



A SCIENCE AND TECHNOLOGY NEWSLETTER

**RESEARCH UPDATE****Promising Technologies**

- ◆ Fluid fertilizers for foliar sprays in apple 1
- ◆ Management of soybean insects through microbial insecticides 4
- ◆ CAZRI Vishal: a new pomegranate variety 5
- ◆ Pusa-Farm SunFridge – for storage of perishables 6

**New Initiatives**

- ◆ ICAR-CIAE develops touch-free sanitizer unit 8
- ◆ AICRP on chickpea brings self-sufficiency 9
- ◆ ICAR Centre, Jorhat, Assam contributes against COVID19 10
- ◆ ICAR-IVRI helps in COVID-19 testing 11

**Natural Resource Management**

- ◆ Indian Pompano, new candidate for Indian Mariculture 12
- ◆ Spice farming systems in Paderu Tribal Agency Area 13
- ◆ Virat (IPM 205-7) – a promising mungbean cultivar 15

**Profile**

- ◆ ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow 16

**Spectrum**

- ◆ Nematode management in protected cultivation through soil solarization and bioagents 23
- ◆ Co 0238: The wonder variety of sugarcane for subtropical India 24
- ◆ ICAR-NBAIR curtails whitefly 26

**Way Forward**

28

**PROMISING TECHNOLOGIES****Fluid fertilizers for foliar sprays in apple**

Foliar feeding emphasizes on the immediate needs of a growing crop, as opposed to long-term soil deficiencies, by spraying water-soluble fertilizers onto the leaf surface of the plants. All plants absorb nutrients through their leaves and stems, using stomata, little openings similar to the pores of our skin. Plants absorb foliar sprays 20 times faster than soil-applied nutrients. Foliar application helps plants to compensate for soil deficiencies (low fertility, low soil temperature, etc.) during the growing season. Apple growers primarily use NPK mineral fertilizers like calcium ammonium nitrate, single super phosphate and muriate of potash, and farmyard manure for orchard fertilization in the late autumn to early spring season. However, increasing fertilizer cost and scarce availability to meet out the real fruit crop demands for specific nutrients



Quality of apple fruits influenced by WSF

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# PROMISING TECHNOLOGIES

## Schedule fluid fertilizers for foliar sprays in apple

Treatment	Fertilizer and Spray		Spray application stage/schedule at an interval of 15 days from
	NPK Version	Number of Spray	
100% of the blanket recommended dose of fertilizers (RDF, NPK-70:35:70)+foliar WSF	+ 19:19:19	3	Foliage sprouting stage
	+ 13:00:45	3	Pink bud stage
	+ 00:00:50	2	Walnut-fruit development stage
87.5% of RDF+ foliar WSF	+ 19:19:19	3	Foliage sprouting stage
	+ 13:00:45	3	Pink bud stage
	+ 00:00:50	2	Walnut-fruit development stage
75% of RDF+ foliar WSF	+ 19:19:19	3	Foliage sprouting stage
	+ 13:00:45	3	Pink bud stage
	+ 00:00:50	2	Walnut-fruit development stage
62.5% of RDF+ foliar WSF	+ 19:19:19	3	Foliage sprouting stage
	+ 13:00:45	3	Pink bud stage
	+ 00:00:50	2	Walnut-fruit development stage
50% of RDF+ foliar WSF	+ 19:19:19	3	Foliage sprouting stage
	13:00:45	3	Pink bud stage
	00:00:50	2	Walnut-fruit development stage
100% of the blanket recommended dose of fertilizers (RDF, NPK-70:35:70)+Water Spray	+ Nil	Nil	Nil



Geographical location of apple orchards at Kinnaur Valley

resulted in lower productivity of the apple orchards. However, for sustainable fruit production, optimum

utilization of plant nutrients with minimum environmental pollution, it is necessary to reorient agricultural producers for effective use of foliar nutrition. Hence, an investigation was initiated at Dr YSP University of Horticulture and Forestry, Nauni, Solan (HP) to optimize the dose of foliar nutrition of water soluble fertilizers on vegetative growth attributes, flowering characteristics, nutrient acquisition, yield and fruit quality attributes of spur and standard apples.

### Technology

Multilocation trials were established to evaluate the conjoint effects of foliar nutrient fluids supplemented along with traditional NPK fertilizers on generative potential of apple cultivars, Oregon Spur and Royal Delicious in dry temperate ecosystem during 2013. The trial sites were located at RHRTS and Farm Science Centre

### Comparative morphological growth traits of standard and spur apples in dry temperate climate

Fertilizer treatment (T)	Oregon Spur						Royal Delicious					
	Plant height (cm)	Canopy diameter (cm)		TG (cm)	ASEG (cm)	Leaf area (cm <sup>2</sup> )	Plant height (cm)	Canopy diameter (cm)		TG (cm)	ASEG (cm)	Leaf area (cm <sup>2</sup> )
		E-W	N-S					E-W	N-S			
T <sub>1</sub>	420.6	328	340	44	46	52.5	346.1	247.5	274.5	42.4	47.5	50.5
T <sub>2</sub>	360.7	360	310	41	43	51.6	286.2	276.5	236.5	39.4	44.5	49.6
T <sub>3</sub>	444.9	320	312	45	46	48.8	370.4	237.5	237.5	43.4	46.5	48.8
T <sub>4</sub>	480.5	380	348	60	52	55.7	396.0	298.5	268.5	58.4	54.5	52.9
T <sub>5</sub>	450.5	380	300	48	48	53.6	376.0	296.5	227.5	46.4	49.5	50.6
T <sub>6</sub>	380.4	280	270	42	40	49.5	295.9	194.5	192.5	40.4	39.5	44.5
CD at 5%	41.1	16.9	39.7	4.63	3.63	1.90	44.3	18.8	41.3	4.63	4.49	2.70

E-W, east-west; N-S, north-south; TG, tree girth; ASEG, annual shoot extension growth



Spur, fruiting and yield attributes of standard and spur apples at various fertilizer treatments

Fertilizer treatment (T)	Oregon Spur				Royal Delicious			
	Spur length (mm)	Spur thickness (mm)	Fruit set (%)	Fruit drop (%)	Spur length (mm)	Spur thickness (mm)	Fruit set (%)	Fruit drop (%)
T <sub>1</sub>	37.5	11.6	52.1	10.5	38.7	12.7	50.7	12.9
T <sub>2</sub>	36.5	11.8	58.4	9.8	37.1	12.8	52.4	10.8
T <sub>3</sub>	35.7	11.8	46.5	11.6	36.6	12.2	45.5	12.4
T <sub>4</sub>	50.4	16.9	64.8	8.9	50.0	16.3	57.5	9.8
T <sub>5</sub>	46.2	12.6	44.5	11.8	47.3	12.6	42.5	12.8
T <sub>6</sub>	31.4	8.7	37.6	12.7	33.4	9.1	31.6	13.9
CD at 5%	9.48	2.97	4.83	1.19	8.86	2.31	5.34	1.32

of YSPUHF at Sharbo on 'Oregon Spur', and 'Royal Delicious' at Telangi of Kinnaur district. Trial procedure included conjoint tree fertilization of foliar nutritive fluids of N: P: K-water soluble fertilizers (WSF, 0.5% solution as foliar spray) viz., 19:19:19, 13:00:45 and 00:00:50 supplemented at different growth stages. Different factor levels included the schedule in RCBD factorial matrix shown in Table below.

Foliar fertilization with 62.5% of RDF (NPK)+ foliar WSF significantly affected phenological and pomological traits as well as leaf nutrients concentration. According to DOP and ÓDOP indexes, the excessive leaf N, P, K and Mg concentrations was noticed. DOP indexing showed that foliar supplementation with the investigated preparation resulted in an increase in N, P, K and Mg concentration in the leaves. 'Oregon Spur' apples exhibited better balanced nutritional values as compared to 'Royal Delicious', confirmed the better adaptation of 'Spur' apples to acidic soils associated with tree vigourness than 'Delicious' apples.

## Recommendation

Foliar application of water soluble NPK fertilizers in full bearing apple trees at fifteen days interval should be given. Spray the trees with water soluble NPK fertilizers (19:19:19, 13:0:45, 0:0:50) at 0.25% concentration (500 g in 200 liter of water) at growth stages namely, (i) vegetative (half inch green leaf stage), (ii) flowering (pink bud) (iii) fruit set to fruit development along with 62.5% of RDF of traditional soil fertilization. Using of specialty foliar fertilization has saved 37.5% of traditional soil NPK fertilizers with improved fruit yield (18.7%) and quality.

## Advantages of specialty foliar fertilizers

- Sprays of water soluble fertilizers increase growth, and improve flowering and fruiting.
- 100% water soluble fertilizers containing all the three major plant nutrients (nitrogen, phosphorus and potash) can be used for other fruits crops.

- Water soluble fertilizers are fully water soluble, virtually free of chloride, sodium, and efficiently absorbed by plants.
- Water soluble fertilizers easily control the precise amount of nutrients available to plants.
- It arrests and prevents deterioration of soil texture, complexation, and mechanical damage of the crops.
- Due to foliar fertilization, there is always high nutrient absorption rate in the plants.
- Such sprays promote photosynthesis and ameliorate crop stress.



A full bearing 'Oregon Spur' apple tree

## PROMISING TECHNOLOGIES

Yield potential of standard and spur apples at different tree fertilization

Fertilizer treatment (T)	Oregon Spur			Royal Delicious		
	Yield (kg tree <sup>-1</sup> )	CY (kg tree <sup>-1</sup> )	ABI	Yield (kg tree <sup>-1</sup> )	CY (kg tree <sup>-1</sup> )	ABI
T <sub>1</sub>	47.0	188.1	0.025	45.5	136.5	0.036
T <sub>2</sub>	44.6	178.4	0.011	43.4	130.2	0.068
T <sub>3</sub>	48.2	192.6	0.031	47.3	141.8	0.084
T <sub>4</sub>	63.5	253.9	0.010	62.3	186.8	0.035
T <sub>5</sub>	53.6	214.4	0.015	52.7	158.2	0.062
T <sub>6</sub>	33.6	134.4	0.038	31.7	95.2	0.024
CD at 5%	11.6	48.9	0.01	11.8	37.6	0.30

CY, cumulative yield; ABI, alternate bearing index

- Foliar sprays of nutrients increase production and improve quality of fruits.
- It is very easy and cost-effective way for supplementing nutrients to apple trees.

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## Management of soybean insects through microbial insecticides

Research was conducted at ICAR-Indian Institute of Soybean Research (IISR), Indore for management of soybean insects through microbial insecticide. Microbial insecticides viz *Beauveria bassiana* @ 4 ml/ha (against *S. litura*), *Metarhizium anisopliae* @ 4g/l (against *Spilarctia obliqua* and *Hedylepta indicata*) and *Nomuraea rileyi* @ 4g/l (against semiloopers) were found to be successful and



Lepidopteran larvae infected with entomopathogenic fungus *Nomuriya rileyi*



Lepidopteran larvae infected with entomopathogenic fungus *Beauveria bassiana*

effectively controlled the insect populations. In addition, naturally occurring bio-control agents were also tested and proved to be highly potential in suppressing the populations of harmful insects. Entomo-pathogens viz. *Beauveria bassiana*, *Nomuraea rileyi* and *Bacillus thuringiensis* could inflict larval mortality to the extent of 41 %, 30 % and 58 % respectively. Further, advanced soybean line NRC 132 was identified to have moderate to strong Antixenosis against *Spodoptera litura*. Likewise on the basis of various digestive indices

(Approximate Digestibility), Efficiency of Conversion Index and Efficiency of conversion of Digested food), genotypes NRC 128, DSb 34, KDS 992 and MACS 1493 exhibited antibiosis resistance against *Spodoptera litura*. These results indicates high potentiality of naturally occurring bio-control agents and microbes for controlling various insects of soybean. The newly identified soybean lines will also be useful in the reduction of losses due to *Spodoptera litura*.

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## CAZRI Vishal: a new pomegranate variety

Pomegranate is an important commercial fruit crop of the dry regions of world. India, Iran, China, USA and Turkey are the five major producers of pomegranate in the world. Globally India is the largest producer of pomegranate both in area (2.46 lakh ha) and production (28.65 lakh MT). Versatile adaptability, higher economic return in shorter time and export demand are driving forces of area expansion under pomegranate cultivation in other semi-arid and arid regions of India. As area under

The pomegranate variety, CAZRI Vishal has been released by CAZRI, Jodhpur in 2020. It is a F1 hybrid between Ganesh and Khog. It is an early maturing (120-130 days after anthesis) variety. Plants are medium headed with medium foliage density, leaves are large and elliptical lanceolate in shape, leaf apex-acute. Fruits are large, attractive in shape and have yellowish red coloured rind. The seeds are soft with pink arils. Aril (60%) and juice content (40-45%) is significantly higher than other popular varieties. The TSS is about



Mean fruit yield of CAZRI Vishal at Jodhpur

Fruit yield Kg/tree	
Year	CAZRI selection
2015	18.6
2016	20.0
2017	20.5
2018	22.8
Mean	20.475

pomegranate cultivation is increasing at faster rate but the whole pomegranate cultivation scenario is single variety dependent which is certainly risky in long term. Therefore new variety should be evolved using available genetic diversity within species to increase option of suitable variety of pomegranate. Hybridization work at ICAR-Central Arid Zone Research Institute (CAZRI), Jodhpur was attempted in 1998 with different parents with objectives of earliness, bigger fruit size, Reddish-Yellow rind colour and seed softness. Wide variations were observed with respect to fruit yield and other physico-chemical traits.

Physico-chemical characters of CAZRI Vishal

Characters	CAZRI Vishal (Mean & Range)
Fruit weight (g)	356.8 (280-550)
Fruit length (cm)	8.3 (7.9-9.1)
Fruit breadth (cm)	8.5 (8.1- 9.5)
Aril weight /fruit (g)	216.7 (185.5-340.6)
Aril length (mm)	9.88 (8.4-12.2)
Aril breadth (mm)	7.11 (6.5-8.5)
Rind weight/fruity (g)	135.0 (120.5-205.0)
Rind thickness (mm)	3.25 (2.8-4.2)
Rind colour value	
L*	76.52 (66.0-92.3)
a*	28.85 (17.5-35.5)
b*	19.22 (14.5-23.5)
Seed length (mm)	6.1 (5.3-7.5)
Seed breadth (mm)	3.2 (2.4-4.2)
Juice content (%)	44.5 (45.0 - 52.5)
TSS (°B)	17.5 (17.0-18.6)
Acidity (%)	0.52 (0.48-0.56)

## PROMISING TECHNOLOGIES



17.5-18.6 °B with low acidic juice (0.48-0.52%). Plants start flowering and fruiting in second year of planting while economical yield starts in fourth years onwards. The fruit yield is about 20-25 kg/plant after five years of planting and onward under improved management practices. Fruit yield of CAZRI Vishal is at par with popular variety like Bhagwa, Jalore Seedless but due to bigger and uniform fruit size of CAZRI Vishal, yield is mainly contributed by “A” grade fruit.

The fruit maturity of CAZRI Vishal is earlier by 15-20

days than the Bhagawa with bigger fruit size advantage of more than 50%. Aril recovery is much higher (60%) than Bhagwa (45%). It is also superior in juice content, seed softness. Description of fruit physico-chemical characters of both cultivars are given in the table.

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## Pusa-Farm SunFridge – for storage of perishables

Pusa-Farm SunFridge (Pusa-FSF) – a grid less, batteryless stand-alone green-energy (*solar-refrigerated*) cold structure has been designed and developed by the Division of Agricultural Engineering, IARI. Such a structure is running successfully in a cluster of villages at Picholiya, Ajmer, Rajasthan, since March 2020. This innovative *green\_cold store* (2000 kg produce capacity) is the result of research work by scientists from ICAR-IARI, India and Dr Randolph Beaudry and Dr Norbert Mueller from MSU, USA under a grant funding by National Academies of Sciences, Engineering and Medicine, USAID. At Picholiya, the Pusa-FSF is being used by farming community for storing fruits and vegetables like tomatoes, cauliflower, coriander, potatoes, flowers; processed



The newly operational gridless, batteryless solar Pusa-FSF at village Picholiya, Ajmer, Rajasthan





Tomatoes and eggs being stored in Pusa-FSF, Picholiya

produce like tomato puree and animal products like eggs.

The postharvest losses of fruits and vegetables in India are 25-30% due to lack of sufficient cold storages and cold supply chain. Cold storages involve a large initial capital investment, and require uninterrupted electrical grid supply, which is not readily available in many farm communities. It is estimated that only 10-11% of fruits and vegetables produced in India are kept in cold storages and the storage capacity needs to be increased by 40% to avoid wastage. Structures, like Pusa-FSF have the potential to benefit 90 million smallholder farmers in India, as these structures can be self-built by farmers from locally available materials and do not need electrical supply for cooling.

The innovative design features in Pusa-FSF are a split evaporator coil in the inverter-solar refrigerator unit, *water battery* for night time cooling and a *sense-and-control* system which can match the demand of the refrigeration system with the available sunlight successfully. The structure of size 3x3x3 m uses 14 solar panels @ 350 W each, in series-parallel circuit, to power 1.5 tons refrigeration capacity and does not need grid for cooling. It has low cost styrofoam panels insulation with mesh and wetted-fabric walls, and keeps the structure cold through combined effects of

evaporative cooling and solar refrigeration. Pusa-FSF could achieve daytime temperatures as low as ~5-10 °C and nighttime temperatures below 14 °C, when the daily ambient maximum temperature reaches approximately 45 °C. The HOBO remote station at

Pusa-FSF at Picholiya collects the data, which could be viewed publicly on our Public Dashboard 2020.

Tilok Devasi, a farmer from Picholiya, who heard of the installation of Pusa-FSF at Picholiya, came with some flowers (*his harvest*) to see how well they might store in it. It was only a few flowers in this trial run, but it marked a new beginning for this cold store. In this covid situation, the farmers have already stored around 8000 eggs in March 2020 and 800 kg tomatoes and 5000 eggs in April 2020. This facility offers smallholder farmers inexpensive access to cold storage even without electrical connection and improves their control over the marketing of their crops to fetch



Tilok Devasi, farmer from Picholiya with his flowers – first commodity stored in newly-operational Farm SunFridge at Picholiya, Ajmer

better prices.

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## NEW INITIATIVES

### ICAR-CIAE develops touch-free sanitizer unit

Scientists of ICAR-CIAE Regional centre, Coimbatore have developed a touch-free hand wash system and portable touch-free hand sanitizer unit. It will disinfect hands of one person at a time.

#### Touch-free hand wash system

The developed touch-free hand wash system consists of water tank, photo diffuser sensor, 12VDC water pump, DC speed regulator, 12VDC battery, relay board, touch-free sanitizer dispensing unit and water disposing plastic hose.

When the hand reaches near the sensor it produces output pulse relay, which triggers (act as a switch) the



ICAE touch free hand wash system for Covid 19 control

#### Technical Specifications of the developed unit

Sl. No.	Component	Specification
1.	Water tank	100 litre
2.	Liquid soap tank	1 litre
3.	Photo diffuser sensor for liquid soap and water	12 VDC 3 wire type Range: upto 125 mm
4.	Relay board for liquid soap and water with control box	12 VDC to withstand upto 9 amp
5.	Battery	12VDC 9 AH
6.	DC Water pump	12VDC 1 AH
7.	DC Speed regulator	Potentiometer to PWM Module type DC 3V-35V; Power – 90 W
8.	Input & Output hose for hand wash	Plastic 6 mm hose
9.	Input & Output hose of water pump	Plastic 15 mm hose



ICAE touch free hand wash system for Covid 19 control

pump to turned it on. Pump in turn ensures the flow of liquid soap/water from tank to liquid soap / water outlet. A single relay triggers up to 5 ml of hand wash from touch-free dispenser unit and 100 ml of water from water tank. The discharge rate of liquid soap and water could be regulated based on necessity by using DC regulator switch. The system can be powered by AC current and provision is also given to use in DC battery for portable use. Single full charge of the battery will make system to

#### Technical Specifications of the developed unit

Sl. No.	Component	Specification
1.	Sanitizer tank	1.5 litre
2.	Photo diffuser sensor	12 VDC 3 Wire type Range: upto 125 mm
3.	Relay board	12 VDC to withstand upto 9 amp
4.	AC pump DC pump (If DC pump available)	220-230 V 12 VDC
5.	Input & Output hose	Plastic 6 mm hose





work up to one day. The provision is also given for charging the battery and operate by solar panel. Cost of the system is about ₹10000/- only.

#### Portable touch-free hand sanitizer unit

The touch-free soap hand sanitizer is a stand alone wall mounted or placed on the table to dispense the sanitizer without touching the unit. In this unit, a Photo diffuser sensor is located near the outlet in order to detect the user hands. As soon as the hand is detected, relay (act as switch) trigger the AC/DC pump to operate and up to 5 ml of sanitizer will be dispense at delivery end. The provision is given to use 12VDC water pump with 12VDC battery. Cost of the portable touch-free hand sanitizer is about ₹1000/- only.

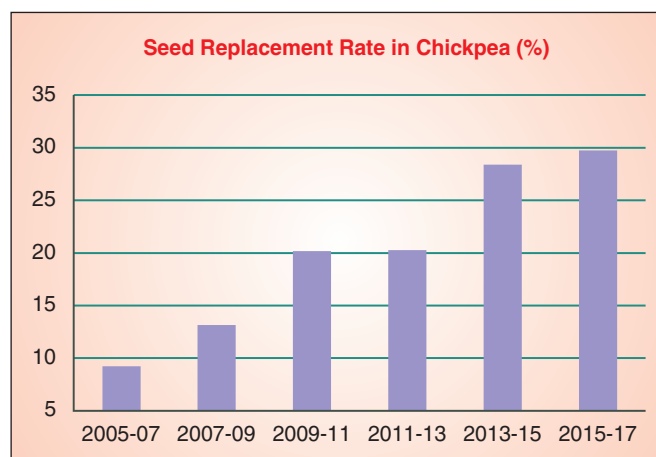
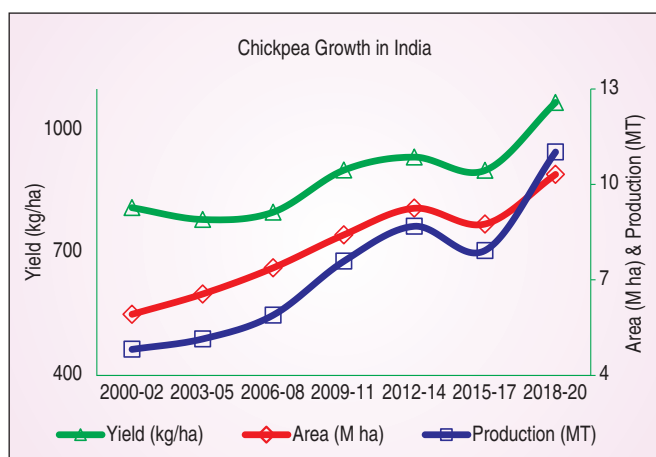
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## AICRP on chickpea brings self-sufficiency

The All India Coordinated Research Project on Chickpea has been continuously striving to achieve self-sufficiency in chickpea in India. During the last 25 years, about 136 chickpea varieties have been developed with higher yield potential, reduced crop duration (90-110 days; e.g. JG 16, JAKI 9218, JG 14 etc.), large seeded *kabuli* with seed weight more than 50g per 100 seeds (Kripa, PKV 4-1, MNK 1), suitable to late sown conditions and niches like rice fallow (BGM 547, JG 14, RVG 202), tolerance to diseases

like *Fusarium* wilt (GNG 1581, CSJ 515, Digvijay), *Ascochyta* blight (PBG 7, GJG 0809), tolerance to abiotic stresses like drought tolerant varieties for rainfed conditions (RSG 888, Vijay), mild salinity (Karnal Chana 1), adaptable to increased moisture and soil fertility condition (DCP 92-3), amenable to machine harvesting (NBeG 47, BG 3062, Phule Vikram) etc. This was accompanied with matching production and protection technologies like resource conservation



## NEW INITIATIVES

technologies involving efficient cropping systems, minimum tillage, residue retention, efficient weed control and small scale farm mechanization; seed treatment/ inoculation with biopesticide/ biorationals/ agrochemicals; improved agronomy against *in-situ* constraints (water logging, climate extremities and probable crop loss) for efficient input use; need based supplementary irrigation involving micro-irrigation, precision agro-technologies (laser leveling, site specific applications) and integrated plant protection modules like, IPM modules for wilt/root rot *etc.* Availability of abundant chickpea genomic resources have led to utilization of genomics-assisted breeding tools for chickpea improvement especially for biotic and abiotic stress resistance (Super Annigeri-1 with *Fusarium* wilt resistance and Pusa 10216 with drought tolerance) and enhancing genetic diversity through Multi-parent advanced generation intercrossing (MAGIC) lines.

To ensure quality seed availability in the country, 37557.89q of chickpea breeder seed based on DAC indent, 6662.99q of additional breeder seed under Enhanced Breeder Seed Production programme, and 98912.1q of quality seed (foundation and certified seed) under Seed Hub project has been produced during 2016-19. This has led to increase in seed replacement rate in chickpea from less than 10% in 2005 to nearly 30% in 2017. Besides, the share of new varieties (<10 years old) have increased to 81.66% during 2019-20. Realizing the yield gaps due to poor seed replacement rate and

inadequate dissemination of pulses cultivation technologies, several programmes *viz.*, National Food Security Mission (NFSM) – Pulses, Accelerated Pulses Production Programme (A3P), Rashtriya Krishi Vikas Yojna (RKVY), 60,000 Pulses Villages, more than 14000 cluster demonstrations on chickpea *etc.* were launched during the XI five year Plan period to boost pulses production in the country. In order to give the much-needed fillip to pulse production, the government has included pulses in the National Food Security Mission (along with wheat and rice). Over the past five years, the MSP in chickpea has been increased by over 45% from ₹ 3175 /quintals to ₹ 4620/quintals. This has created a buffer stock of chickpea in the country which enabled the GOI to include 1 kg of pulses including chickpea along with rice and wheat for distribution to public during COVID 19.

There is ample scope for further increasing area, production and productivity of chickpea in India by way of adopting suitable research, development and related policies. The research needs include insulation of varieties against major biotic and abiotic stresses, precision phenotyping, speed breeding, genomics enabled improvement, germplasm enhancement, pre-breeding for breaking yield barriers, nutrient use efficiency, digitalization of breeding records for better efficiency *etc.*

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## ICAR Centre, Jorhat, Assam contributes against COVID19

To accelerate fight against the deadly COVID19, ICAR-NBSS&LUP, Regional Centre, Jorhat, Assam led by Dr GK Sharma, Scientist along with Shri Pradeep Kotoki, Technical Assistant operationalised a training programme for preparation of hand sanitizer in Majuli district, Assam. It may be mentioned that ICAR Centre at Jorhat has experimented and standardised the method of preparation of hand sanitizer as per WHO standards in the wake of COVID 19. On request of

the civil administration of Majuli district to help them to prepare hand sanitizer which was in acute shortage in the district, Dr Sharma provided training and first



hand information to employees of Swachhagrahis under Public Health Engineering Department (PHED) Majuli, Assam. Shri Bikram Kairi, IAS and Deputy Commissioner of Majuli district, Assam, Shri Naranarayan Nath, Chief Executive Officer, Zilla Parishad, Majuli, Shri Palash Rajkumar Ahom, Additional Deputy



Commissioner, Majuli and some PHED workers were present during the training programme. Shri Ahom, ACS, Majuli arranged necessary chemicals, and a modest laboratory for the preparation of hand sanitizer. Dr Sharma showed the methodology to prepare one litre of hand sanitizer. Later the PHED workers were given hands on training and in total 50 litres of hand sanitizer was prepared collectively for distribution among local residents of Majuli. The DC

applauded help of ICAR Centre at Jorhat for coming forward to help the administration during this hour of crisis.

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## ICAR-IVRI helps in COVID-19 testing

Three Animal Science Institutes (*viz.*, ICAR-NIHSAD, Bhopal; ICAR-NRCE, Hisar and CADRAD, ICAR-IVRI, Izatnagar) were approved by Dr Trilochan Mohapatra Secretary (DARE) and DG (ICAR), Ministry of Agriculture and Farmers' Welfare, Government of India for testing of COVID-19 human samples in respective states. Further, the Ministry of Forest, Environment, and Climate Change, Government of India also approved these three Animal Science Institutes of ICAR for testing of Coronavirus-suspected samples originating from animals. Laboratory at Izatnagar started testing COVID-19 samples from human *w.e.f.* 16-4-2020. A team of 12 scientists is involved in COVID-19 testing in the BSL-3 and BSL-2 Laboratories at CADRAD. Dr VK Gupta, Joint Director, Centre for Animal Disease Research and Diagnosis (CADRAD) is the Nodal Officer for COVID-19 testing of Human Samples at ICAR-IVRI. Dr AM Pawde, Incharge, Centre of Wildlife Conservation, Management and Disease



### Attention authors and contributors of ICAR News

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- **No PDF files** of photographs and **No internet pictures** please.
- The text with photographs and captions may also be provided in the **MS Word** for reference purpose.

– Editor

Surveillance at ICAR-IVRI is the Nodal Officer for COVID-19 animal sample testing at ICAR-IVRI. The overall activities of the COVID-19 testing in human and animal samples at ICAR-IVRI are being steered by Dr Raj Kumar Singh, Director/Vice Chancellor, ICAR-IVRI, Izatnagar.

**Dr RK Singh**

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### Indian Pompano, new candidate for Indian Mariculture

#### ICAR-CMFRI standardises farming technology of the species for marine cages

In a major achievement that would help transform lives of fishermen across coastal region of the country, ICAR-Central Marine Fisheries Research Institute (CMFRI) has successfully standardised the farming protocol of Indian Pompano, a new candidate species for Indian mariculture. Indian pompano (*Trachiotus mookalee*) is a pelagic fish species belonging to the family of Carangidae. This fish has immense potential for mariculture as it has fast growth rate, easy adaptability to farming environment, acceptability to formulated feed, firm white as well as tasty meat and high market demand. It is a newly bred marine finfish, adding to list of available candidate fishes for mariculture. Breeding technology for the species was developed by Vishakhapatnam Regional Centre of ICAR-CMFRI during 2017. Since then seeds of the species have been constantly produced with good survival rate and experimental farming has been carried out in marine cages. Now, the Institute has successfully standardised the viable farming technology of this species for marine cages.

Sea cage farming is an aquaculture production system where juveniles of commercially important aquatic finfishes and shellfishes are stocked in cages, fed and grown to marketable sizes. Marine fish farming in cages is a lucrative business for poor coastal communities providing an important source of income. Fingerlings of Indian pompano (0.5-1.0 g) produced at Mariculture Hatchery of CMFRI, Vishakhapatnam centre stocked in hapa @ 300 nos./m<sup>3</sup> for nursery rearing. Nursery rearing was carried out for a duration of 2 months during which

fishes grew from 0.5 – 1.0 g to 30-35 g with survival rate of >90%. While in nursery, the fish fingerlings were fed at 10-8% of the body weight with a feeding frequency of

four times in a day. In the nursery, high protein pellet feed (45% Crude Protein and 10% Crude Fat) of different sizes (1.2, 1.8 and 2.0 mm) were used according to growth. After 2 months of nursery rearing, the fishes were transferred to cage culture system for farming.



Circular High Density Polyethylene (HDPE) cage of 6 m diameter having net depth of 4 m was installed using single point revolving mooring system and was stocked with Indian pompano fingerlings (10 g) in May 2019. The fingerlings were produced in Mariculture Hatchery of Vishakhapatnam Regional Centre of ICAR-CMFRI. The stocking density was 25 numbers / m<sup>3</sup>. The fishes were fed with artificial pellet containing 40% protein and 10% fat twice a day. Feeding was done 5-8% of biomass initially which was later reduced to 2-3%. Partial harvest of one cage was performed on 28<sup>th</sup> January, 2020 after approximately eight months of culture. Survival rate was >95%. FCR calculated was 1:1.75.

Around one-fourth of the cage biomass amounting to 488.5 kg was harvested and handed over to

Mr Anil Kumar, the beneficiary. Subsequently, each week, the remaining biomass was harvested. In total, 1.9 tonne of Indian pompano was harvested from a single cage. The harvest was carried out in presence of Shri Mopidevi Venkaramana Rao, Minister for Animal Husbandry, Fisheries and Marketing, Govt. of Andhra Pradesh; Shri Simhadri Ramesh Babu MLA, Avanigadda; Shri G Rathinraj, Executive Director (Tech.), NFDB, Shri Dronamraju Srinivasa Rao, Chairman, VMRDA; Joint



Director, Department of Fisheries, Govt. of Andhra Pradesh and other officials of state and centre. The harvested fish was sold to an entrepreneur at ₹320/kg. This successful cage harvest of Indian pompano is expected to trigger large scale development of cage mariculture in the country.

A net profit of ₹one lakh/tonne of fish will be realised by undertaking pompano farming in cages. This economic performance will attract fish farmers to adopt this

farming practice ushering in a blue revolution in the country.

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## Spice farming systems in Paderu Tribal Agency Area

Vishakhapatnam is identified by NITI-AYOG as Aspirational District in Andhra Pradesh. The district has about 14.5% of the total tribal population in the state. Out of three divisions, Vishakhapatnam, Narasipatnam and Paderu, a major proportion of tribal communities (89.98%) are dwelling in Paderu Tribal Agency area. Out of eight tribal groups identified as Primitive Tribal Groups, (PTGs) which require special treatment, three communities are living only in the Paderu agency area. Black pepper and turmeric are the two spices cultivated in Vishakhapatnam. Turmeric is the subsistence cash crop cultivated by tribal farmers. Black pepper was introduced in 1970's as an intercrop in traditional coffee plantation in the hill zones. The net income of tribal farmers from agriculture is as low as ₹10,000/-. The farmers follow traditional and conservative agricultural practices bound by age old customs. ICAR-Indian Institute of Spices Research (IISR) has implemented a multi institutional project leveraging



several technologies for immediate benefit to tribal community at Paderu. Work plan for the project followed a value chain, multi institutional and multi disciplinary approach.

- Comparative Varietal Yield Trials and Research Station trials of technologies.
- Participatory Rural Appraisal for gathering bench mark information
- Establishing demonstration plots of Good Agriculture Practices
- Skill enhancement training to promote adoption of standardized Good Agriculture Practices (GAP) in spices cultivation
- Establishing state of the art spice primary processing units that are commercially viable for small groups or existing FPOs.
- Quality testing and chemo profiling of spice produce and value added products for branding and commercialization.



Farmers get training at Paderu



Demonstration of improved turmeric boiler TNAU model

## NATURAL RESOURCE MANAGEMENT

The major impact was recorded due to two interventions namely – improved varieties of turmeric (Roma and IISR-Pragathi) and mechanization of primary processing in turmeric. A survey conducted during two seasons indicated that average yield for local cultivars were 3 MT of dry turmeric and 8 MT for Roma variety. The dry recovery of Roma was also higher (22-24 %) compared to local cultivars (15-16% dry). The improved variety Roma spread over an area of 1,300 ha replacing the traditional cultivars and the net returns increased almost threefold – ₹4,20,000/- for improved varieties and ₹1,65,000/- for local cultivars.

The introduction of simple operated farm machinery for turmeric boiling and polishing helped to improve standards of on farm primary processing operations. The establishment of four pilot units for turmeric processing gained wide acceptance among target tribal communities. The polished turmeric sold in local markets fetched a higher price of ₹3-5 /kg.

An area of 1,483 ha. of turmeric involving 1,050 farmers organized under two FPO's was brought under organic cultivation adopting the technologies developed by ICAR-IISR.

The programme on black pepper was initiated by establishment of a master black pepper nursery at the farm owned by ITDA in Chintapalle with six thousand cuttings of eight improved varieties of black pepper developed by ICAR-IISR. A total of 1,45,000 cuttings were distributed to tribal farmers in Arakku valley during two seasons.



Hands on training on pulverising at ICAR-IISR, kozhikode



Hands on training on Packaging at ICAR-IISR

The significant innovative outcomes of the project can be summarized as introduction of improved varieties in turmeric – Roma and IISR-Pragathi, replacement of age old traditional practice of 2-3 seasons turmeric cultivation in the same land with one season cultivation and adoption of farm machinery for primary processing in turmeric. The area expansion in black pepper in traditional coffee



Value added turmeric powder

based agro forestry system not only enhanced the income of farmers but also broadened the scope of carbon sequestration for ecological sustainability. Based on findings of the project, the Integrated Tribal Development Agency (ITDA), Paderu has envisaged futuristic schemes for large scale supply of seeds/planting material of turmeric and black pepper.

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## Virat (IPM 205-7) – a promising mungbean cultivar



Mungbean 'Virat' under CA in rice-wheat-mungbean system

Intensive tillage and crop residues removal in continuous rice-wheat cropping system has emerged as an unsustainable practice. Conservation agriculture (CA) and cropping system intensification (and diversification) with spring/summer mungbean are advocated for higher crop productivity, profitability and soil sustainability. Therefore, screening/evaluation and identification of appropriate spring/summer mungbean cultivar is imperative to fit in the window between wheat harvest and rice sowing in IGP for sustainable cereal-cereal cropping intensification/diversification. Hence, five cultivars of mungbean such as 'Samrat', 'Virat' (IPM 205-7), 'HUM 16', 'IPM 02-3' and 'IPM 2-14' were evaluated considering the variation in maturity, crop and system productivity, and profitability in rice-wheat cropping system under conservation agriculture for continuously five years.

Among the cultivars evaluated, Virat resulted in higher mungbean grain yield (1345 kg/ha) with a maturity period of 52-55 days. Also, this cultivar resulted in significantly higher (cropping) system productivity

(4191 kg/ha) in terms of mungbean equivalent yield. The sequence of yield of different mungbean cultivar followed the decreasing order (mean of five years) as under:

**Virat (IPM 205-7) > Samrat > HUM 16 > IPM 02-3 > IPM 2-14**

In addition, conservation agriculture (zero tilled direct seeded rice along with crop residue retention) increased the rice (19%), wheat (5%) and cropping system yield (10%) compared to residue removal. 'Virat' has emerged as the promising cultivar of spring/summer mungbean and is recommended for sustainable intensification of rice-wheat cropping system under conservation agriculture in whole of India.

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## PROFILE

### ICAR-Indian Institute of Sugarcane Research (IISR), Lucknow



#### Brief history and inception

To strengthen sugarcane research and coordination at pan-India level, a Central Commodity Committee named “The Indian Central Sugarcane Committee” was constituted in November, 1944 as a Society with the Headquarter in New Delhi. The Indian Central Sugarcane Committee established **The Indian Institute of Sugarcane Research (IISR), Lucknow** on 16<sup>th</sup> February, 1952 for conducting researches on both fundamental and applied aspects of sugarcane culture as well as to co-ordinate the work done on this crop in different states of India. Later on, the administrative control of Indian Central Sugarcane Committee was abridged with effect from 1<sup>st</sup> January, 1954 to the Government of India, Ministry of Food and Agriculture. Finally, on April 01, 1969 IISR, Lucknow was transferred to The Indian Council of Agricultural Research (ICAR), New Delhi.

#### MISSION

Enhancement of sugarcane production, productivity, profitability and sustainability to meet future sugar and energy requirement of India

#### MANDATE

- Basic, strategic and adaptive research on production

and protection in sugarcane and breeding for subtropical region of the country.

- Coordination and monitoring of applied research on national and regional issues to develop improved varieties and technologies.
- Dissemination of technologies and capacity building.

#### ORGANIZATION STRUCTURE

At present the institute is organized into five divisions viz., Crop Improvement, Crop Production, Crop Protection, Plant Physiology & Biochemistry, and Agricultural Engineering. Besides these divisions, the Institute has independent units like Extension-Training, PME, AKMU etc. and central facilities for analysis like soil, water and plant samples; juice quality analysis; and agro-meteorology laboratory (having A class meteorological observatory). The well-equipped Jaggery Unit conducts researches for improving technology for juice, jaggery and other value added products. Presently, the Institute is an ISO 9001:2015 accredited agency and has one regional and two specific purposes outposts for nationwide coverage of its activities. The regional center of the institute is located in Motipur, Muzaffarpur (Bihar). The institute has a Biological Control Centre at Pravaranagar (Maharashtra) and sugar beet breeding outpost at Mukteshwar (Uttarakhand). The scientific



strength of the institute is 74, including the Director. They are supported by 134 technical, 49 administrative category and 72 skilled support staff. ICAR-IISR has responsibility of regulating pension of its employees and employees of seven ICAR institutes of eastern UP. ICAR-IISR also got the responsibility to run a KVK for the district of Lucknow (from 25<sup>th</sup> October, 1999). It has helped in transformation of villages of Lucknow and received the best KVK award from Prime Minister in 2018. Recently, one KVK for Lakhimpur Kheri district has been given to ICAR-IISR, Lucknow.

**Accreditation of tissue culture lab:** ICAR-IISR has been accredited by NCS-TCP Management Cell of DBT established at Biotech Consortium India Limited, New Delhi for virus indexing and genetic fidelity testing of tissue culture related plants.

**Online examination centre of ASRB, New Delhi:** IISR has the responsibility to act as the centre for conducting examination by ASRB, New Delhi. Now IISR has dedicated online facility for conducting such competitive examinations conducted by ASRB.

**NARAKAAS:** Institute is the Head Office of *Nagar Rajbhasha Karyanvayan Samiti (Karyalaya-3)*, Lucknow. It regularly monitors six monthly progress related to Rajbhasha of 73 Central Govt. Offices located in Lucknow.

## ACHIEVEMENTS

Since its inception in 1952, ICAR-IISR has made an indelible impression in the overall agriculture scenario of the country and has helped in transforming sugarcane agriculture. Sugarcane farming in India has now become the livelihood of around 7.5 millions of farmers, around 1.2 million skilled and semi-skilled workers and around 4 millions of farm labourers. Sincere efforts of scientists of the Institute have resulted in development of many technologies which are well adopted by farmers.

### Varietal contribution

IISR enriched the National Hybridization Garden (NHG) facility located at SBI, Coimbatore with sugarcane parental stock to breed sugarcane suitable for subtropical agro-climate. The cultivation of cane variety CoLk 8102 developed in the past benefitted sugarcane farmers of Uttar Pradesh by ₹ 500 crore in ten years during eighties and nineties.



At present CoLk 94184 alone is being cultivated in more than 2.65 lakh hectares, resulting in economic benefit of ₹303 crore per year. Four sugarcane varieties developed by IISR viz., CoLk 11203, CoLk 11206, CoLk 12207 and CoLk 12209 have been released by CVRC recently.

### Spaced planting technique

The spaced planting technique (STP) developed at IISR has helped in faster multiplication of seed cane of newly released sugarcane varieties.



### Three-tier seed production programme and MHAT

Work on varietal decline and promulgation of the Three-tier seed production programme for production and distribution of healthy seed cane involving MHAT saved the nation from impending sugar crisis, and this effort culminated into bestowing of the prestigious Shanti Swarup Bhatnagar Award.



### Bio-control of insect pests and diseases

IISR developed the first bio-control of top borer in early 1960s by introduction and redeployment of *Isotima javensis* in Tamil Nadu. IISR advocated in favour of biological control of *Pyrilla* through the use of *Epiricania*





Cotesia



Isotima



Rhaconotus

*melanoleuca* during early 1980's which is now a classical example of successful biological control in sugarcane.

## Integrated insect pests and disease management modules

In a holistic manner, location specific integrated management (IPM) schedules for different insect pests and diseases of sugarcane and sugar beet have been developed. Integrated management module of insect pests and disease with the motto of "*healthy seed in a healthy field*" backed with IPM, developed by IISR, gives better cane productivity and profitability. This has helped in attaining self sufficiency in sugar, *gur* and *khandsari*.

The credit for establishing mycoplasmal etiology of grassy shoot disease (GSD) and its transmission through leaf hopper vector also goes to IISR. Nematode problem of sugarcane was also critically investigated at IISR and for the first time several new species of nematodes were also identified.



## Need based agronomical practices

IISR has developed several planting techniques such as paired row planting, the ring pit planting, trench method of planting, RBS method of planting for intercropping. Management of weeds and intercultural operations have been standardized with application of pre and post emergence herbicides, manual as well as tractor operated hoeing, trash mulching, etc. Residue recycling and nutrient management, as well as irrigation water management were key areas where IISR had made an all-round impact on sugarcane agriculture of the country.



## Intercropping

The technology package for intercropping in sugarcane with grain crops, pulses, vegetables, spices, sugar crops, etc has been developed to sustain the profitability and increase land, water and nutrient use efficiencies.



Cane + mustard



Cane + peas SK1 9395



Cane + potato companion cropping



Cane + wheat



## Soil health – key to crop productivity

IISR has always worked on soil nutrient management which has maintained the soil fertility status better than any other field cropping systems prevalent in the subtropical India. The recommendation of 150 kg nitrogen (N), 60 kg phosphorus ( $P_2O_5$ ) and 60 kg potassium ( $K_2O$ ) along with 10-15 tonnes of FYM per hectare is now the standard practice for sugarcane growing. IISR has developed technologies to use this huge bio-mass (12-15 t/ha) gainfully through trash mulching as a water conservation tool, residue decomposition for nutrient recycling and *in situ* incorporation of residues with the backing of appropriate machinery as well as residue enrichment with application of appropriate microorganisms.

## Addressing sugar recovery problems

ICAR-IISR has come up with chemical(s) which, when applied to the standing cane before harvesting, hastens the maturity. The problem of post harvest sucrose loss was also addressed with the spray application of a mixture of sodium metasilicate and bezalkonium chloride on harvested canes.

## Mechanization of sugarcane agriculture

The Institute has become the Centre of Excellence in Design and Development of machinery for mechanisation of sugarcane farming in India. The sugarcane planters have traversed a long way from bullock drawn to tractor operated; from semi-automatic to automatic; from simple planter to complete trench planting system. The engineers pioneered the development of ratoon management device and also the development of small implements or carrying out various intercultural operations.

## Gur – khandsari and value addition

IISR has also taken a major stride in improving the process of quality jaggery production through the gradual modification of furnaces and boiling pans for efficient



energy utilization. Shape and size of the solid jaggery and their appropriate packaging have also been standardized. Similarly, by increasing storability and further value addition, using spices and condiments and medicinal herbs ICAR-IISR has helped the product diversification and opened up new market possibilities to fetch better remuneration. This has provided necessary boost to the ailing cottage industry of *gur* and *khandsari* and also helped in the development of self help groups involving the rural youths and rural entrepreneurship. During last 2 years the Institute has extended its expertise to more than 30 FPOs, NGOs and Govt. agencies for establishing jaggery manufacturing units in Uttar Pradesh and Bihar.

## Sugarbeet

Breeding efforts in sugarbeet resulted in development of two popular sugarbeet varieties namely LS 6 and IISR Comp-1.



## AICRP (Sugarcane)

The Head Quarters of two All India Coordinated Projects on Sugarbeet (with effect from 1<sup>st</sup> April 1970) and Sugarcane (with effect from 16<sup>th</sup> July 1970) were added to the responsibility of IISR, Lucknow to Co-ordinate the sugarcane and sugarbeet researches



Deep furrower-cum-fertilizer applicator



Sugarcane trench planter with attachments for laying of sub-surface drip laterals



Ratoon Promotor



Sugarcane harvester for cutting of two rows of whole cane stalks and windrowing it linearly between tractor wheels

## PROFILE

conducted by different State and Central agencies including willing private partners. Today AICRP(Sugarcane) is operating through 22 regular centres and 14 voluntary centres in five sugarcane agro-climatic zones of the country [North West Zone, North Central Zone, North East Zone, East Coast Zone and Peninsular zone (I & II)]. Till date 120 sugarcane genotypes have been identified and out of these 63 sugarcane varieties have been released by the CVRC for general cultivation.

### REACHING OUT TO UNREACHED

#### Capacity building programme for cane managers of sugar industry

The Institute regularly conducts 10-15 days training on Sugarcane Management and Development for cane managers and development personnel of sugar industry during July every year. Accelerating large-scale adoption of sugarcane technologies in sugar mill zone areas is targeted by grooming and developing cane managers/officers of sugar mills into “torch-bearer” of IISR technologies.



#### Skill Development Residential Training

The institute regularly conducts residential skill development training of 3 to 7 days duration for different clientele groups on cane production



techniques, seed cane production, advances in sugarcane research and means to enhance income from sugarcane based production systems including jaggery making. Every year more than 20 such trainings are organized in which more than 500 farmers/students/agri-graduates participate to learn cane cultivation.

#### Doubling Farmers' Income in PPP Mode

ICAR-IISR signed a MoU on August 19, 2017 with DCM Shriram Limited (DSL), New Delhi to implement a collaborative project in Public Private Partnership mode in the command areas of 4 sugar mills. The basic objective of the project is to double income of all 4136 farm families cultivating crops on 2090 ha land by introducing technological, human resource and development interventions in 8 adopted villages in Lakhimpur and Hardoi districts of UP. Functional linkages with development departments, other research institutes, private partners like Namaste India, AMUL and NGOs was made for integrated development of the farmers. The positive impact of the project is quite apparent as income from sugarcane increased to about ₹1.35 lac/ha in 2018-19 from ₹0.70 lac/ha in 2016-17. The Institute has signed revised MoU with DSL, New Delhi in September 2019 to extend project in 20 villages.

### Doubling Farmers' Income: IISR Model



DSL (UP) → 2 districts → 4 sugar mills → 8 villages → 4136 farm families → 2090 ha cult. area



## Impact of EDP on production, productivity and profitability

Interventions	Enhancement in cane yield (t ha <sup>-1</sup> )	Increase in net income of farmer (₹ ha <sup>-1</sup> )	% increase in farmers' income (ha <sup>-1</sup> )	Adoption area in ha (tentative)	Additional income earned by farmers (Crores ₹)
Seed cane Production	40	153250	108.69	6000	91.95
Ratoon Promoter Machine	20	63000	55.26	5000	31.50
Intercropping in sugarcane	13-24 + intercrop yield	140000	107.28	4500	63.00
Total				15500	186.45

For fast spread of newly released cane varieties, large numbers of FLDs are being conducted every year in different districts of UP, Bihar, Madhya Pradesh and Maharashtra.

### Entrepreneurship development programme

The Institute is implementing entrepreneurship development programme for farmers on Seed cane production, intercropping, ratoon management and agri-business. As a result about 20000-25000 quintals of healthy seed cane of improved varieties of sugarcane is



being produced in farmers' fields every year and profitability of the farmers increased considerably. The intercropping of pulses and vegetables with autumn planted cane provided ample opportunity to farmers to earn considerably high profit as well as to ensure nutritional food to their family members. At the same time intercropping also helped in improving soil health through in-situ mulching of intercrops bio-mass after harvest and fixing of atmospheric nitrogen in the soil. The adoption of ratoon management practices by entrepreneur farmers led them to earn higher profit. Now more than 15500 ha area is under adoption of above three technology in operational districts (Sitapur, Lakhimpur and Hardoi) of Uttar Pradesh.

### CONSULTANCIES

The Institute offers consultancy and contractual services

on areas such as scientific cane development in sugar mill area, mechanization, ratoon management, varietal planning, micro irrigation, fertigation, sugarbeet production technology, healthy seed production technology, establishment of tissue culture laboratory, establishment of biocontrol laboratory, jaggery production, post-harvest sugarcane management to check the reduction in sucrose content.

### Linkages

The institute has developed linkages with many national/international research institutes, SAUs, Sugar Mills and NGOs. The Institute has tried to explore areas of common interest in sugarcane research with Japan and Australia and visits have been undertaken towards this objective in Brazil, Australia, China, Sri Lanka etc. Efforts were also made to establish institutional linkages with International Bureau of Plant Genetic Resources and International Society of Sugarcane Technologists to participate in sugarcane genetic resources programme, and with different foreign universities and Governments dealing with sugarcane like, USA, Brazil, Cuba, China, Sri Lanka, Bangladesh, Vietnam and Australia.

At national level, the institute has developed linkages with National level research organizations such as ICAR-SBI, Coimbatore for effecting crossing programme. It has strengthened its linkages with CSIR-NBRI, Lucknow; CSIR-CDRI, Lucknow; CSIR-CIMAP Lucknow and NSI, Kanpur. The Institute has signed MoAs with seven private agencies for manufacturing of IISR machines and jaggery making through IISR technology.

### MAJOR EVENTS OF 2018-19

#### Krishi Kumbh 2018

A three day Grand *Krishi Kumbh* 2018 including International Conference and Exhibition was organized at the premises of ICAR-IISR, Lucknow on October 26-28, 2018 in collaboration with Department of Agriculture, Govt of UP and other UP state line departments which was inaugurated by Shri Narendra Modi Ji, Honorable

Prime Minister through video conferencing. In this event, improved production technology for food grains viz., paddy, wheat, maize, sorghum, pearl millet, pigeonpea, urdbean, mungbean, chickpea, lentil and oilseed crops apart from improved technology of animal husbandry, fisheries, dairy and poultry etc., was showcased through state-of-the-art agriculture exhibition. All the State Agricultural Universities located in the State, more than 30 ICAR Institutes, about 70 industries/manufacturers/private agencies have participated in this Mega Programme. More than 75000 farmers visited during three days of this mega event.

## Launching of Pradhan Mantri Kisan Samman Nidhi scheme

A Kisan Mela was inaugurated by Shri Ram Naik, Governor, Uttar Pradesh on the occasion of launching of "Pradhan Mantri Kisan Samman Nidhi" scheme on February 24, 2019. On this occasion, Shri JP Nadda, Health and Family Welfare Minister, Govt. of India and Shri Kaushal Kishore, Member of Parliament, Mohanlalganj Parliamentary Constituency were also present as Guests of Honour. During this event, "Man Ki Baat" telecast of Shri Narendra Modi, Prime Minister was also viewed by participants. On this occasion, ICAR-IISR, and KVK, Lucknow along with manufacturers of farm implements, insecticides, weedicides and seed producing agencies exhibited their products to farmers.

## International Conference Sugarcon-2019

An International Conference Sugarcon-2019 on Green Technologies for Sustainable Development of Sugar and Integrated Industries was organized by ICAR-IISR in collaboration with the Society for Sugar Research and Promotion, and International Association for Professionals in Sugar and Integrated Technologies from February 16-19, 2019. More than 200 Scientists, including 23 delegates from China, Sri Lanka, Thailand, Brazil, Vietnam and Belgium participated to discuss

the green technologies to be adopted in sugarcane production to produce more sugar, bio-ethanol and electricity in sugar processing complexes.

## Ikshu-Fest 2019

To popularize activities of the Institute and attract youth in agriculture and related enterprises, Ikshu-Fest-2019 was organized from February 16-19, 2019 at ICAR-IISR, Lucknow.



Ikshu-Fest 2019

## Awards conferred

Some important awards conferred to the Institute or its scientists during recent years include *Rajbhasha Kirti Puraskar* of *Rajbhasha Vibhag*, Ministry of Home Affairs, Govt. of India for the years 2013-14, 2014-15, 2015-16 and 2017-18; *Rajshri Tandon Rajbhasha Award* for 2016-17; *Ganesh Shankar Vidyarthi Award* (2016-17); *Global Agriculture Leadership Award* 2016; *ICAR-Hari Om Ashram Trust Award* 2012-13; *The Best KVK (Zonal) of Pandit Deen Dayal Upadhyay Rashtriya Krishi Vigyan Protshahan Puraskar* 2017, *Mahindra Samridhi India Agri Awards* 2018 and *Rajshri Tandon Rajbhasha Award* for 2017-18.

## IISR's agro-technologies

### adopted by farmers

The agro-technologies developed by ICAR-IISR, Lucknow has spread manifold during recent years. The area under sugarcane with IISR developed technologies has spread manifold during last five years. At present, about 2.26 million hectare area under sugarcane has been covered with IISR developed agro-technologies.

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## Nematode management in protected cultivation through soil solarization and bioagents

### Recommendations

- Soil solarization by 2-3 deep summer ploughings in May-June at 15 days interval followed by light irrigation and covering the soil with 25 micron thick transparent polythene sheet for 30 days during June-July for management of root knot nematodes.
- Soil application of bioagents (mentioned below) mixed with neem cake/ FYM/vermicompost @ 100 g/m<sup>2</sup> for the management of root knot nematodes.
- Raising nurseries in plug trays in nematode free soil.

### Brief Methodology

#### Site selection and sample collection for protected cultivation

- Preliminary sampling for determining population density prior to the harvest in established polyhouses or after harvest of the previous crop is essential for quantifying the nematode population. Quantification of initial nematode population is also essential as it multiplies tremendously fast in newly planted crops as at present no management measures are available to rectify the problems completely, once nematodes are established.
- Since plant parasitic nematodes are concentrated in the root zone, samples should be collected from the soil at a depth of 15 to 30 cm and samples should be taken only from the soil with appropriate moisture avoiding extremely dry or wet places. On an average 20 to 30 soil samples should be collected from an acre of soil.
- Once samples are collected from the field, they can be pooled carefully in polythene bags with proper labeling along with the details of previous operations and crops grown on the same land.
- Fresh sample should always be submitted immediately for nematode analysis to an accredited or designated laboratory.



#### Summer solarization along with application of organic amendments fortified with bio agents

- Farmers should be advised to remove left over roots, thoroughly plough the field and lightly irrigate just to dampen the soil. Soil should be covered with a transparent thin polythene sheet of 25-30 µm of thickness for 2-4 weeks period so that heat is trapped that can kill nematodes.
- The plastic sheet should be spread nicely and sealed with mud properly. After covering the open soil with polythene sheet in the polyhouse, sides of polyhouse should also be sealed by polythene curtains on all the sides for one month. There should not be any ventilation or air circulation from outside.
- Simultaneously farmers should raise the nursery separately in nematode free soil. Mean while, farmer should enrich/fortify vermicompost/FYM with the bioagents namely *Trichiderma viridae* (2.5 Kg/ha, 1×10<sup>8</sup>cfu/gm), *Pseudomonas fluorescens* (2.5 Kg/ha, 1×10<sup>8</sup>cfu/gm) and *Paecilomyces lilacinus* 1.15 % WP (1×10<sup>8</sup>cfu/gm) for two to four weeks with proper mixing weekly and should be covered with chaff/wet gunny bags for aeration.
- Polythene sheet covering soil in the polyhouse should be removed after 30 days and before transplantation of seedlings or sowing of seeds, soil should be again analyzed for nematode population density.

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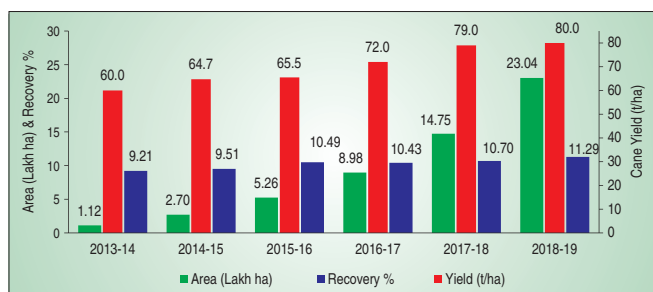
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## Co 0238: The wonder variety of sugarcane for subtropical India

The early maturing sugarcane variety Co 0238 (Karan 4) developed by ICAR-Sugarcane Breeding Institute (SBI), Regional Centre, Karnal, has revolutionized sugar production in India. The variety gives high average yield (> 81 t/ha) with a sugar recovery of more than 12 per cent. The widespread cultivation of this variety has generated a cumulative gross value of ₹1,93,520 crores during 2014-15 to 2018-19, accounting to ₹38,704 crores per year. The total additional benefit from sugar and by-products during the period was ₹46,226 crores or ₹9,245 crores per year, bringing livelihood-security and prosperity to lakhs of farmers and cheer to the sugar industry in sub-tropical states especially Uttar Pradesh, Punjab, Haryana, Bihar and Uttarakhand.



Impact of Co 0238 on cane yield and sugar recovery in five states of subtropical India

The release of sugarcane variety Co 0238 (Karan 4) evolved from the cross CoLk 8102 x Co 775 and developed by ICAR-SBI, Regional Centre, Karnal for commercial cultivation in North West Zone (Punjab, Haryana, Rajasthan, Uttarakhand, Central and Western Uttar Pradesh) has brought substantial yield and recovery improvement and revolutionized sugarcane cultivation in the sub-tropical part of the country.

### Salient Features of Co 0238

- Co 0238 has high average cane yield of 81 t/ha against 68 t/ha of the zonal check variety CoJ 64. Its high yield potential has been demonstrated to be 329.6 t/ha reported in the farmer's field (Shri Achal Mishra S/o Shri Udhav Mishra, Village - Neraipurva,



Co 0238 at ICAR-SBI, Regional Centre, Karnal

Distt. – Lakhimpukheri, Uttar Pradesh in the State Competition Plot, 2017-18).

- This variety has 18% sucrose in juice at 300 days crop age that steadily increases to more than 20% during March-April as against 17.9% sucrose in CoJ 64. On peak maturity Co 0238 has given as high as 14.01% sugar recovery at M/s Bajaj Hindustan Ltd., Bilai (UP) on April 3, 2019.
- In spite of an early maturing variety (10 month), Co 0238 maintains its higher sucrose content during very late in crushing season as M/s Uttam Sugar Mills, Barkarpur recorded 11.2% sugar recovery on June 4, 2020.
- The variety is moderately resistant to red rot and smut diseases; tolerant to low temperature, water deficit, water logging and saline conditions making it widely adaptable to all prevailing situations and suitable for all planting seasons viz. autumn, spring and summer of the sub-tropical region. Tolerance to low temperature further makes it durable for raising a second ratoon crop.
- The thick canes, to match the tallness of the crop, have favoured Co 0238 for wider row planting, which is a pre-requisite for mechanical harvesting.

### Spread of Co 0238 in sub-tropical India

Co 0238 with its remarkably impressive field stand and agronomic performance including superior cane yield and juice quality, spread at an exceptionally faster rate in sub-tropical region of the country. After its release and notification during 2009, the North Indian states started reporting data on area occupied by Co 0238 in successive years and these figures are uniformly available since 2014-15 season. Accordingly, the area under this variety increased from 2.70 lakh hectares (2014-15) to 25.88 lakh hectares (2019-20) in sub-tropical region, which is the highest ever area (79.15%) occupied by a single variety in the country in a very short span of five years.



## Quantity of cane and sugar produced and their values since 2014-15 to 2018-19

State	Cane produced (lakh tonnes)	Value of cane (₹ in crores)	Sugar produced (lakh tonnes)	Value of sugar (₹ in crores)
Uttar Pradesh	3,819.7	1,21,785	448.9	1,58,360
Punjab	275.7	8,340	27.2	9,490
Haryana	251.1	8,230	26.0	9,176
Bihar	170.3	5,179	17.0	5,835
Uttarakhand	77.0	2,483	8.0	2,783
<b>Total</b>	<b>4,593.8</b>	<b>1,46,017</b>	<b>527.1</b>	<b>1,85,644</b>

## Impact on cane yield and sugar recovery

## Sub-tropical region

The impact of Co 0238 on cane yield and sugar recovery per cent in sub-tropical states was assessed during 2014-15 to 2018-19 with 2013-14 as base year. Area under this variety increased from 9.84% (2.72 lakh ha) in 2014-15 to 66.13% (23.04 lakh ha) in 2018-19. The improvement in cane yield was the maximum in the state of Bihar. Improvement in cane yield varied from 11.2 t/ha in Haryana to 18.9 t/ha in UP, whereas improvement in sugar recovery varied from 1.01 units in Punjab to 2.28 units in UP.

## National

Impact of the increase in area of Co 0238 (from 2.70 lakh ha in 2014-15 to 23.04 lakh ha in 2018-19) was observed not only in individual states but also at the national level. There was linear impact of increasing area under the variety on national average sugar recovery. Slight reduction in sugar recovery was observed during 2016-17 in comparison with previous year, which might be due to drastic reduction in sugar recovery of tropical states (Karnataka, Maharashtra and Gujarat).



Co 0238 at farmer's field in Lakhimpurkheri

## Economic impact of Co 0238

**(I) Gross economic value:** Economic impact of Co 0238 was assessed based on its area covered in five subtropical states (Uttar Pradesh, Punjab, Haryana, Bihar and Uttarakhand) from 2014-15 to 2018-19. During this period, 4,593.8 lakh tonnes cane of ₹1,46,017 crores value and 527.1 lakh tonnes sugar worth ₹1,85,644 crores were produced from Co 0238 (Table 1). This variety also produced 597.2 lakh tonnes fodder fetching ₹3,066.9 crores, 206.7 lakh tonnes molasses worth ₹0,225.8 crores, 1,378.1 lakh tonnes bagasse of value ₹27,868.6 crores and 13.78 lakh tonnes of pressmud worth ₹27.9

crores. The cumulative gross value of Co 0238 from sugar and additional quantity of its by-products is estimated to be ₹1,93,520 crores during five years of its cultivation.

**(II) Additional profit:** By virtue of its high yielding potential, Co 0238 has produced additional 873 lakh tonnes sugarcane worth ₹27,781 crores during 2014-15 to 2018-19. Similarly, higher sugar recovery of Co 0238 led to production of an additional 107.81 lakh tonnes sugar worth ₹38,349 crores.

Co 0238 yielded an additional return of ₹46,225.5 crores in five years (2014-15 to 2018-19) from sugar and by-products (113.5 lakh tonnes of fodder worth about ₹585.5 crores, 261.9 lakh tonnes of bagasse worth ₹5,307.4 crores, 39.3 lakh tonnes of molasses worth ₹1,978.2 crores and 2.62

lakh tonnes of pressmud worth about ₹5.3 crores). The total additional benefit from sugar and by-products was estimated to be ₹9,245 crores per year. During this period, Co 0238 fetched an additional return of ₹28,366.5 crores to the farmers (from sugarcane and fodder) in Uttar Pradesh, Punjab, Haryana, Bihar and Uttarakhand. The Economic Surplus Model was fitted to estimate the total gain to society/economy due to adoption of Co 0238 and its distribution among consumers and producers. Accordingly, the total annual economic gain (surpluses) was

₹13,107.1 crores, distributed in the share of 37:63, between consumers and producers, respectively.

Mere cultivation of Co 0238 brings ₹51,849 per hectare additional income and with the adoption of more crop husbandry packages including intercropping and wide row spacing, Co 0238 has the potential of multi-fold increase in income of farmers as has already been demonstrated by 12 farmers associated with ICAR-SBI, Regional Centre, Karnal.

Co 0238 has greatly contributed towards achieving the 32.1 million tonnes sugar production (about 7 million tonnes in excess than the consumption) in the country

## Additional benefit to farmers and sugar mills (2014-15 to 2018-19)

State	Additional cane produced (lakh tonnes)	Additional benefit to farmers (₹ in crores)	Additional sugar produced (lakh tonnes)	Value of additional sugar and by-products (₹ in crores)	Yearly additional benefit (₹ in crore)
U.P.	764.6	24,873	98.23	41,931.6	8,386.32
Punjab	29.58	926	2.06	985.1	197.00
Haryana	26.3	891	3.13	1,340.8	268.14
Bihar	38.16	1201	2.52	1,204.5	240.90
Uttarakhand	14.34	468	1.87	763.5	152.70
<b>Total</b>	<b>872.98</b>	<b>28,359</b>	<b>107.81</b>	<b>46,225.5</b>	<b>9,245.06</b>

during 2017-18, that in turn led to a Governments' Policy decision on permitting direct conversion of sugarcane juice into ethanol. A record sugar production of 33.2 million tonnes was reported during the 2018-19 season. Co 0238 thus has brought in a *Sweet Revolution* benefitting lakhs of farmers and for the sugar industry

which has been in the doldrums, this variety is bringing fresh cheer and hope.

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## ICAR-NBAIR curtails whitefly

Highly polyphagous invasive rugose spiralling whitefly (RSW), *Aleurodicus rugioperculatus* Martin was recorded on coconut at Pollachi, Tamil Nadu in 2016 by scientists from ICAR-National Bureau of Agricultural Insect Resources (NBAIR), Bengaluru. Subsequently, the pest rapidly spread to coconut growing districts of entire South India. It was later found to be feeding on banana, sapota, maize, oil palm, mango, cashew and many other ornamental plants. Recently, its occurrence was reported in Goa, Assam, West Bengal, Maharashtra and Gujarat. Nymphs and adults of this whitefly damage the plants by sucking the plant sap, especially from under surface of the leaves.

Adults produce prodigious quantities of honeydew which in turn gets darkened by the development of sooty mould on the upper surface of leaves. The characteristic concentric waxy spiralling symptoms are noticed on several parts of the host plants. The hybrid and dwarf varieties of coconut like Chowghat orange dwarf, Malayan orange dwarf and Ganga bondam are preferred by the RSW.

### Failure of chemical pesticides

Alarmed by the invasion of a pest unknown to them, farmers resorted to spraying of chemical pesticides to control RSW. But the efforts were in vain as the chemicals turned out to be a temporary fix and moreover, other ill effects like environmental pollution, killing of natural enemies and health risks to the people involved in spraying operations made the insecticide application risky and uneconomical.

### Biological control as an effective solution

Explorations were carried out so that biological control of the pest could be accomplished through naturally occurring insect predators and parasitoids which are economically feasible, ecologically compatible and environmentally benign. Among natural enemies encountered, two aphelinid parasitoids, *Encarsia guadeloupae* and *E. dispersa* were found to have colonized the RSW and naturally suppressing the pest. The dominant parasitoid was found to be *E. guadeloupae* as it recorded natural parasitism of 56-82% while *E. dispersa* recorded 5-10%. Apart from these parasitoids, *Dichochrysa astur*, *Jauravia pallidula*,

*Cheilomenes sexmaculata* and *Cybocephalus* sp. were also observed to be feeding on RSW.

### Conservation of *Encarsia guadeloupae*

Since natural enemies, particularly *E. guadeloupae* was found to be suppressing





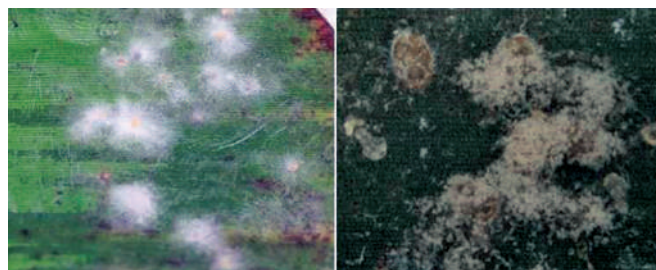


*Encarsia guadeloupae* nymphs (L) and adult (R)

the population of RSW effectively; farmers were advised to re-distribute parasitoids wherever they were absent or found in inadequate numbers by using field insectary techniques. In areas where chemicals were not applied, parasitoids were observed to have multiplied rapidly and natural parasitism increased phenomenally thus preventing severe outbreaks. Frequent monitoring of the pest occurrence were carried out and pesticide holidays were declared so as to conserve the natural enemies. Banana and *Canna indica* were found to be harbouring maximum population of parasitoids in field as well as in net-houses. Growers were advised to grow these plants as banker plants in coconut garden for conservation and augmentation.

### Entomopathogenic fungus, *Isaria fumosorosea* Wize (ICAR-NBAIR pfu-5)

ICAR-NBAIR has identified a promising entomopathogenic fungus, *Isaria fumosorosea* (ICAR-NBAIR pfu-5) based on laboratory bioassays and also on multi-locational field evaluation in Andhra Pradesh, Karnataka, Kerala and Tamil Nadu. The fungus was effective in killing all its life stages. The egg and early instar nymphal mortality was up to 91% and the late nymphal instars and pupal mortality was up to 80%. Mass production technology for this fungus has



*Isaria fumosorosea* (NBAIR-Pfu5) growth on RSW nymphs

been standardized using solid state fermentation (rice grains) and liquid state fermentation technology (Saboroud dextrose yeast broth, potato dextrose broth). Talc, rice grain and oil formulations have been developed with long shelf life. There is a huge demand for this biocontrol agent from the coconut farming community.

ICAR-NBAIR has developed biocontrol strategies using parasitoids and the entomofungal pathogen *I. fumosorosea* for efficient management of RSW. Economic analysis of the impact of conservation and augmentation of *E. guadeloupae* and foliar application of *I. fumosorosea* for management of RSW indicated that about ₹9500/ha crop protection cost and 900 ml of pesticides/ha are being saved.

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Talc and rice based formulations of *Isaria fumosorosea*

## WAY FORWARD – ICAR Response to COVID-19 Pandemic

ICAR has responded to challenges posed by COVID 19 to farmers and farming sector. Farmers and other stakeholders were alerted across the country on the precautions, safety measures and need for social distancing while carrying out time bound field operations such as harvesting, post-harvest processing, storage and marketing of grains, fruits, vegetables, eggs, meat and fish. Farmers have been informed about various exemptions given by the Govt. in farm operations, seed and fertilizer availability, safety in using machines and their movement etc. Besides, advisories issued by the Central as well as State Governments regarding precautions to be taken to prevent spread of COVID-19 have been uploaded and updated on the ICAR as well as Institute websites all over the country.

ICAR institutes and KVKs have prominently disseminated the message for use of Arogya Setu mobile application to fight COVID-19 pandemic. As a result, over 63.27 lakh farmers have been reached and over 8.16 lakh farmers downloaded the application for their use. Besides advisories, the handholding of farmers was also strengthened by distributing about 52003 q of improved seed of crops, 78.78 lakhs of planting material and 13.0 lakh fish fingerlings by KVKs. ICAR institutes have also developed a few sanitizer formulations. A seaweed-based hand sanitizer developed by ICAR can be effectively used to prevent spread of corona viral infection.

ICAR Research Institutes; NIHSAD, Bhopal, IVRI, Izatnagar, and NRC on Equines, Hisar have been designated for COVID-19 testing in humans. These institutes have also been designated for COVID testing of samples from Zoo animals by MoEF. Till date over 42500 human samples have been tested at these three institutes. The farmers were also assisted with the Custom Hiring Centers (CHCs) of machines at village level, to cater their needs of farm implements during harvesting.

Close interaction and liaisoning were established with State Government to help the farmers and other stakeholders. Specific guidelines for fisheries and flowers and other perishables were providing to State Government for benefit of farmers. The tips for converting unsold flowers into value added products were also provided. Central Institute on Postharvest Engineering and Technology (CIPHET), Ludhiana have provided advisories on ways to process raw material by minimally processing, shrink wrap packaging solution to extend shelf life by 1-2 weeks and also advised farmers to prepare zero energy evaporative storage to store perishables for 2-3 days. ICAR-CIFT has been providing technical guidance for setting up of Reefer container based fresh fish storage system at Kerala to manage the glut caused by the lock down. ICAR-CIFT has made all their laboratories ready for analysing of fish/shellfish samples received from seafood industry for boosting their export.

The IIHR, Bengaluru provided 20 fruit and vegetable vending van to Karnataka Department of Horticulture, which are given to FPOs in 10 districts. Van is also given to HOPCOMS, Mysore to sell the fruits and vegetables to the door step of consumers during lock down. These were used in Tumkur, Koppal, Bidar, Gadag and Vijayapura districts. Even other



**Dr T Mohapatra, Secretary (DARE) and Director General (ICAR)**

states like Haryana and Kerala have taken vans to supply fresh fruits and vegetables to consumers' doorstep to help the people during the lockdown period.

ICAR National Institute for Plant Biotechnology (NIPB), New Delhi besides informing and advising farmers in the adopted villages about various advisories issued by the government from time to time has conducted comparative analysis of more than 400 Coronavirus sequences in NCBI and traced its origin from bats to human in China based on sequence phylogeny. A seaweed-based hand sanitizer has been developed by ICAR as a preventive hygienic measure to control the spread of the corona viral infection affecting the people massively all over the world. The formulation of the developed product includes isopropyl alcohol (above 60%) possessing antimicrobial activities, seaweed extract from red algae constituting chemical components with pronounced antiviral properties. The seaweed component is also used as an emulsifying agent. Aloe Vera gel is used as a moisturising agent.

One of the very important activity that got affected by the COVID-19 pandemic is education and classes of the students and evaluation of the research and thesis. The Vice-chancellors of Agricultural Universities and Deemed Universities were advised maximum application of the online systems for taking classes. ICAR has also promoted such systems in-house for all the meetings and reviews of All India Coordinated Research Projects, periodical meetings of the senior officers and other official meetings. The entrance examination for UG and PG courses in SAUs is already online. The State Agricultural Universities have also readily accepted the need for moving to online systems and majority of them have resorted to.

To strengthen the care and support to the needy, DARE/ICAR family has contributed about ₹6.06 crores in the PM CARES. The Agricultural Universities have also been asked to donate at least one-day salary to either PM CARES and/or respective state Government funds created for the purpose. Besides, several officers' women clubs and Labour welfare Funds also contributed in PM-CARES.

**(T Mohapatra)**

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