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Vegetable-Newsletter

ICAR-Indian Institute of Vegetable Research

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RESEARCH UPDATE

From the Director's Desk

The incidence of pandemic virus COVID-19 has changed the lifestyle and food system of human beings globally. Vegetable production is marked by its highly seasonal and local nature, its high labour needs, and perishability of fresh produce and require good logistic support systems from post-harvest to end users. With the unfortunate incidence of COVID-19, fresh food supply chain is in jeopardy more than ever before and the need to bring fresh vegetables easier and faster directly to the consumers is important than ever. COVID-19 restrictions during lockdown in India and worldwide had posed serious logistical challenges for production system at farm as well as off-farm movement of vegetables which resulted in steep fluctuations in prices. Vegetables are important in creating the employment (2-3 times higher than cereals), enhancing the profits (2-5 times higher than cereals), providing the economic security to the farmers particularly to the marginal ones; and supply viable nutritional security to the consumers. The foods you eat play a key role in determining your overall health and enhancing the immunity. Regular consumption of vegetables, fruits and other foods which are rich in carotenoids, ascorbic acid, vitamins, omega-3 & 6 fatty acids, phenolics and antioxidants are required to enhance immune system and to build resilience in the body against infections. Certain vegetables, like leafy greens (spinach, leafy chenopod, kale & collards, water spinach, etc), broccoli, red cabbage, capsicum, beet root, moringa, orange & purple cauliflower, black & rainbow carrots, red & purple radish, red beans, red & yellow watermelons, orange muskmelon, red okra, orange tomato, mushroom, etc are very good in enhancing immunity of body. Besides, there are several herbs/spices that help in boosting immunity like garlic, onion, ginger, aonla, turmeric, citrus, basel (tulsi) leaves, cinnamon and black cumin. Some of these superfoods are common ingredients in Indian dishes and snacks. So, don't let vegetables fall off from the farm as well as from the plate that will ultimately trigger in generating employment opportunities, enhancing income, promoting immune system, and providing nutritional security.

Jagdish Singh
Director, ICAR-IIVR

Vegetables and COVID-19

Vegetable sector has potential to combat COVID-19 on multiple fronts

Vegetables are important part of horticulture and agriculture in India. Annual vegetable production is 184 mt which is about 60% of total horticultural production in India during 2019-20. In pre-COVID-19 era, average monthly gross income of agriculture household was Rs. 8931/- and per capita net monthly income was Rs. 335.8 (NABARD, 2016-17). Increased cost of cultivation, food loss/waste, failure of assured remunerative returns has been major challenges before policymakers and sustainability of agricultural growth. Indian vegetable farming scenario is characterized by highly seasonal nature, labour intensive, perishable nature and lack of modern logistics during post-harvest to marketing. With the unfortunate incidence of COVID-19, fresh food supply chain is in jeopardy more than ever before and the need to bring fresh vegetables easier and faster directly to the consumers is important than ever. On the other side, consumption of local fresh vegetables is highly recommended by health professional to build up immunity nowadays. The ongoing pandemic has forced urban human resources to return to rural areas and they have largely engaged in various farming activities. Area under farming has increased due to migration and on-time monsoon and preference was mainly for field crops in view of food security. There was substantial reduction in vegetable cultivation area as farmers opted for safe & storable field crops instead of risky and perishable vegetable crops. It was predicted that there will be increase in vegetable prices due to reduction in area of vegetable crop and converted these areas for field crop, due to which prices might be on higher side from July till Mid Nov, 2020. As vegetable area is occupied by field crop during this period, vegetable crop can't be grown till September, so the vegetable prices might be normalizing during Nov-Dec, 2020. Moreover, vegetable farming has potential to combat the challenges posed by ongoing COVID-19 pandemic on multiple fronts:

I. **Nutrition:** There are numerous health benefits associated with consumption of nutrition rich vegetables as they strengthen bone health, help in maintaining healthy weight, beneficial for skin and hairs as they are rich in antioxidants, aid in improving eye health, prevent hypertension and multi-morbidity and many mores. The WHO panel on diet, nutrition and prevention of chronic diseases recommended a daily intake of at least 400 g of fruits and vegetables, excluding potato, cassava and other starchy tubers to prevent diet related chronic diseases and micronutrient deficiencies. Given the fact, it should also be noted that Indians are eating less quantity of vegetables than recommended. Vegetable crops like capsicum, spinach, broccoli, garlic and ginger have been listed as most important vegetables which helps in boosting immunity. Therefore, intake vegetables in our daily diet should be increased to strengthen our immunity system for combating the present pandemic crisis.

ii. **Vertical/kitchen gardening:** Vertical vegetable production is the practice of growing vegetables in vertically stacked layers often in soilless medium using techniques such as hydroponics, aeroponics, aquaponics, etc. It can be done indoor, outdoor or in combination of both. Vertical gardening has emerged as reliable source for enhancing fresh food production in pandemic like Covid-19 besides keeping inmates engaged. Moving in this direction will be a step forward in realizing the dream of Atmanirbhar Bharat. It will provide productive time pass for aged persons who cannot go outside their homes due to pandemic. It also offers much needed food farming education to children. Studies conducted globally have indicated that kitchen gardening helps in CO_2 reduction from environment. Availability of fresh nutritive vegetables at reduced water and nutrient input is one of the best tangible benefit realized through kitchen gardening. Besides, providing reliable food supply, home gardening brings peace of mind.

iii. **Employment generation:** Employment scenario during COVID-19 is disappointing in the country and overall unemployment rate is nearly 25%. About 400 million people are facing risk of falling into poverty. Lot of success stories of income generation through vegetable farming are being reported now a days. Vegetable sector has potential to generate substantial

employment opportunities especially in processed vegetables, organic vegetable production, export oriented production, vegetable kiosk and related online platform and mobile apps. Aggregation, fostering innovations, leveraging advanced technologies, investment in agri-infrastructure and enhancing export competitiveness are key growth drivers for generating the job opportunities.

iv. **Export Potential:** During 2018-19, India exported vegetables worth Rs 5419.48 crores. Though India's share in the global market is <1%, there is increasing acceptance of horticulture produce from the country. However, non-availability of exportable varieties, lack of post-harvest treatment facilities such as of vapour heat treatment, pack houses from farm to port, high cost of obtaining certification for exports like Eurep-Gap, inconsistency in supply, etc. are major hurdles in enhancing vegetable export.

v. **Climate resiliency:** Detrimental impact of climate change in vegetable sector can be mitigated by adopting several climate smart strategies which includes use of climate smart seeds, climate-smart crop management and cropping systems, climate smart post-harvest practices and circularity. To achieve this, mobilization of private sector for R&D investment and policy engagement through government sector is need of the hour.

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Price volatility and supply disruptions amid COVID-19 lockdown: a case of tomato crop in India

Tomato is one of the most versatile vegetables widely grown and consumed in India. It ranks 3rd in the production of vegetables after potato and onion. This crop has a year-round production and consumption in India. The production of tomato has increased by 8.0% in 2019-20 compared to its previous year production. Area and productivity have increased by 4.0 and 4.1 % respectively. The outbreak of COVID-19 pandemic in India has affected economy of all sectors. The lockdown period from the last week of March to May 2020 had posed several problems to farmers engaged in agriculture and marketing of the produce, despite giving waiver for essential commodities. Tomato being a perishable commodity has the harvest period during March-April coincided with the lockdown period. Farmers faced shortage of labour for harvesting of the crop, transportation issues as district and state borders were closed, APMCs' and other markets were not open. Further, absence of bulk buyers of tomatoes like hotels, restaurants, marriage functions and social gatherings affected the domestic demand. Despite higher production of the crop, it faced huge losses in major tomato producing states. Further, the supply disruptions caused due to the lockdown restriction in movement of produce from major producing states to potential markets of metro cities and other states. As a result, the prices of tomato highly fluctuated. The total arrivals of tomato in the Indian domestic market reduced by on an average of 20% in the month of April 2020 compared to its previous year. The real average wholesale prices of tomato decreased drastically in the month of March to May (lockdown period) to the extent of 25-30% and started rising as the lockdown opened as shown in Fig.1.

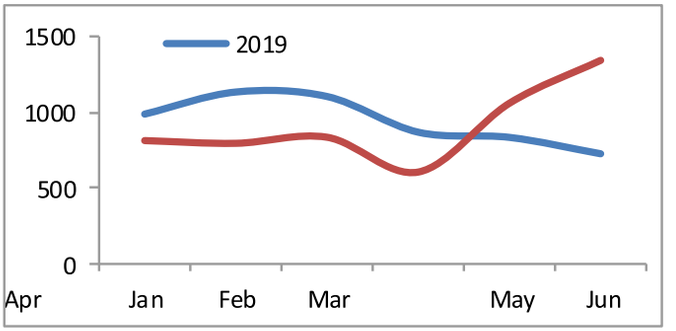

Fig.1 : Trend in average wholesale prices of tomato in India (Jan-June) 2019-20

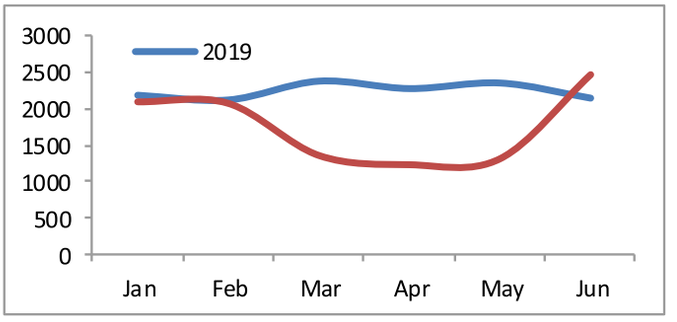

Fig.2 : Trend in average retail prices of tomato in India (Jan-June) 2019-20

Whereas, the real average retail prices of tomato decreased to the extent of 40-45% in early weeks of March, had a constant pace during the lockdown period and had a drastic raise in the average retail prices once the lockdown was opened during the month of June 2020 (Fig. 2). This was a result of increase in domestic demand of the produce due to panic bulk buying, changes in purchase behavior/pattern of the consumers buying in bulk at once for a week/fortnight. Though the crop witnessed eight per cent increase in its production, the crop faced huge losses and high price fluctuations in both average wholesale and retail prices in the domestic market.

In view of such marketing problems faced by the farmers, two ordinances were passed by the Honorable President of India to safeguard the interest of farmers involved in farming. These ordinances have direct impact on the agriculture produce marketing system. This may ease the marketing hurdles of perishable commodities like tomato and other vegetables. The ordinances passed during June 2020 are given below:

(I) The farmer's produce trade and commerce (promotion & facilitation) ordinance- 2020: Provides different market ecosystems/zones outside the purview of APMC market yards where farmers and traders have competitive alternate trading channels, remunerative price discovery and freedom of choice for direct selling by farmers.

(II) The farmers (empowerment & protection) agreement on price assurance and farm services ordinance- 2020: Provides a national framework on farming agreements to protect and empower farmers in contract farming with agribusiness firms/ processors/ wholesalers/ large retailers/ exporters. Agreement for mutually agreed remunerative price of future farming produce has been made more transparent and e-registration of the agreement is encouraged.

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PRODUCTION TECHNOLOGY

Kashi Sukshma-Shakti: Quenching the thirst for micronutrients

Keeping in view the prevailing multi-micronutrients deficiencies in Indian soils and its adverse effect on crop growth and yield, different crop-group specific micronutrient formulations (Micromix A, Micromix B, Micromix C and Micromix D), comprising of mixture of plant essential micronutrients, were prepared and evaluated in tomato, cauliflower, cabbage, cowpea and

okra for their efficacy under field conditions. A commercial formulation available in the market as well as the formulation from ICAR-IIHR, Bengaluru was also taken for comparison. Based on the findings of two-year field experiments, Micromix A proved better recording the maximum fruit yield in tomato, okra and cowpea, while in cauliflower and cabbage Micromix B recorded the highest yield. The best performing formulations for particular crops were selected and christened as 'Kashi Sukshma-Shakti'. Foliar spray of Kashi Sukshma-Shakti at the interval of 10-15 days after 30 days of planting, by alleviating the deficiency of micronutrients, improves plant's growth and yield.

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Yield and attributing characters as the function of pruning system in capsicum

Capsicum plants grown in a vertical culture tied to strings were trained onto one-stem and two-stem systems for canopy management under naturally ventilated polyhouse, while and unpruned plants were treated as control. One-stem produced heavier, larger, blocky shaped fruits, which are suitable for export or sell in Malls; however, it produced the lowest yield. The two-stem on the other hand produced not only the good size and blocky shaped fruits but also had comparatively higher yield. On the contrary, multiple stem (control) registered the highest yield but of lighter weight and misshapen (Fig. 1), which may find its taker in the local market. Therefore, the choice of training system in capsicum may depend upon the targeted market.

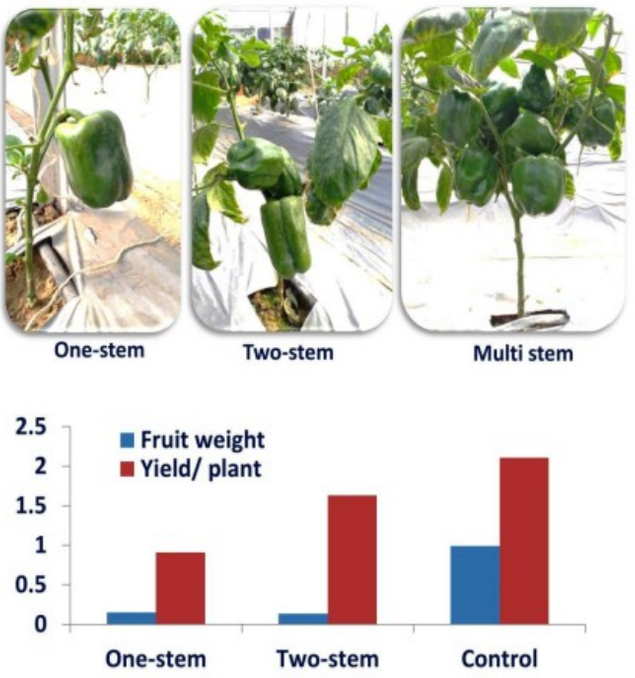

Fig.1 : Fruit weight and yield as affected by different training systems in capsicum

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Pointed gourd in naturally ventilated condition in eastern parts of India

Pointed gourd (*Trichosanthes dioica* Roxb.) is a perennial and dioecious vegetable grown as vine with a pencil thickness stem. It is widely cultivated in Bihar, West Bengal, Odisha, Assam and Uttar Pradesh. The crop is cultivated over an area of 18,000 hectares in India with a production of 2,52,000 tonnes (NHB, 2017). Frost injury during winter season is a limiting factor for successful cultivation which adversely affects the overall plant growth, fruit set and ultimately interrupts supply chain. Under such prevailing condition, naturally ventilated protected structure i.e. net house having polyethene cladded top with insect proof sides can be a viable option to provide specified climate for crop growth. Presently pointed gourd is gaining popularity for greenhouse production due its vine growth, and response to training and pruning. By planting pointed gourd seedlings during September-October in the polyhouse, their yield could be taken 30-45 days early than the open field conditions which fetches premium price of produce. The environmental conditions particularly increased temperature inside polyhouse hastens the germination and early growth of pointed gourd fruits. Needless to emphasize, growing of pointed gourd inside polyhouse eliminates danger of biotic and abiotic stresses during the period of rainy season. Protection against biotic and abiotic stresses becomes easier. Very few reports are available on pointed gourd production under protected condition in India. Present study was undertaken to identify a suitable pointed gourd for early summer season production, based on different vegetative and reproductive growth, under naturally ventilated polyhouse condition of eastern part of India by keeping honeybee boxes inside to facilitate pollination. Five popular varieties of pointed gourd (Swarna Rekha, Swarna Alaukik, Kashi Alankar, Rajendra Parwal-1 and Rajendra Parwal-2) were evaluated under naturally ventilated polyhouse at Hi-tech Horticulture unit of RPCAU, Pusa. The female and male plant populations in the experimental field were maintained in the ratio of 10:2 to ensure effective pollination. Two Honey bee boxes were also kept on the boundary of the side ventilation and inside the polyhouse to facilitate pollination.

Result revealed that Kashi Alankar (64.88) was the earliest in days to first harvesting which is at par with Swarna Rekha (65.47), whereas the variety Swarna Alaukik (74.68) took highest number of days to first harvesting. Non-significant difference in number of primary branches was recorded during the course of study. Increasing trend were observed in characters like number of fruits per plant, fruit weight per plant and fruit yield per 1000 m^2 because plants were in second and third years. Swarna Rekha variety dominated in yield attributing characters like number of fruits per plant, fruit weight per plant and fruit yield per 1000 m^2 Swarna Rekha variety (3.45 t) recorded significantly higher fruit yield per 1000 m^2 followed by Kashi Alankar (3.11 t) whereas Swarna Alaukik (2.72 t) recorded significantly lower fruit yield per 1000 m^2. There is immense possibility to grow pointed gourd under naturally ventilated polyhouse and varieties like Swarna Rekha and Kashi Alankar were found highly suitable for production.

Fig : Pointed gourd crops inside NVP

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PROMISING GENOTYPE

VRWS-1: A promising genotype of water spinach suitable for upland field conditions

Water spinach (*Ipomoea aquatic*) is commonly used as a food plant in several parts of the country. Water convolvulus, Kang Kong and Swamp cabbage are some alternative names. The leaves are good source of minerals and vitamins especially carotene and is considered a possible source of food protein. Water spinach possesses several medicinal properties. It has long, jointed and hollow stems. Adventitious roots are formed at nodes which are in contact with water or moist soil. Leaves are heart-shaped; leaves are 5.5 cm wide and 20-30 cm long. The leaves have a very pleasant, mild, sweet flavour and a slightly slippery texture, which contrast when cooked with the crispness of the stems. National Bureau of Plant Genetic Resources, New Delhi and World Vegetable Center, Taiwan are maintaining the germplasm of water spinach. ICAR-Indian Institute of Vegetable Research, Varanasi is also maintaining several diverse forms of water spinach. Leaf biomass of VRWS-1 is ready for harvest 30-40 days after sowing/planting. More than three harvests per month can be taken if shoots are cut above ground level, allowing secondary shoots to grow from nodes below the cut. The upper part of the main shoot, about 35- 40 cm long, is cut about 2.0 cm above ground level. Leaf bundles of 8-10 shoots are marketed. About 30-40 t/ha/cutting leaf biomass can be harvested. Plants should be harvested during the coolest part of the day. After bunching, a fine spray of cold water should be applied, and the leaves kept in a cool place away from the wind. In addition, when water spinach is commonly grown in waterlogged areas, it requires cumbersome practices for plant protection measures and harvesting. This also invites water pollutants harmful for human health. Therefore, an attempt at ICAR-IIVR, Varanasi has been made for cultivation of VRWS-1 water spinach in "Upland field condition" and promising results were obtained for

VRWS-1 in submerged condition	VRWS-1 in Upland field condition	VRWS-1 healthy crop in field condition	VRWS-1- leaves bunch for marketing

Fig : Cultivation practices of water spinach as "Upland field water spinach" in field condition

the same. This technology proved to be simple and be cultivated round the year which can serve as boon for the socio-economic upliftment of farmers with added advantages of 3-4 cuttings per month and submerged condition is not necessary, produce is to be free from water pollutants, technology promises “Safe Biomass” as “Upland Field Water Spinach”. Leaves are usually sold in 500.0 g bunches in the markets at the rate of 35- 40/Kg.

In view of the importance, popularization of VRWS-1 water spinach for Upland field condition cultivation on a large scale could make a significant contribution towards nutritional security and economic upliftment of the society. In addition to food and nutritional security, this is also likely to generate on-farm and off-farm employment.

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VRRAD-201 (IC 0625064): First Ogura-CMS line of radish from Public Sector in India

Globally, the usages of F_1 hybrids of many vegetables have increased manifold during last few decades, including India. Hybrid vigour is of direct interest for development and commercialization of F_1 hybrids in various vegetable crops, which is being facilitated by use of two genetic emasculation techniques i.e. cytoplasmic male sterility (CMS) and self-incompatibility (SI) in radish. But, SI system in most of the radish genotypes is very weak; hence CMS system is mostly preferred. CMS was first identified in a cultivar of Japanese radish by Ogura (1968) popularly known as Ogura-CMS, and thereafter it has been transferred into various backgrounds of different *Brassica* vegetable. Although it is the most important salad crop in India because of availability of roots round the year, yet it is unfortunate that none of the radish CMS lines by Public Sector Institutes is available on public domain in our country. Keeping in view of the importance and advantage of CMS lines; ICAR-Indian Institute of Vegetable Research, Jakhini, Varanasi, UP has developed CMS lines. The Ogura-CMS line 'VRRAD-201' (IC0625064, First Ogura-CMS line from Public Sector in India) was developed by crossing CMS plants from open population with an elite line. VRRAD-201 possesses desirable leaf shape i.e. sinuate type of leaf morphology; triangular white root; develops root during winter, spring and summer seasons; bears whitish-purple flower; and ready to seed harvest in about 4 months after transplanting of stecklings. The quantitative traits of 'VRRAD-201' during winter season of 2016-2019 were observed as gross plant weight 258.5-275.0 g, root weight 181.2-190.0 g, root length 24.8-26.0 cm, days to first root harvest 40.2-52.4, days to 50% flowering 34.2-38.1, number of seeds/pod 4.2-4.5 and 1000 seed weight 12.8-13.5 g. The newly developed CMS line 'VRRAD-201' would be very effective in harnessing heterotic potential, developing F_1 hybrids, and cost-effective hybrid seed production in radish, and ready for commercial use.

CMS line (VRRAD-201) and its Maintainer

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VRO-120: A yield potential YVMV and ELCV tolerance line of okra

With respect to okra production, India is the top-ranking country, contributes >60% share to the global production and having array of varieties for various morpho-horticultural traits. Cultivars with deeply lobbed leaf are meagre in public domain. With an objective to develop deeply lobbed leaf okra genotypes with high

yield, fruit quality, tolerance to VMV and ELCV diseases, ICAR-IIVR developed VRO-120 (IC 0630302) through pedigree breeding. In okra lobed leaf is very common, but VRO-120 is a unique advance line with deeply lobbed leaf resembling to papaya leaf. It has semi-dwarf plant stature i.e. 90-110 cm height, short inter-nodal length, 2-3 branches in narrow angle and flowering started 38-40 days after sowing at lower nodes (4-5 nodes). Effective fruiting period found to be 45-100 days after sowing. This line produces uniform dark green fruit, free from pubescence and seed bulging, 12-14 cm in length, 1.3-1.4 cm in diameter and 10-13 g of average fruit weight. Beside this line also facilitate easy harvesting by single or double bending. VRO-120 showed high degree of tolerance to YVMV and ELCV as it remains free from the incidence of these two viral diseases under Varanasi conditions for 3 cropping seasons. Yield potential of this advance line is 160-175 q/ha with about 335 g average fruit yield per plant. It is suitable for growing during both summer and rainy seasons. Moreover, this line has great potential for utilizing as a parent in hybrid breeding as reflected from the performance of its experimental F_1 hybrids developed and tested at ICAR-IIVR, Varanasi with respect to yield, quality and resistance to YVMV and ELCV diseases.

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PEST MANAGEMENT

Incidence of Encyrtid Parasitoids and Hyperparasitoids of brinjal mealybug

Brinjal is an important vegetable of tropics and subtropics. It is an annual crop cultivated all over India. Practically, the fruits are available throughout the year. Dark purple brinjal has more vitamin C than those with white and green skin. As the crop available round the year, several biotic stresses are posing major constraint to brinjal cultivation. Brinjal mealybug, *Coccidohystrix insolita* (Green) (Hemiptera: Pseudococcidae) is one of the serious insect pests of brinjal. The infestation of this pest was observed on the older brinjal plants at Research Farm of ICAR-IIVR, Varanasi during the period of July-October 2018. The lower leaf surfaces and tender shoots of brinjal plants were covered by many nymphs and adult female mealybugs with long ovisacs. The infested plants were observed with stunted growth, yellowing and leaves were covered with black sooty mould. Potential and highly active encyrtid parasitoids were collected on *C. insolita* during August-October 2018. *Leptomastix nigrocincta* Risbec and Aenasius spp. (Hymenoptera: Encyrtidae) were encountered as the most common primary parasitoids of *C. insolita*. Hyperparasitoid *Prochiloneurus pulchellus* Silvestri (Hymenoptera: Encyrtidae) is reported for the first time emerging from the mealybug, *Coccidohystrix insolita* feeding on brinjal crop in Varanasi. *Prochiloneurus pulchellus* is reported to be the common hyperparasitoid of primary parasitoids of mealybugs such as *Coccidohystrix insolita* (Green) and *Phenacoccus solenopsis* Tinsley, which may reduce the efficacy of primary parasitoids in the field.

1.Brinjal mealybug (*Coccidohystrix insolita)* infested leaves
2. Nymphs and adults of *C. insolita*

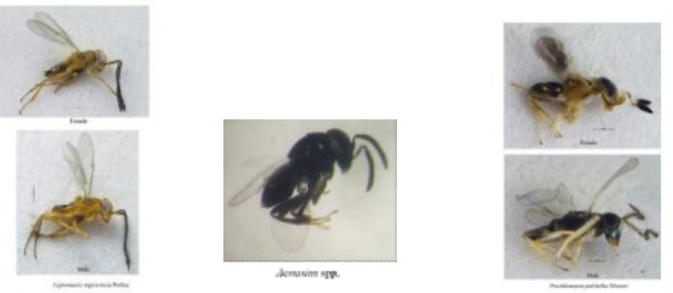

Fig : *Coccidohystrix insolita* mealybug primary parasitoids *Leptomastix nigrocincta* (Left), *Aenasius* spp. (middle) and the hyperparasitoid, *Prochiloneurus pulchellus* (Right).

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Host preference of *Diaphania indica* (Saunders) among different cucurbitaceous vegetable crops

Diaphania indica (Saunders) (Lepidoptera: Crambidae), is a polyphagous pest and it is widely distributed in Asia, Africa, America, Europe and Oceania. This pest is known as cucumber moth, pumpkin caterpillar or cotton caterpillar based on the host plants on which it feeds. *D. indica* is a serious pest of Cucurbitaceae in Asia and Africa and occasionally feeds on plants of Fabaceae and Malvaceae family. But no quantitative data are available on the damage caused by the larvae of this pest. On hatching from eggs, young larvae feed on leaves by scraping the chlorophyll content, whereas later instars fold and webs the leaves together and feeds within. The severe infestation causes development of lace-like patches on leaves with network of small intact leaf veins. The larvae also rarely feed on flowers and bores into the developing fruits particularly those fruits that touch leaves or the soil and cause substantial yield loss. Fully grown larvae are bright green in colour with a pair of white mid dorsal lines and pupation takes place among the leaves inside a transparent silken cocoon. Adult moths have translucent whitish wings with broad and dark brown marginal patches. The body is brown on top of head and thorax as well as the end of the abdomen and in between whitish in colour. Females with tuft of light brown or orange coloured hairs at anal end. The host suitability of *D. indica* among different cucurbitaceous vegetable crops under field conditions was recorded during *summer* and *kharif*, 2019 at the research farm of ICAR-Indian Institute of Vegetable Research, Varanasi. Ten cucurbitaceous vegetable crops such as ash gourd, bottle gourd, sponge gourd, bitter gourd, pumpkin, long melon, round melon, water melon, musk melon and cucumber were observed frequently for *D. indica* larval infestation and the host suitability was determined based on the average number of larvae per plant in the field. Significant variation in the *D. indica* larval infestation was observed on the different cucurbit host plants. The results of the study revealed that, among the ten cucurbitaceous vegetables, sponge gourd (0.40 larvae/plant) and ash gourd (0.76 larvae/plant) were observed to be the most preferred host plants for *D. indica* as the maximum number of larvae per plant were recorded on these plants during *summer* and *kharif*, 2019, respectively. Regarding larval infestation, the preference among different plants in field condition is as follows: sponge gourd > musk melon > cucumber > bottle gourd > long melon > ash gourd > water melon > round melon > pumpkin > bitter gourd during *summer*, 2019 and ash gourd > cucumber > long melon > pumpkin > sponge gourd > bitter gourd > round melon > bottle gourd > water melon during *kharif*, 2019. This difference in the relative preference of *D. indica* among different cucurbitaceous host plants appear to be due to variations in their nutritive qualities. The preference for most suitable hosts influences the survival and reproduction of the pest species. This behaviour of the insect can be exploited for the integrated management of this pest. The current findings will help in the further investigations and eventually benefit farmers for appropriate management of this insect pest.

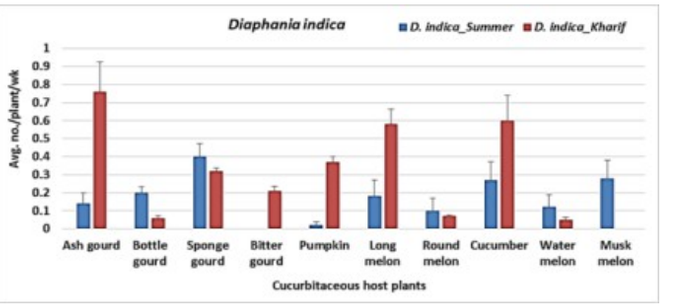

Fig : Relative preference of *Diaphania indica* among different cucurbitaceous vegetable crops during summer and kharif, 2019

Fig : Larva and adult moth of *Diaphania indica* and larvae feeding on flowers and leaves of musk melon in the field

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Integrated disease management in bitter gourd

Bitter gourd (*Momordica charantia* L.) is one among the nutritious vegetable crop, grown extensively in India. It is excellent source of minerals, vitamins, dietary fibres and possesses antimicrobial properties. As the area under bitter gourd cultivation is increasing, so too is the incidence of pests and diseases. Among diseases, downy mildew (*Pseudoperonospora cubensis*), powdery mildew (*Erysiphe cichoracearum*), leaf spot (*Cercospora citrullina*) and mosaic disease (*Begomovirus*) have become a major hindrance in bitter gourd cultivation. The yield loss due to viral diseases in cucurbits is estimated to be around 69%. It is therefore important to manage these diseases to reduce the yield loss and to produce safe bitter gourd crop. It can be achieved by adopting integrated disease management (IDM) packages, including deployment of cultural, biological and chemical components for bitter gourd disease management. Considering this fact, IDM module has been devised comprising of growing bajra as border crops, use of black silver polythene mulching, seed treatment with carbendazim 12% + mancozeb 63% @ 3g/kg, soil drenching with captan 70% +hexaconazole 5% WP @ 0.1% at 15 days after germination followed by sequential spray of imidacloprid 17.8 SL@ 7.5 ml/ 15 l + Neem oil 0.2%, captan 70%+hexaconazole 5% WP @0.1%, imidacloprid 17.8 SL @7.5 ml/ 15 l + Neem oil 0.2% and fosetyl-Al @0.1% at 10 days interval from 30 days after sowing at 10 days interval. The IDM module has reduced the incidence of mosaic disease by 40% and severity of downy mildew by 27% over the untreated control. Besides, low incidence of powdery mildew and leaf spot disease has also been observed. The same module has increased yield by 2.46 times over the control. Furthermore, highest cost benefit ratio of 1:2.1 has obtained in this module against control (1:1.20).

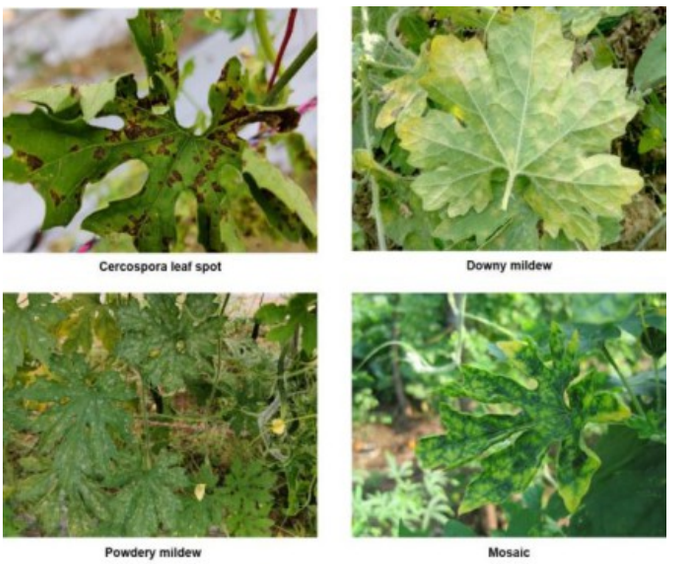

Figure : Symptoms of bitter gourd diseases

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Eucalyptus oil-based formulation can reduce microbial load on harvested vegetable

Eucalyptus is a tall, evergreen tree native to Australia. It is well known worldwide for its medicinal properties. The most important species used to produce essential oil is *Eucalyptus globulus*. Its oil is in great demand and finds application in pharmaceutical, soap and cosmetic industries. They have very good antibacterial, antifungal, antiviral, insecticidal, and antioxidant properties. The antimicrobial property is mainly because of terpenoids and phenylpropenes (1,8-cineol, limonene, α-pinene, γ-terpinene, and α-terpineol) present in them of which phenols are the most important bioactive compound. Antimicrobial property of eucalyptus oil against both plant (*Magnaporthe grisea*, Fusarium, *Pythium ultimum*, *Rhizoctonia solani*, and *Colletotrichum gloeosporioides*) and human pathogens (*Staphylococcus aureus, Streptococcus pyogenes, Streptococcus pneumonia, Escherichia coli, Pseudomonas aeruginosa*, and *Haemophilus influenza*) is well known. Eucalyptus oil based formulation can be used to wash vegetables and reduce their microbial load. The corona pandemic has raised awareness amongst the vegetable consumers leading to the demand for a vegetable wash. The efficacy of the eucalyptus oil-based formulation to reduce the microbial load on freshly harvested green chilli was checked. Washing of chili with the prepared formulation could cause 10-fold reductions in microbial population as compared to washing with tap water alone. Eucalyptus oil along with other essential plant oils with antimicrobial activity can be used to make formulation for reducing microbial load on the harvested vegetable.

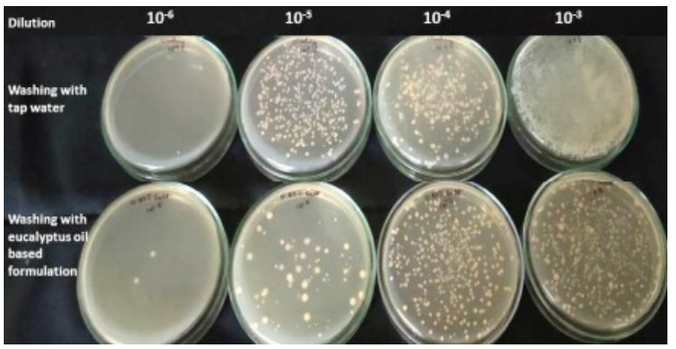

Figure : Enumeration of bacterial colonies on NA (nutrient agar) plates

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Degradation of kresoxim-methyl in/on green chilli fruit

Many pesticides are being frequently used to control pests in vegetable crops. Kresoxim-methyl, used to control powdery mildew and scab in grapes, cucumbers and vegetables. However, residues may remain in the crops and soil and may causes the health hazard to consumers. Thus, Kresoxim-methyl residues in vegetable (green chilli) were analyzed for dissipation behavior study. Field experiments were conducted during November 2019 at ICAR-IIVR, Varanasi. Chilli (Kashi Anmol) was raised following good agricultural practices (GAP). Kresoxim-methyl (Ergon® 44.3% SC formulation) was applied at 250g (recommended dose) (RD) and 500g (double the recommended dose) (DD) a.i. ha^{-1}. The green chilli fruit samples were collected at random from each replicate of the treated and control plots separately at a regular time interval on 0 (2 h after spraying), 1, 3, 5, 7, 10, 15 and 21 days after the final spray. Samples were collected in polyethene bags and stored at -4 °C until analysis to avoid any degradation. The chilli fruits were separated from the pedicels and directly analyzed without any washing or pretreatment. The residues at both the doses dissipated to below the MRL of 0.8 mg kg^{-1} with similar pattern. The dissipation behavior of kresoxim-methyl pertaining to recommended dose and double the recommended dose as per CIB&RC. The residue dissipation data reflects that the initial concentration of kresoxim methyl decreased by 91.42% (RD) and 94.12% (DD) after 21 days of spray (Figure). In this study, the dissipation kinetics of the kresoxim-methyl in green chilli showed first–order kinetics with correlation of determination (R^2) of 0.992. The half–life of kresoxim-methyl was found 6.3 days at the RD and 5.33 at the DD.

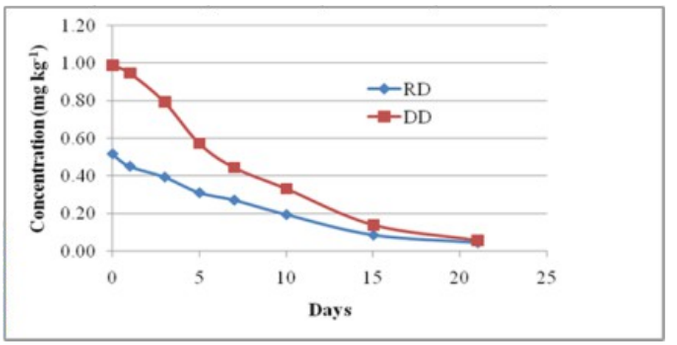

Fig : Degradation pattern of kresoxim-methyl in green chilli fruits

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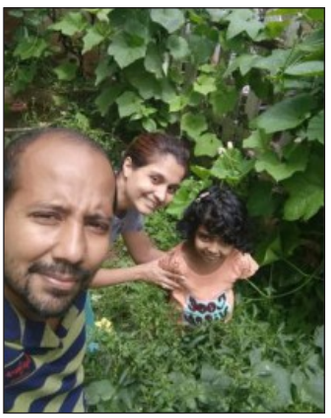
SUCCESS STORY

Home Garden produced fresh vegetables: A great stress reliever during COVID-19 lockdown

Pavan Pali from Pune is software professional. He purchased a new house in the outskirts of city in January 2018. He has a terrace and about 700 ft^2 area for gardening. He passionately started gardening buying plants, seeds and fertilizers from nurseries. But to his dismay nothing grew for 14 months and he became frustrated. The plants were lifeless, and nothing was working. To go chronologically he tried youtube channels and tried to put home fertilizers like banana peel, onion peel and then switched to composting and finally got super frustrated and went for chemical fertilizers. Chemicals like urea worked a little but plants were still not growing and were lifeless. One day he bought some vermicompost and used it in his garden. He observed no big change but the tulsi plant and curry plants showed major improvement. Next, he bought around 200 kg of

vermicompost and applied in his garden. Everything grew. Finally, he started making vermicompost in vermi-bed near his uncle's gowdown. And yes, with vermicompost everything grew well. In the pursuit of getting the best products he procured vegetable seeds from Indian Institute of vegetable research, Varanasi. He reported that, the seeds were of excellent quality and got over 95% germination. Gardening is a stress buster. His daughter Anishka and her mother Shraddha enjoy the garden and take care of it. And in the words of Pavan… *"It's a great feeling seeing a seed turn into a sapling, sapling to a plant and see that plant to fruit. My advice is to take care of the soil, the plant will take care of itself. Nourish the soil with vermicompost, organic manure, neem powder and cocopeat. In lockdown, Pune is shut, and everyone is a little pushed for fresh vegetables. The satisfaction of having something in your garden gives you peace which cannot be expressed. I was never worried about getting vegetables. The value which you get from it is priceless. Your immunity improves, you are at peace, your movement is curtailed in panic times like we are going through now. For the last two months I bought vegetable only once except potato and onion. Big thanks to IIVR"*



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Pumpkins with a purpose

A farmer demonstrates some new practices to produce a healthy, vigorous crop of pumpkins, and gets some beans as a bonus!

When a farmer has grown vegetables for more than 20 years, it seems there would not be much more to learn or try in pursuit of a better crop. That wasn't the case with Prodip Hazarika, a 46-year-old farmer who lives in Bhokotgaon, Koliapani, Jhanjimukh, Jorhat, Assam. By using new methods to produce pumpkin, a favorite crop in the area, Mr. Hazarika carved out a special niche for himself in his community.

A team from the Assam Agribusiness and Rural Transformation Project (APART), an initiative funded by the World Bank with technical support from the World Vegetable Center, approached Mr. Hazarika in 2019 and invited him to cultivate pumpkin on a climate-resilient demonstration plot. The demonstration aimed to show the differences between agricultural methods promoted by World Veg and the usual practices farmers use in their fields. Mr. Hazarika planted pumpkin on a 0.15-hectare field for the demonstration. He also implemented three improved production practices—seed trays, intercropping, and sticky traps to foster better plant growth, increase returns, and minimize his dependency on synthetic fertilizers.

Seed trays for healthy seedling production: Planting seed in trays with individual cells allowed Mr. Hazarika to closely monitor his seed use. Hybrid seed is expensive, and farmers want every seed they purchase to result in a robust healthy seedling. He filled the seed trays with sterile planting medium free from soil-borne diseases. The disease-free medium helps seedlings thrive and develop vigorous root systems, and there is less damage to delicate roots because each seedling develops in its own cell. "I used to sow the pumpkin seeds directly into the soil, but the plants often lacked vigor and were plagued with diseases," said Mr. Hazarika. "This year, after receiving the training from APART, I was enlightened about this new seed tray technique and I have seen a difference in the growth and vigor of my plants compared to last year."

Intercropping for impact: The APART team and WorldVeg introduced Mr. Hazarika to intercropping: the practice of growing two or more crops at the same time on the same field. The goal is to produce a greater yield (and income) from a given piece of land through more efficient use of resources and agro-ecological processes. Intercropping also reduces a farmer's risk by insuring against crop failure; if one crop fails from pests or diseases, the other may continue to thrive. In the training,

it was recommended to plant six rows of French bean as an intercrop between the rows of pumpkin, Mr. Hazarika said. This practice was new to me and has helped me to gain more returns from my field. Mr. Hazarika harvested 4.8 q of French bean, which was sold at Rs 15-20/kg. This yield helped him to get some bonus returns in addition to the returns from his main crop.

Yellow and blue sticky traps: Pesticide misuse is a problem in many food systems. Farmers often over-apply agricultural chemicals to protect their crops from the ravages of pests and diseases in the mistaken belief that using more pesticide will provide greater protection. But consumers want to know their vegetables are safe to eat, farmers want to stay healthy and reduce their exposure to chemicals when producing those vegetables, and everyone wants a cleaner, healthier environment.

A safer, more sustainable way to curb pests involves the use of yellow and blue sticky traps. The colors attract different pests: Yellow dazzles aphids, whiteflies, leafhoppers, leaf miners, and moths; blue draws in thrips. The APART project showed Mr. Hazarika how these simple, yet effective traps can catch some of the most troublesome pumpkin pests. "Our village is a flood-affected area and hence our crops are plagued with various insects and pests," said Mr. Hazarika. "The yellow sticky traps and blue sticky traps provided this year helped me tackle the problem."

Success in the field pays off with a good harvest: Mr. Hazarika harvested 37.35 q of pumpkin (3.735 t) from his WorldVeg supported demo plot, which he sold at an average market price of Rs 30-35 per piece. While on the other hand, from his control plot he harvested 26.12 quintals (2.612 t) of produce. Following the interventions suggested by WorldVeg, Mr. Hazarika found a difference of 11.23 q of pumpkin between both his plots. Seeing Mr. Hazarika's success, other fellow farmers in the village has also enquired him about these improved production practices and they are now planning to adopt such good agricultural practices.

Mr. Hazarika planting pumpkin seedlings on 0.15 ha field

Intercropping: French bean intercropped with pumpkin

Mr Prodip Hazarika (extreme right) along with Angshuman Bezbaruah (second from extreme right)

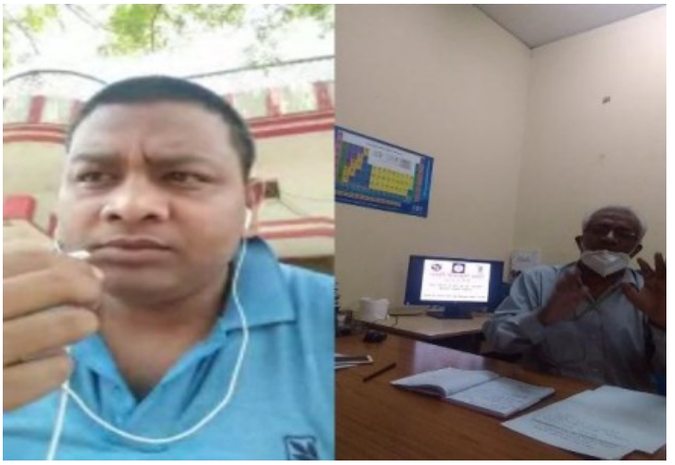
Angshuman Bezbaruah
World Vegetable Center- APART Project, Assam

EVENTS

Online training on beekeeping organized at ICAR-IIVR through video conferencing

An online training on beekeeping was organized at ICAR-IIVR on the occasion of World Honeybee Day 20th

May 2020. The experts from the institute discussed several issues with the bee keepers through video conferencing. The beekeepers were encouraged to visit Integrated Beekeeping centre at IIVR.



Kisan Gosthi and awareness programme organized under SCSP and NICRA project

A kisan gosthi cum awareness programme was organized at Badagaon, Varanasi on 25th February 2020 under SCSP and NICRA project. Dr. A. K. Singh, DDG (Hort. Science), ICAR, New Delhi was the chief guest of the function. Dr. Singh told that, improved variety of vegetables should reach to the farmers along with scientific package of practices. Dr. Jagdish Singh, Director of the institute informed that, main purposes of these projects are to increase knowledge of the farmers as well as to provide need based technologies.

Constitution Day (4th Phase) organized at ICAR-IIVR

Constitution Day (4th Phase) was organized at the institute. On that occasion Dr. A. N. Tripathi, Scientist delivered a speech on "Constitution and duty of the citizen"

ICAR-IIVR observes 3rd phase of Constitution Day workshop

A workshop was organized on 20th January 2020 to observe 70th anniversary of Constitution Day of India. All the staff of the institute along with school children took part on the workshop. Dr. Rajesh Kumar, Principal Scientist delivered a lecture on New Seed Act 2019 on that occasion.

Solanacious Day observed to popularize technologies developed by the institute

Solanacious Day was observed at ICAR-IIVR on 18th January 2020 to popularize the improved varieties of tomato, brinjal and chilly. Representatives of 19 major seed companies of India participated in this programme and showed interest in varieties developed by the institute.

Shri Sunil Baburao Mendhe, Honourable MP of Bhandara, Gondia, Maharashtra visited ICAR-IIVR, Varanasi

Shri Sunil Baburao Mendhe, Honourable MP of Bhandara, Gondia, Maharashtra visited ICAR-IIVR, Varanasi with a group of farmers. The team visited IIVR research farm and understood the novel technologies being developed by the institute. Shri Mendhe interacted with the scientists of the institute and expressed his satisfaction towards innovative works done by them.

Three scientists of IIVR awarded in ICAR Day

The agricultural scientists of the country being awarded by honourable cabinet minister for Agriculture and Farmers Welfare Shri Narendra Singh Tomar for their outstanding acheivements on the occasion of 92th foundation day of Indian Council of Agricultural Research (ICAR) on 16th July 2020. Dr. D. R. Bhardwaj, Principal Scientist, IIVR and Dr. Rekha Singh, SMS, KVK, Bhadohi were awarded with Dr. Rajendra Prasad award for writing books in Hindi and Dr. Vidyasagar was awarded with Jawarharlal Neheru best PhD thesis award during 2019.

Okra Field Day 2020 organized at ICAR-IIVR, Varanasi

A field day on Okra was organized at ICAR-IIVR, Varanasi by its Zonal Technology Management Unit on 28th October, 2020 to showcase and commercialize the promising okra varieties, hybrids and advanced lines developed by the Institute. Keeping in view the Covid Pandemic, the event was organized in virtual mode through online virtual meeting. Kashi Lalima-the red coloured Bhindi along with advance breeding lines tolerant to Okra Yellow Vein Mosaic Virus and Enation Leaf Curl Virus like VRO-120 and VRO-124 were the center of attraction for the delegates.

Dr. Debesh Chaturvedi and Kaushal Raj Sharma (DM, Varanasi) visited IIVR

Additional Chief Secretary (Ag) Dr. Debesh Chaturvedi and Kaushal Raj Sharma, DM, Varanasi visited IIVR on 28th December 2020. Director of the institute Dr. Jagdish Singh described about the importance of vegetables in nutritional security and income generation for the rural people. Dr. Chaturvedi interacted with the scientists of the institute and asked to emphasise research on underutilised vegetables for nutritional security.

Transfer/Superannuation

Transfer	Date of Relieving
Dr. C. Manimurugan	14.08.2020
Shri Bharat Raj Meena	20.08.2020
Superannuation	**Date of Superannuation**
Dr. Sudhir Singh	28.02.2020
Dr. S.K. Verma	31.08.2020
Shri Jagwat Ram	31.07.2020

Published by

Jagdish Singh, Director, ICAR-IIVR

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