of efforts made by taxonomist together with programmers ease the difficulty of species identification by developing a range of tools that involves the use of computer.

The new advances of plant identification base on three main AI technologies: expert system, artificial neural network and machine vision. Non-experts in plant species identification can use the techniques to easily identify the species. A number of AIT (Artificial Intelligence Techniques) models are developed in the recent years such as Artificial Neural Network (ANN), Support Vector Machine (SVM), K-nearest neighbor (KNN), deep learning approach to identify plant species using image analysis are common techniques recently used in various fields of plant researches.

Convolution Neural Network (CNN) model are being successfully used in a wide range of image classification tasks including plant image identification, with state-of-the-art models performing CNN has an ability to exact image features, i.e. colour, shapes and edges. Some of the plant identification apps not only give the genus and common name of the plant but also provide information on its origin.

The automatic plant image identification is the most promising solution receives considerable attention involving both botany and computer technologies. A number of sophisticated models have been proposed for automatic plant identification, as the machine learning technology has advanced recently. The development of AIT based models will not only used in classification but also used to invasive species prediction, forestry, food grains identification, horticulture, environment stress, insect and disease detection.

Machine learning algorithms (MLA) which can analyze large amounts of data and helps in development of prediction models based as patterns and relationships. AI helps in analyzing the large amount of data generated by genomics sequencing, identify genes responsible for specific traits such as, drought resistance, pest resistance, and utilization of the information in development of new plant varieties suitable for changing environmental conditions.

AI has also been employed in the development of precision agriculture techniques which aim to optimize crop production by employing a large amount of data about planting, fertilizing and harvesting. Drones powered with AI can be used to monitor crop health and detect signs of diseases or pest, informed farmers to take targeted action regarding protection of their crop in advance.

The soil conditions, weather patterns and other factor to predict crop yields and optimal planting strategies can be analyzed by machine learning algorithms. AI can also help in crop management by which farmers can increase their productivity by reducing the environmental impacts.

AI can advance our understanding of plant biology and ecology. Researchers can use AI models to understand the complex interactions between plant and their environment such as effects of climate change in plant growth and distribution.

The available interactions simulate researchers an insight into how plants will respond to the changing environmental condition and thus develop strategies for conservation of plants and species in an ecosystem. Despite a number of advances in application of AI in botanical researches, still there is a need for high quality data to train AI algorithms, collection and annotation of large databases on plant lineages or genome sequences. The amount of databases available needs too much of time to consolidate and expensive and again there is a risk of bias and error in the data followed by ethical considerations such as, job displacement and hand over the power to few technologist.

It is well evident that AI has potential benefits in the botanical researches and continuous research and development in this area will definitely lead to new discoveries and innovations that will help to understand and protect the planet plant life as the AI will continue to develop and evolve more in future.

विश्व का सर्वश्रेष्ठ चावल कालानमक धान उत्तर प्रदेश की विरासत

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उत्तरी पूर्वी उत्तर प्रदेश की सर्वाधिक चर्चित एवं विख्यात धान की स्थानीय किस्म कालानमक विगत तीन हजार वर्षो से खेती में प्रचलित रही है। सुधरी प्रजातियों की अनुपलब्धता के कारण तथा मूलतः स्वाद और सुगन्ध में कमी के कारण किसानों की यह धान की किस्म विलुप्त होने के कगार पर थी। इसके अतिरिक्त कालानमक की खेती घाटे के सौदा रही है। इसकी खेती का क्षेत्रफल 50 हजार से घटकर 2 हजार पर आ गया था और पूरा अन्देशा था कि धान की यह दुर्लभ प्रजाति जोकि भगवान बुद्ध के प्रसाद के रूप में प्रचलित रही है, हमेशा के लिये विलुप्त हो जायेगी। वर्ष 1997 से प्रारम्भ किये गये पीआरडीएफ संस्था के गोरखपुर केन्द्र और उ0 प्र0 कृषि अनुसंधान परिषद् ''उपकार'' के सहयोग से 250 से अधिक कालानमक के नमूने एकत्र किये गये थे। उ0 प्र0 कृषि विभाग से परीक्षण कराकर उक्त नमूनों से सर्वोत्तम नमूना केएन3 के रूप में एक प्रजाति के रूप में नामित किया गया (तालिका 1)। कृषि मन्त्रालय भारत सरकार और भारतीय कृषि अनुसंधान परिषद नई दिल्ली की केन्द्रिय प्रजाति अनुमोदन समिति ने इसे 2010 में इसकोअधिसूचित किया। इस प्रकार किसानों और उपभोक्ता को कालानमक धान की पहली प्रजाति मिली जिसमें स्वाद और सुगन्ध दोनो ही पाये गये। प्रजाति केएन3 की उपज 20 से 25 कुन्तल प्रति हैक्टेयर ही होती थी।

इसकी उपज को बढ़ाने के उददेश्य से संकरण की विधि से पहली बौनी प्रजाति बौना कालानमक 101 भारत सरकार द्वारा 2016 में अधिसूचित किया गया। इसमें उपज तो बढ़कर 45 कुन्टल प्रति हैक्टेयर हो गयी किन्तु इसके दाने में टूड़ था और भूसी का रंग हल्का होता था तथा सुगन्ध भी कम थी। पुनः सकरण करके वर्ष 2017 में बौना कालानमक 102 प्रजाति पीआरडीएफ संस्था ने विकसित की। यह प्रजाति उ0 प्र0 कृषि विभाग द्वारा विमोचित करके 2017 में केन्द्रिय समिति द्वारा अधिसूचित की गई (तालिका 1) टूढ़ रहित यह प्रजाति अच्छे सुगन्ध वाली किन्तु हल्के काले रंग की भूसी वाली किसानों की चहेती बन गई। किसान और उपभोक्ता दोनो खुश थे किन्तु पूर्ण रूप से सन्तुष्ट नही थे। इन्ही कमियों को दूर करके 2019 में पीआरडीएफ संस्था ने कालानमक किरण नामक प्रजाति भारत सरकार से विमोचित कराई। वर्ष 2023 में कालानमक धान का क्षेत्रफल बढ़का 80000 हैक्टेयर हो गया (तालिका 2 अ)। प्रस्तुत लेख में कालामक किरण के विषय में विस्तृत जानकारी दी गई है।

कालानमक किरण का उद्भव एवं विकासः

कालानमक केएन3 और स्वर्णा सब1 के संकरण से एक प्रजनक लाइन पीआरडीएफ–2–14–10–1–1 विकसित की गई। लगातार 3 वर्षो तक 2013 से 2016 तक इसका परीक्षण कृषि विभाग के सम्भागीय कृषि परीक्षण एवं प्रदर्शन केन्द्रों पर कराया गया। यह पाया गया कि इस प्रजनक लाइन की उपज केएन3 की तुलना में 25 से 30 प्रतिशत अधिक रही है (तालिका 3)। किसी परीक्षण केन्द्र में तो इसकी उपज दुगुनी भी रही है (तालिका 5)। अखिल भारतीय धान उन्नयन योजना के अन्तर्गत यह प्रजनक लाइन 28 केन्द्रों पर परीक्षित की गई, वहा भी इसकी उपज प्रशंसनीय रही है। वही पर कीड़े और बिमारियों से लड़ने की क्षमता का भी परीक्षण किया गया जोकि अत्यन्त सन्तोषजनक पाया गया (तालिका 4)। इसके बीज का नमूना राष्ट्रीय बीज बैंक (आईसी618718) में भी रखा गया है ताकि अन्य प्रजनकों को यह उपलब्ध रहे और किसी घटना या दुर्घटना की स्थिति में इसे वहा से प्राप्त किया जा सके।

खेती की विधिः

विभिन्न प्रयोगों में यह पाया गया कि कालानमक की अन्य प्रजातियों (केएन3 और बौना कालानमक 102) की तरह कालानमक किरण भी एक प्रकाश अवध की संवेदी प्रजाति है। इसमें बालिया 20 अक्टूबर के आस–पास निकलती है तथा 25 नवम्बर के आस –पास यह कटाई के लिये तैयार होती है। अतः इसकी बुआई का उचित समय जून का अन्तिम पखवारा (15 से 30 जून) के बीच ही है। एक हैक्टेयर में खेती के लिये 30 किलोग्राम बीज की आवश्यक्ता होती है। जुलाई पहले सप्ताह के

बाद बुआई करने से इसकी पैदावार कम हो जाती है, लेकिन 15 जून से पहले बुआई करने पर इसकी पैदावार में कोई बढ़ौत्तरी नही होती। इसलिये संस्तुति दी जाती है कि 15 से 30 जून के बीच ही इसकी नर्सरी ड़ाली जाये।

रोपाई की विधि :

जब पौध 20 से 30 दिन की हो जाये तो इसे उखाड़ कर 20 सेमी कतार से कतार और 15 सेमी पौधे से पौधे की दूरी पर रोपाई कर दी जाये। एक स्थान पर 2 से 3 पौध ही लगावे एक स्थान पर एक पौध लगाने से भी अच्छी पैदावार होती है किन्तु 3 से अधिक लगाने पर पैदावार में कोई बढ़ोतरी नही होती। एक स्थान पर कम पौध लगाने से बीज की मात्रा कम की जा सकती है।

खाद की मात्रा :

कालानमक की बौनी प्रजातियों में 120 ग्राम नत्रजन, 60 किलोग्राम फास्फोरस और 60 किलोग्राम पोटास की आवश्यक्ता होती है। फासफोरस एवं पोटास की पूरी मात्रा तथा नत्रजन की आधी मात्रा रोपाई से पहले मिलाकर खेत में ड़ाल दी जाती है। रोपाई के एक महीने बाद खर पतवार नियन्त्रण के बाद बची हुई 60 किलोग्राम नत्रजन की मात्रा ऊपर से छिड़काव करके ड़ाल दी जा सकती है। अधक उर्वरता पर यह अधिक पैदावार देती है किन्तु आर्थिक रूप से इसके लिये 120 किलो नत्रजन, 60 किलो फास्फोरस और 60 किलो पोटास देने की संस्तुति दी जाती है।

यदि जैविक विधि से इसकी खेती की जाये तो जैविक विधि के मानको के अनुरूप इसमें यूरिया, डाईअमोनियम फास्फेट अथवा कृषि रक्षा में उपयोग होने वाले कारखाने में निर्मित किसी भी रसायन का उपयोग नही करना चाहिये। इसके लिये हरी खाद, गोबर की खाद, मुर्गी की खाद, बीजामृत, जीवामृत, नीमास्त्र आदि का प्रयोग ही करना चाहिये। इसके जैविक प्रमाणिकरण के लिये पूरी प्रक्रिया अगले लेख में दी जायेगी।

फसल प्रबन्धन :

यदि जस्तें की कमी के लक्षण दिखाई पड़े तो 5 किलोग्राम जिंक सल्फेट और 2.5 किलोग्राम चूने को 500 लीटर पानी में घोलकर फसल पर छिड़क दे। खर पतवार नियन्त्रण के लिये रोपाई के एक माह के अन्दर खुरपी से उगे हुये खरपतवारों को निकाल दे इसके पश्चात् यदि 2 –3 सेमी पानी भरा रहे तो आगे निराई की आवश्यक्ता नही पड़ती। रोपाई के समय खेत तैयार करते समय जो कुछ भी खरपतवार उगे रहते है वे स्वयं ही नष्ट हो जाते है। पहली निराई के बाद फसल की बढ़वार इतनी तेजी से होती है कि पूरा खेत पत्तियों से ढ़क जाता है। जिस कारण उसमें निराई की आवश्यक्ता नही होती। यदि रासायनिक खरपतवारनाशी का प्रयोग करना पड़े तो रोपाई के 15 से 20 दिन के बाद उसे ड़ाल सकते है।

कालानमक किरण में प्रमुख कीटों और बिमारियों से रोधिता पायी जाती है (तालिका 4)। अतः उनके लिये किसी भी रासायनिक दवाओं का उपयोग नही करना पड़ता किन्तु कीडों में गन्धी कीट व सीथ ब्लाइट पर्ण गलन रोग के लिये दवाओं का उपयोग करना पड़ता है।गन्धी कीट का उपचार बीएचसी का बूरकाव करके किया जा सकता है। पर्ण गलन रोग के उपचार के लिये 0.2 प्रतिशत हैक्साकोनाजोल अथवा 1 लीटर प्रोपीकोनाजोल 25 ईसी का छिड़काव करके किया जा सकता है। सुगन्धित होने के करण इसमें तनाछेदक कीट का भी प्रकोप होता है कार्टाप हाइड्रेक्लोराइड 18 किलोग्राम प्रति हैक्टेयर खेत में 5से 6 दिन तक 3 से 4 सेमी पानी बनाये रखे। किन्तु इसके उपचार महंगे तथा नुकसान कम होने के कारण किसी दवा के उपयोग की सलाह नही दी जाती।

रासायनिक खरपतवारनाशी जैसे : ब्यूटाक्लोर 2.5 लीटर प्रति हैक्टेयर, अनिलोफास 1.5 लीटर प्रति हैक्टेयर अथवा नोमिनी गोल्ड 250 एमएल प्रति हैक्टेयर अच्छे खरपतवारनाशी है। उपयोग इन पर लिखे हुये अनुशंसा के अनुरूप कर सकते है।

कालानमक किरण की जैविक खेती:

यदि कालानमक किरण का उत्पादन जैविक विधि से करना है तो पहले से तैयार जैविक खेत का ही प्रयोग करे। बीजोपचार के लिये ट्राइकोडर्मा अथवा बीजामृत से बीज शोधित कर ले। रोपाई करते समय या रोपाई करने से पहले सूडोमोनास के दो प्रतिशत घोल में पौध की जड़े डुबाने के पश्चात् रोपाई करें। चूकि किसी भी उर्वरक का उपयोग जैविक खेती में नही किया जाता इसलिये खादों के उपयोग से ही पोषक तत्व देने पड़ते है। इसके लिये 5 टन प्रति हैटेयर गोबर की सड़ी खाद या मुर्गी की खाद डाले। सर्वोत्तम है कि रोपाई के 40 दिन पहले 40 किलोंग्राम ढ़ैचा (सिसबानिया)/हैक्टेयर का बीज मुख्य खेत में बोये।जब पौधे 35 से 40 दिन के हो जाये तो उसको खेत में पलटकर पानी भरकर सड़ा दे। इस हरी खाद के पलटने के एक सप्ताह के अन्दर रोपाई कर सकते है। इसके अतिरिक्त कई और उपादान (पीएसबी, हर्बोजाइम, बीजीए, प्रोम, वर्मीकम्पोस्ट इत्यादि) उपलब्ध है जिनका उपयोग करके पोषक तत्वों की उपलब्धता की जा सकती है। कीड़े तथा बिमारियों की नियन्त्रण (अमृतपानी, नीमोलीन, जीवामृत आदि) के लिये नीम आधारित अनेक उपादान बाजार में उपलब्ध है। इनमें अधिकांश नीम आधारित अथवा अमृतपानी व बायोकम्पोजर आधारित उपादान उपलब्ध है जिनका उपयोग मानव द्वारा संश्लेषित रसायनो का उपयोग किये बिना कालानमक किरण की खेती की जा सकती है।

यदि जैविक विधि से कालानमक किरण की खेती की जा रही है तो उसका जैविक प्रमाणीकरण नितान्त आवश्यक है। इसके लिये दो में से कोई प्रणाली उपयोग में लायी जा सकती है। पहला है पार्टीसिपेटरी गारंटी सिस्टम (पीजीएस) जो कि भारत सरकार के कृषि मंत्रालय से प्रतिपादित एवं राष्ट्रिय जैविक खेती केन्द्र, गाजियाबाद द्वारा संचालित प्रणाली हैं। यह सस्ती तथा सरल विधि है, दूसरी प्रणाली है थर्ड पार्टी सर्टीफिकेशन जिसमें कुछ सरकारी एवं 24 निजी कम्पनिया प्रमाणित करती है, यह महंगी है किन्तु इससे प्रमाणित उत्पाद निर्यात किया जा सकता है। प्रमाणीकरण के बाद ही कालानमक किरण का उत्पाद जैविक माना जायेगा।

फसल की कटाई व मड़ाई:

चूँकि कालानमक की भूसी का रंग काला होता है। अतःइसकी कटाई का समय निधार्रित करना थोड़ा कठिन होता है, उन प्रजातियों की तुलना में जिनमें दाने का रंग हरा होता है। दूसरा कारण, कि नवम्बर के महीने में सूरज की धूप कमजोर पड़ जाती है तथा शाम को ओंस पड़ने लगती है इस कारण इसका दाना सूखने में समय अधिक लगता है। सामान्यतया 50 प्रतिशत बाली निकलने के 30 दिन बाद धान की फसल कटाई के लिये तैयार होती है किन्तु कालानमक किरण को 40 से 45 दिन लगते है। इसके पहले फसल की कटाई करने से दाने की गुणवत्ता खराब होती है, कुटाई के समय चावल टूटता है तथा सफेद चावल की संख्या अधिक होती है। इसलिये कालानमक की कटाई का समय अति महत्वपूर्ण है।

फसल कटाई के बाद, यदि कम्बाइन हार्वेस्टर का उपयोग नही किया जा रहा है तो 3 दिन के अन्दर ही पिटाई करके दाने पौधों से अलग कर लिये जाये और उसको 3 से 4 दिन धूप में अच्छी तरह सुखाकर भण्डारण कर ले। कम्बाइन हार्वेस्टर द्वारा कटी फसल को उसी दिन से लगातार 3–4 दिन धूप में सुखाकर भण्डारण कर सकते है।

पैदावार :

कालानमक की औसत पैदावार 45 से 50 कुन्तल होती है। जैविक खेती जिसमें की हरी खाद के साथ–साथ ट्राईकोडर्मा तथा सूडोमोनास का प्रयोग किया गया हो कि पैदावार 50 से 55 कुन्तल तक हो सकती है।

भण्डारण :

धान सुखाने (14प्रतिशत नमी) के बाद प्लास्टिक की बोरियों अथवा टिन की बनी बुखारी में इसका भण्डारण इस प्रकार करे कि उस कमरे का तापक्रम 30 डिग्री सेल्सियश से अधिक न होने पाये। सलाह दी जाती है कि चावल का भण्डारण न करके धान के रूप में इसका भण्डारण करे जिससे इसकी सुगन्ध एवं पाक गुण ठीक रहते है। तात्पर्य यह है कि धान से चावल उतनी ही मात्रा में बनाये जितना खाने या बेचने के उपयोग में आ सके।

कालानमक किरण की कुटाई :

कुटाई के लिये अच्छी मशीनों का उपयोग करने से चावल कम टूटता है तथा निर्धारित 5 प्रतिशत पालिश की जा सकती है। ध्यान रहे कि ट्रैक्टर के पीछे चलने वाली कुटाई की मशीने जो घर–घर घूमती है उनसे कुटाई कदापि न करावें। ये लोग 10 से 15 प्रतिशत चावल के ऊपर का हिस्सा खुरचकर पालिश करते है जिससे सुगन्ध के साथ–साथ प्रचुर मात्रा में पोषक तत्व भी निकल जाते है।

कालानमक किरण के दाने व पाक गुण :

कालानमक के दाने के भौतिक गुण तालिका 8,9 और 10में दिये गये है। इससे प्रतीत होगा कि इसकी भूसी का रंग काला तथा चावल का रंग सफेद होता है। मध्यम लम्बा इसका चावल एक मध्यम एमाईलोज और जिलेटाइजेशन तापक्रम वाला होता है। इस कारण चावल पकाने के बाद ठण्डा होने पर भी काफी समय तक मुलायम बना रहता है जबकि बासमती का चावल ठण्डा हो जाने के बाद कड़ा हो जाता है। अति सुगन्धित होने के साथ–साथ उत्तरी भारत की यह एकमात्र प्रजाति है जिसमें लोहे और जस्ते दोनो की मात्रा अधिक होती है (तालिका 5, 6 व 7)। चूकि इसका ग्लाइसिमिक इंडेक्स 52 प्रतिशत है (55 से कम) इसलिये इसको सर्करा विहीन (शुगर फ्री चावल) प्रणाली में रख गया है। तात्पर्य यह है कि मधुमेह के रोगी इसको बेझिझक अपने नित्य के भोजन में खा सकते है। इस प्रजाति की यह विशेषता कालानमक किरण को एक नया आयाम देगी। इसके पौष्टिकता सम्बन्धी अन्य गुण तालिका 8, में दिये गये है। कालानमक किरण ही एक ऐसी प्रजाति है जिसमें कि बिटामिन ए पाया जाता है बिटा कैरोटीन के रूप में। अतः कालानमक किरण शर्करा विहीन, दुगुना प्रोटीन, तीनगुना आयरन, चारगुना जिंक और विटामिन ए से परिपूर्ण धान की सर्वोत्तम पोषक तत्वों से भरपूर प्रजाति है। इसको मधुमेह के रोगी भी भरपेट प्रतिदिन खा सकते है तथा इसके खाने वाले में रोगों से, विशेषकर कोरोना, से लड़ने की क्षमता है।

कालानमक चावल में सामान्य चावल से दोगुना प्रोटीन, तीनगुना आयरन, चारगुना जिंक पाया जाता है। इसके अतिरिक्त इसका ग्लाइसिमिक इंडेक्स 49 से 52 प्रतिशत के बीच में है, जिसके कारण इसको 'शुगर फ्री' कहा जाता है। अतः यह मधुमेह के रोगियों के खाने के लिये सर्वथा उपयुक्त है। यह सम्भवतः इकलौता चावल है जिसमें विटामिन ए भी पाया जाता है। सुगन्धित व बासमती से भी अधिक है और उसके चावल (भात) कम एमाइलोज होने के कारण ठण्डा होने पर भी बना रहता है। इसके धान की कुटाई किसी भी प्रकार की मिल में हो सकता है। उपरोक्त गुणों के कारण इसको 'विश्व का सर्वश्रेष्ठ चावल चावल' कहा जाये अतिश्योक्ति नही होगी।

तिगुनी आमदनीः

भारत सरकार वर्ष 2022 तक किसान की आमदनी दुगुनी करने का लक्ष्य रखी है कालानमक किरण की खेती उस दिशा में एक मील का पत्थर साबित होगी जोकि तालिका 9 से स्पष्ट हो जायेगा ।

तालिका 1. कालानमक धान की तीन प्रजातियों (केएन3, बौना कालानमक 102 और कालानमक किरण) के विमोचन एवं आकारिक गुण

क्रम0	विवरण / प्रजाती	केएन3	बौना कालानमक 102	कालानमक किरण
1	CSCNRVअधिसूचना वर्ष	2010	2017	2019
2	CSCNRV*CSCNRVअधिसूचनांक	57th meeting* No. SO.2137 (E); Gazette of India No. 1816 (Part II (3) dated31.08.2010	77th meeting* No.3-5412017-SD.IV dated 03.07.2017	82nd meeting* notification No. 3-71/2019-SD IV
3	राजपत्र संख्या	Gazette No. SO2137-E dated 31.08.2010	Gazette of India No. 2458 (Part II (3) dated 29.08.2017	Gazette of India No. 3220 (Part II (3) dated 06.08.2019
4	प्रजनन विधि	शुद्ध वंशक्रम चुनाव	संकरण एवं वंशावली	संकरण एवं वंशावली
5	पैतृक	Acc. PRDF - केएन3सिद्धार्थनगर	केएन3xपरिष्कृत साम्भा मसूरी	केएन3xस्वर्णा सब1
6	आईसी न0	आईसी-551884	आईसी-613958	आईसी-618718
7	पर्ण आवरण का रंग	हरा	हरा	हरा
8	पकने की अवधि (दिनों में)	145 (प्रकाश अवध संवेदी)	135 (प्रकाश अवध संवेदी)	135 (प्रकाश अवध संवेदी)
9	तने की लम्बाई	111 सेमी.	60सेमी.	60सेमी.
10	पौधे की ऊचाई	142 सेमी.	95सेमी.	95सेमी.
11	बाली की लम्बाई	31 सेमी,विरल	35 सेमी,सघन	35 सेमी,सघन
12	दाने प्रति बाली	300	400	400
13	टूड़	अनुपस्थित	अनुपस्थित	अनुपस्थित
14	उपज(कु0 / है)	25	45	50

* The Central Sub-Committee on Crop Standards, Notification and Release of Varieties for Agricultural Crops (CSCSNRV)

तालिका 2. भौगोलिक सूचकांक क्षेत्र के अन्तर्गत कालानमक का अनुमानिम क्षेत्रफल (2021)

क्रम	मण्डल	जिला	कालानमक अनुमानित क्षेत्रफल (है)	उपलब्ध तकनीक
1	बस्ती	बस्ती	5,000	1.कालानमक की चार प्रजातिया क्रमशः केएन3, बौना कालानमक 101, बौना कालानमक 102, कालानमक किरण 2. उक्त प्रजातियो काप्रजनक, आधार बीज एवं प्रमाणित बीज उपलब्ध। 3. भौगोलिक सूचकांक 4. जैविक प्रोटोकाल 5. बाजार से जुड़ाव
2		संत कबीर नगर	3,000	
3		सिद्धार्थनगर	10,000	
4	देवीपाटन	बहराईच	3,000	
5		बलरामपुर	2,000	
6		गोण्डा	2,000	
7		श्रावस्ती	1,000	
8	गोरखपुर	देवरिया	3,000	
9		गोरखपुर	9,000	
10		कुशीनगर	4,000	
11		महराजगंज	8,000	
		कुल	50,000	

Table 2a. Area under Kalanamak rice and the reasons of decrease or increase.

Year	Area of Kalanamak (ha)	Remark on technologies
1960	50,000	Traditional area under Kalanamak
1990	2,000	Spread of HYYV rice varieties
2010	3,000	Notification of Kalanamak KN3 variety, UPCAR support
2015	10,000	Demo of KN3 by Dept. of Agriculture, Tata Trust fund
2016	20,000	Notification of Bauna Kalanamak 101, Tata Trust fund
2017	25,000	Notification of Bauna Kalanamak 102, Tata Trust fund
2018	35,000	Release of Kalanamak Kiran by SVRC
2019	40,000	Notification of Kalanamak Kiran by CVRC
2020	45,000	Seed distribution and market promotion
2021	50,000	Kalanamak Mahotsav in Siddharthnagar
2022	70,000	Govt. support, inspiration from the President Sri Ram Nath Kovind, PM Sri Modi Ji and CM Sri Yogi Ji, MSME and Department of Agriculture, U. P.
2023	80,000 (estimate)	Govt. support, inspiration from the PM Sri Modi Ji and CM Sri Yogi Ji, MSME and Department of Agriculture, U. P. , exporters and many others

तालिका 3 कालानमक किरण पर केएन3 की तुलना में बुआई की तिथि का 50 प्रतिशत पुष्पन पर प्रभाव

क्रम	बुआई की तिथि	कालानमक किरण		केएन 3	
		पुष्पन की तिथि	पुष्पन में दिन	पुष्पन की तिथि	पुष्पन में दिन
1	15 मई	19 अक्टूबर	157	27 अक्टूबर	165
2	30 मई	19 अक्टूबर	142	27 अक्टूबर	150
3	15 जून	19 अक्टूबर	126	27 अक्टूबर	134
4	30 जून	19 अक्टूबर	111	27 अक्टूबर	119
5	15 जुलाई	22 अक्टूबर	100	30 अक्टूबर	108
6	30 जुलाई	23 अक्टूबर	84	30 अक्टूबर	91

तालिका 4. कालानमक किरण में बिमारियों और हानिकारकं से रोधिता (आईआईआरआर हैदराबाद, 2014)

क्रम0	विवरण/प्रजाती	केएन3	बौना कालानमक 102	कालानमक किरण
1	शाकाणु झुलसा	मध्यम रोग्राही	मध्यम रोधिता	मध्यम रोधिता
2	आवरण झुलसा	मध्यम रोधिता	मध्यम रोग्राही	मध्यम रोग्राही
3	शाकाणु पर्णधारी	रोधिता	रोधिता	रोधिता
4	झोका	मध्यम रोधिता	मध्यम रोधिता	मध्यम रोधिता
5	भूरा झुलसा	रोधिता	रोधिता	रोधिता
6	टूंगरों	रोधिता	रोधिता	रोधिता
7	तनाछेदक	मध्यम रोग्राही	मध्यम रोग्राही	मध्यम रोग्राही
8	भूरा फुदका	मध्यम रोधिता	मध्यम रोधिता	मध्यम रोधिता
9	हरा पत्ती फुदका	मध्यम रोधिता	मध्यम रोधिता	मध्यम रोधिता
10	पत्ती लपेटक	मध्यम रोधिता	मध्यम रोधिता	मध्यम रोधिता
11	बंका कीट	मध्यम रोधिता	मध्यम रोधिता	मध्यम रोधिता
12	जड़ भृंग	रोधी	रोधी	रोधी
13	गंधी कीट	रोगग्राही	रोगग्राही	रोगग्राही
14	आवरण सड़न	मध्यम रोगग्राही	मध्यम रोगग्राही	मध्यम रोगग्राही

तालिका 5. कालानमक किरण चावल के आकारिक एवं पाक गुण, – (आर–फ्राक), उ0प्र, लखनऊ

क्रम0	विवरण/प्रजाती	केएन3	बौना कालानमक 102	कालानमक किरण
1	1,000 दाने का वजन	15 ग्राम	16ग्राम	15 ग्राम
2	महक	अत्यधिक सुगन्धित	अत्यधिक सुगन्धित	अत्यधिक सुगन्धित
3	भूसी का रंग	बैंगनी से काला	बैंगनी काला	बैंगनी से काला
4	चावल का लम्बाई	5.76 मीमी	5.76 मीमी	5.76 मीमी
5	चावल का मोटाई	2.18 मीमी	2.18 मीमी	2.18 मीमी
6	लम्बाई/मोटाई अनुपात	2.64 मीमी	2.64 मीमी	2.64 मीमी
7	दाने का आकार	मध्यम पतला	मध्यम पतला	मध्यम पतला
8	चावल का रंग	सफेद	सफेद	सफेद
9	कुटाई	80 %	80 %	80 %
10	छटाई	75 %	75 %	75 %
11	साबुत चावल	70 %	70 %	70 %
12	क्षार मान	6 - 7	6 - 7	6 - 7
13	आयतन वृद्धि	4.5	4.5	4.5
14	जैल अविरोध	80 मीमी	80 मीमी	80 मीमी
15	एमाईलोज की मात्रा	20 %	21 %	20 %
16	ग्लाइसेमिक इंडेक्स	53.5	52.5	53.1 *

तालिका 6 कालानमक किरण के चावल में पोषक तत्व (प्रति 100 ग्राम) –एशिया पेसिफीक प्रा0ली0, सिंगापुर, 2019

पोषक तत्व	दैनिक मात्रा	दैनिक मात्रा का %	प्रति 100 ग्राम	विधि
कुल वसा	0.7ग्राम	1 %	0.8ग्राम	Stats-FC-SOP-005
संतृप्त वसा	0.4ग्राम	2 %	0.48ग्राम	AOAC Official Method No.996.06
ट्रन्स फेट	0ग्राम	-%	0ग्राम	AOAC Official Method No.996.06
कोलोस्ट्रोल	0मिलीग्राम	0 %	0 मिलीग्राम	In-House 14.2a, HPLC

सोडियम	1मिलीग्राम	0 %	0.67मिलीग्राम	Stats-FC-SOP-003 Ref. to AOAC method
कुल कोर्बोहाईड्रेट	61ग्राम	20 %	68.13ग्राम	Stats-FC-SOP-005
आहारिक रेशा	4ग्राम	18 %	4.96ग्राम	AOAC Official Method No.985.29
चीनी	0ग्राम	-%	0ग्राम	In-House Method 2.11 Gravimetry
प्रोटीन	9 ग्राम	-%	10.4ग्राम	Stats-FC-SOP-001
कुल ऊर्जा	321.32Kcal*			Stats-FC-SOP-005

** 1 Kal = 4.2 KJ

तालिका 7 कालानमक किरण के चावल के पोषक तत्व (आर–फ्राक) उद्यान विभाग, उ0प्र, लखनऊ

क्रम	प्राचल	परिणाम	परीक्षण विधि
1	वसा%	0.51	IS:12711:1989 RA 2005
2	प्रोटीन %	10.45	IS:7219:1973 RA 2005
3	कोर्बोहाईड्रेट	87.96	SP 18 (P-6) 1981
4	ऊर्जाKcal/100ग्राम	395	-
5	कुल भस्मावशेष%	0.32	FSSAI manual 2016
6	लोहा मीलीग्राम/100ग्राम	3.0	FSSAI manual 2016
7	जस्तामीलीग्राम /100ग्राम	0.37	FSSAI manual 2016

तालिका 8 अखिल भारतीय धान समन्वित परीक्षण, हैदराबाद में कालानमक किरण के चावल की गुणवत्ता, खरीफ 2014–15

प्रजाति	कुटाई %	छटाई %	साबुत चावल %	लम्बाई	मोटाई	ल/म अनुपात	वर्ग	आयतन फैलाव	जल ग्रहण	पकाने पर लम्बाई	बढ़ोतरी अनुपात	क्षार फैलाव	एमाईलोज	जैल अविरोध
कालानमक किरण	78.9	68.5	63.2	5.06	1.98	2.55	मध्य पतला	4.8	250	9.6	1.89	4.0	18.86	45
केएन3	80.1	70.5	63.1	5.55	2.06	2.69	मध्य पतला	4.7	150	10.8	1.94	5.0	23.17	68
साम्भा मसूरी	78.5	69.9	68.2	5.20	1.85	2.81	मध्य पतला	4.6	195	10.2	1.96	4.0	24.05	54

तालिका 9 कालानमक की खेती से तुलनात्मक लाभ, 2019

विवरण	सामान्य चावल (बीपीटी–5204)	कालानमक किरण	जैविक कालानमक किरण
औसत ऊपज (कु/है)	40	45	45
विक्रय मूल्य (रू/कु0)	1,815	3,000	3,500
सकल लाभ	73,400	1,35,000	1,57,500
उत्पादन लागत(रू/है)	34,500	33,750	30,000
शुद्ध लाभ(रू/है)	38,900	1,01,250	1,27,500
वार्धिक आय(रू/है)	0	62,350	88,600


गोरखपुर रत्न

Media Coverage

स्वतंत्र प्रभात

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व्याख्यान में बताएं प्रबंधन के तरीके

● - चन्द्रभानु गुप्त कृषि स्नातकोत्तर महाविद्यालय में व्याख्यान का आयोजन

स्वतंत्र प्रभात

सीतापुर क्लीन एंड ग्रीन एनवायरमेंटल सोसायटी तथा चंद्रभानु गुप्त कृषि महाविद्यालय के संयुक्त तत्वावधान में व्याख्यान का आयोजन। कार्यक्रम की शुरुआत सरस्वती की प्रतिमा पर माल्यार्पण एवं दीप प्रज्वलित कर हुई। मुख्य वक्ता इंडियन इंस्टिट्यूट ऑफ़ टॉक्सिकोलॉजिकल रिसर्च के प्रधान वैज्ञानिक डॉ बी पी शर्मा ने जीवन में विभिन्न प्रकार के पहलुओं को ध्यान में रखते हुए आगे बढ़ने तथा विभिन्न प्रबंधन के तरीके बताएं। महाविद्यालय के प्राचार्य ने प्रो बीपी शर्मा को वृक्ष स्वागत किया। इस अवसर पर चंद्रभानु गुप्त कृषि महाविद्यालय के अध्यक्ष डॉक्टर फिदा हुसैन अंसारी सदस्य आर पी सिंह , ग्रीन एनवायरमेंट समिति के प्रेसिडेंट इंजीनियर सुमेर अग्रवाल, प्रो योगेश कुमार, वाइस प्रेसिडेंट डॉ एस सी शर्मा शर्मा,महाविद्यालय के प्राचार्य प्रो गजेंद्र सिंह, विज्ञान संकाय के डॉक्टर रवी शंकर वर्मा, डॉ रजनी शुक्ला, डॉ अनिल वर्मा, डॉ हरीश

यादव, डॉ विवेक अग्रवाल, कीट विज्ञान विभाग के प्रवक्ता धर्मेंद्र कुमार सिंह पशुपालन विभाग के सुधीर कुमार सिंह, कृषि प्रसार विभाग के प्रवक्ता डॉ कमला कांत सहित 150 से अधिक छात्र- छात्राओं ने हिस्सा लिया। कार्यक्रम का संचालन महाविद्यालय के कुलानुशासक डॉ योगेंद्र कुमार सिंह ने किया।

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