Annual Report 2019

ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan

(An ISO 9001:2015 Certified Institute)

Almora - 263 601, Uttarakhand

www.vpkas.icar.gov.in

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2019

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ICAR-Vivekananda Parvatiya Krishi Anusandhan Sansthan
(ISO 9001 : 2015 Certified Institute)
Almora - 263 601, Uttarakhand
Telephone (O): (05962) 230208, 230060
Fax: (05962) 231539
E-mail: director.vpkas@icar.gov.in
Website: www.vpkas.icar.gov.in

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Ph: 45576780, Mobile : 98100 89097
E-mail: pawannanda@gmail.com

PREFACE

Innovations and their successful diffusions are main drivers of economy. In agriculture, it includes improved varieties, cultivation methods, efficient machines and effective diffusion techniques. Informal knowledge and informal institutions are also parts of the agricultural economy of the hills. Agriculture in the Himalayan region is slowly diversifying from traditional cereal based system to a blend of cereal and commercial crops like fruits and vegetables-based system. This not only increases farm income but also increases demand for fresh innovations in productivity, natural resource management, mechanization, health and nutrition of farmers, etc. Change in climate is partially being addressed through measures like water conservation, pollinator conservation, introduction of new crops, etc. However, crop damages by wild animals like monkey and wild boar are still rampant in hills.

During the last year, the Institute worked on various aspects of yield improvement of agricultural and horticultural crops, their protection and processing. In addition, focus on water harvesting, nutrition and drudgery reduction of women farmers, off-farm income generation, use of solar energy in farm mechanization, innovative extensions using ICT were more precise and location specific. Although not in its mandate, scientists in the Institute took up the challenge to address the increasing wild animal menace. Several new technologies were tested; some of them were introduced based on their effectiveness and ease of use. Awareness meetings across the society were held to develop effective combat strategy.

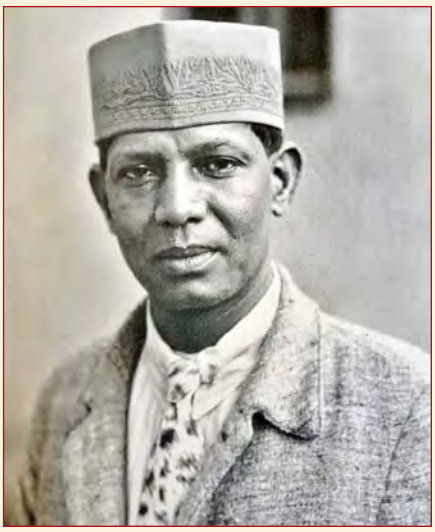
Seed is the most important component of a production increase. It was ensured by the ICAR-VPKAS that all the indented requirements are fulfilled. Working with the underprivileged, the institute provided material and technology support to farmers in the far-flung areas of North West and North East Hills. In addition, on and off-farm trainings, front-line demonstrations and awareness programmes were carried out to educate the farmers, line department officials and students who have been our clients. Skill development programmes for youths were conducted to increase availability of trained manpower in agriculture.

I place on record my sincere thanks to the Secretary (DARE) & Director General (ICAR), Additional Secretary (DARE) & Secretary (ICAR), Financial Advisor (DARE), Deputy Director General (Crop Science), Deputy Director General (Engineering), Deputy Director General (Extension), Assistant Director General (Seeds), Assistant Director General (Food & Fodder Crops) for their wholehearted support to ICAR-VPKAS. I also express my sincere appreciation to the Editorial Board, PME Cell, all my colleagues and staff members of the institute for their dedicated effort and cooperation in carrying out various activities of the institute.

Place: Almora
Date: January 2020

(A. Pattanayak)
Director

Unity of Life in the words of Padmabhushan Professor Boshi Sen



Padmabhushan Professor Boshi Sen
1887 to 31.08.1971

"Since we are hoping to evolve our conception of the unity of life let us inquire, 'What is life? To our primitive ancestors anything moving was living- the Sun, the Moon, the rushing river, the hurricane. Our legacy has been many poetic imageries. As our knowledge increases alike in depth and extent, we find it extremely difficult to define life. We say life is something that happens. But we do know that life starts its career with a single cell. Some forms of life even end their cycle as an individual cell."

"The higher we ascend in the evolutionary scale, we find multi-cellular organisms. These also begin with an individual cell. After fertilization, it multiplies and differentiates and develops into the adult structure. With this simple beginning, diverse structures and organs are formed with specified functions – attaining the climax of complications in man."

"From the study of the forms, diversity and not unity would seem to be the scheme of life. But form is not all of life. Life has other functions. To develop a living thing, it must gather energy from outside and transform it to make it its own and must also eliminate the unusable excess. To survive, it must adjust itself to the ever-changing environment. It is from the survey of functions that the unit emerges as an individual organism. The different organs of the body do not work for different masters but for the organism."

"But man is not content with merely surviving. There is something in us which propels us, consciously or unconsciously to our higher destiny. Thought and feeling are at once our great encumbrances and assests. These lead us on to dismal depths and rare altitudes. Is there any integarting background for our thoughts and emotions? That is the subjective background of our being. To know this, we have to become both the subject and object of investigation- the capacity to isolate the object of investigation from the external disturbances and at the same time the capacity to perceive with greater minuteness and refinement. This in plain words means control of our senses. With perfect control of our senses, a unity of a different quality emerges and is felt with the whole being. Then we perceive our real nature, which is full of bliss – existence, knowledge and bliss absolute."

(Taken with the permission of Author of the book – Nearer Heavan than Earth – The Life and Times of Bosi Sen and Gertrude Emerson Sen)

CONTENTS

Executive Summary

During the year, ten varieties of different crops were notified. These include two centrally released hybrids of maize - *Vivek* Maize Hybrid 57 (6,766 kg/ha) and VL Sweet Corn Hybrid 2 (10,347 kg/ha green cob) and four varieties of wheat & barley for Uttarakhand - VL *Gehun* 967 (1,988 kg/ha), *VL Gehun* 3004 (4,388 kg/ha), VL *Gehun* 2014 (5,207 kg/ha) and VLB 130 (2,100 kg/ha) in the main cereals group. In millets, finger millet variety VL *Mandua* 380 (2,000 kg/ha) was notified for Uttarakhand. Likewise, in soybean VL *Soya* 89 (2,324 kg/ha) was notified for Himachal Pradesh and Uttarakhand hills. In garden pea, VL *Sabji Matar* 13 (11,500 kg/ha) and VL *Sabji Matar* 15 (12,800 kg/ha) were notified for organic condition of Uttarakhand.

A total of nine varieties were identified for release in organic production condition of Uttarakhand hills. These include two varieties of wheat- VL *Gehun* 2029 (2,431 kg/ha, timely sown rainfed conditions) and VL *Gehun* 2028 (2,270 kg/ha, timely sown rainfed conditions); three varieties of rice - VL *Dhan* 210 (2,157 kg/ha, rainfed upland spring sown conditions), VL *Dhan* 211 (2,088 kg/ha, upland spring sown conditions) and VL *Dhan* 159 (1,964 kg/ha, rainfed upland June sown conditions) in the main cereal group. In pulses, VL *Masoor* 150 (841 kg/ha) of lentil and VL *Matar* 64 (990 kg/ha) were identified for release in timely sown rainfed condition. Likewise, in finger millet VL *Mandua* 378 (2,290 kg/ha) was identified for Uttarakhand. In vegetables, VL Cherry Tomato 1 with an average yield of 25,000-30,000 kg/ha under open-field condition and 40,000-50,000 kg/ha under polyhouse condition is the first variety of cherry tomato identified for release in the country by the AICRP - Vegetable crops. To popularize the newly released hybrids and varieties, Front Line Demonstrations (FLDs) were conducted in a total of 94.2 ha (79.2 ha area in Uttarakhand and 15.0 ha in other states). The newly released hybrids and varieties recorded a yield advantage of 37-52% in maize, 20.5% in wheat, 21.6% in rice, 36-50% in millets, 25-30% in soybean and 45-55% in black soybean over the local varieties in farmers' field. In 2018, 337.0 q seeds of various crops were produced, and in 2019 318.7 q seeds were supplied to seed producers and farmers. These seeds were supplied to clients across various states in India for both production and research purpose.

Significant progress was made in maize doubled haploid production. More than 600 doubled haploid lines of normal corn, sweet corn and QPM were generated during *kharif* 2018 and evaluated during *kharif* 2019. Eleven induction crosses involving normal corn, sweet corn and double/triple-trait biofortified hybrid combinations have been generated during *kharif* 2019, which are expected to yield another 550-600 DH lines during *kharif* 2020.

Studies on maintaining soil fertility as well as sustainability of rainfed wheat-soybean cropping system indicated that application of 67 kg P/ha/year through FYM or 58 kg P/ha/year through vermicompost (VC) is adequate to achieve the same wheat equivalent system grain yield as can be obtained by adding the recommended P (110 kg/ha) through SSP. The highest wheat equivalent grain yield of rainfed wheat-soybean cropping system was recorded with the application of 'P' through VC (67 kg/ha) provided 18% higher than the recommended NPK. Application of P-enriched compost @125% of the recommended P with seed inoculation of *Pseudomonas fragi* CS11RHI provided 50 and 53% higher microbial biomass carbon (552 $\mu g\ g^{-1}$ soil) and soil respiration (1,603 $\mu g\ CO_2\ g^{-1}$ soil) than the recommended SSP treated plot under irrigated soybean based cropping systems

(soybean-wheat, soybean-lentil and soybean-toria). These were finally reflected in the higher grain yield of different crops.

Research on cultivation methods of wheat showed that spraying of 0.5% $ZnSO_4.7H_2O$ at tillering and dough stage helped in harvesting 25% higher grain yield of irrigated wheat than without spraying. Seed drill sowing of rainfed wheat recorded 25% higher grain yield compared to broadcasting (2,096 kg/ha). Zero tillage sowing of wheat provided 3% more grain yield than conventional tillage (2,474 kg/ha). The dust mulching provided 8% higher wheat yield compared to no mulch (2,420 kg/ha). For the control of weeds in maize crop, a post-emergence spraying of tembotrione @ 120 g/ha (10,864 kg/ha) at 25DAS provided 6% higher grain yield and 33% less weed competition index as compared to the recommended pre-emergence spraying of atrazine (1500 g a.i./ha) followed by post-emergence spraying of 2,4-D amine (400 g a.i./ha). Hence, the post-emergence spraying of tembotrione @ 120 g/ha at 25DAS can substitute the recommended atrazine+2,4-D amine for weed control in maize. Experiment on the use of bioinoculant/bio-fertilizer indicated that inoculation of wheat seed with cold tolerant PGP *Pseudomonas* sp. PPERs23 recorded significantly higher grain yield of VL *Gehun* 804 (2,129 kg/ha) and VL *Gehun* 907 (2,110 kg/ha) than control. Bacterization with cold tolerant PGP consortium C2 recorded higher grain yield of VL *Gehun* 804 (2,130 kg/ha) and VL *Gehun* 953 (2,090 kg/ha) compared to uninoculated control. However, inoculation with consortium C4 provided higher yield of VL *Gehun* 907 (2,418 kg/ha).

For the availability of forage grass in hills, two varieties, *i.e.* Setaria-25 (*Setaria anceps*) and Palam perennial rye-1 (*Lolium perenne*) were identified. In fruit based agri-horti system, higher grain and fodder yield of dual-purpose wheat was recorded under open condition compared to lemon, pear, plum and apricot. The highest grain yield of wheat was recorded from VL *Gehun* 804 compared to VL *Gehun* 892, VL *Gehun* 829 and VL *Gehun* 907 under peach based agri-horti system during *rabi* season. In *kharif* season, significantly higher grain yield (1.80 t/ha) was recorded by VL *Mandua* 149 than rest of the finger millet varieties. In pecannut-based agroforestry system, variety *RCT*-1 recorded significantly higher turmeric yield (15.09 t/ha) compared to *Pant pithab* and *Swarna.* The pecan nut based agri-horti system provided higher soil enzyme activity (dehydrogenase, urease, phosphatase and β-glucosidase) compared to open condition. Significantly higher green fodder (20.70 t/ha) and wood yield (11.30 t/ha) was recorded in cutting of oak at 3 m height than others, except in cutting at 2 m height for wood yield. The highest green fodder of *Setaria kazungula* (5,583 kg/ha) was obtained under *Quercus lecuotrichophora*, compared to *Grewia optiva, Morus alba, Bauhinia retusa* and *Melia azedarach* based silvi-pastoral system. Pollarding at 3-meter height produced the highest green leaves (2,591 kg/ha) compared to coppicing, pollarding at 1-meter height and pollarding at 2-meter height.

Under conservation agriculture practices, zero tillage recorded higher wheat yield (3,223 kg/ha) compared to conventional tillage (2,646 kg/ha), but the reverse was the trend for rice. Application of recommended NPK+10 t FYM/ha to the wheat crop and growing soybean on residual fertility provided significantly higher wheat grain yield (3,625 kg/ha) compared to the application of recommended NPK to both season crops. Five years' mean annual discharge was 140% higher during 2015-19 in comparison to discharge recorded before treatment inception in 2000. This was obtained by harvesting roof and surface water in trenches along with plantation on the sides of trenches. The irrigation water requirement of 346-376, 131-189, 1.4, 1.3, 78.6, 93.5, 104.1, 176, 96.9 and 16.2 mm was estimated for rice, wheat, maize, soybean, vegetable pea, *rajma*, barley, tomato, french bean and chili crop, respectively using CROPWAT Model of FAO. The Google Earth derived Digital Elevation Models (DEMs) could be used for investigation and preliminary analysis with low initial investment and is suitable for hydrological and other water resources modelling.

The modified version of VL *Syahi Hal* "VL Metallic Plough", was found more suitable for both upland and irrigated valley conditions. For threshing of maize cobs, a maize sheller (VL Maize Sheller) has been designed with shelling capacity of 115 kg grain/h and 93% efficiency. This sheller can shell grain of maize without breaking the cob wood, which is mainly used by farmers as fuel wood. Animal feed block machine was improved for a block of 250×250×150 mm with a tropozoidel shape. It was also used to prepapre wheat straw block to grow oyster mushroom. VL hand fork and VL line maker was modified for better penetration and soil coverage.

During the year, severe rust disease was observed in garlic at Mukteshwar, whereas, medium to high incidence of purple blotch (20-30%) was noticed on both onion and garlic during March-April at experimental farm, Hawalbag. Frogeye Leaf Spot (FLS) on soybean reached up to 77.7% infection index in a few entries by September. In rice, leaf and neck blast were moderate to severe (30-50%) and high severity (>40% incidence) of false smut occurred naturally in all the experimental trials as well as at farmer's field. In finger millet, leaf, neck and finger blast were moderate to severe. Under polyhouse conditions, medium infestation of whiteflies in tomato was found during May, while in capsicum high infestation of mites was recorded during September. Low to medium incidence of root-knot nematode in rice, tomato, chilli and brinjal was recorded. Severe incidence (60-70%) of rust in *Parthenium* caused by *Puccinia abrupta* var. *partheniicola* was observed in February.

Magnaporthe sp. infecting rice have cross infectivity on wheat (VL *Gehun* 907, VL *Gehun* 892, VL *Gehun* 829 and Agra local) and barley (BL-2) varieties/genotypes under artificial inoculation conditions but not on finger millet. Out of the 51 rice genotypes, four (VL 8654, A 57, GSR-125 & GSR-142) and five genotypes (VL 31817, VL 31851, VL 31916, VL 31997 & GSR-132) were highly resistant to leaf and neck blast, respectively. Out of 162 hill germplasm collections of finger millet, 24 germplasms (14.81%) were found moderately resistant to leaf blast. The frequency distribution of neck blast and finger blast ranged 0 to 31.5 and 0 to 32.4, respectively. The identified resistance sources include GPU45, VL347, VHC 4171, VHC 4180 and VHC 4200. The entries, *viz.* GPU45, VRB-MF-859, VRB-MF-1816, VHC 3595, VHC 3607, VL 324 and VL 3796 were highly resistant to finger blast (<1% incidence). A field evaluation of bioagents and chemical fungicides against banded leaf and sheath blight of maize revealed maximum germination (88%) in seed treatment with *Pseudomonas fluorescens* (Pant bioagent 2). A minimum disease index (39.7%) was observed with seed treatment and spraying of *Pseudomonas* sp. PCRP7(2), while, least sclerotia were developed in carbendazim treatment.

During May to October, the trapped beetle diversity comprised of 33 species predominanted by *Anomala* sp. (13.1%) and *A. dimidiata* (12.1%). The catches of *A. dimidiata* were found to have decreased over previous years and become the second species in predominance. An *in-vitro* plate compatibility assay among selected insecticides and four potent *Bacillus thuringiensis* (Bt) (VLBt27, VLBt38, VLBt109 and VLBt135) showed that all the tested insecticides were toxic to *Bt,* except nimbecidine and spinosad. An outgel assay after native polyacrylamide gel electrophoresis (PAGE) was standardized and a 130 kDa protein band with chitinase activity was identified in four potent *Bt* isolates. An entomopathogenic fungi, *Alternaria alternata* strain VLH1, isolated from infected insect cadavers of greenhouse whitefly (*Trialeurodes vaporariorum*) is highly toxic against greenhouse whitefly and different aphid species.

The casing application of *Pseudomonas* strains NARs9, NPRs3, NARs1 resulted in 116.1, 54.6 and 46.1% higher yield of *Macrocybe gigantea.* The casing incorporation of siderophore producing *Pseudomonas* strains PPERs23, PGRs1 and NARs1 enhanced *Agaricus bisporus* yield by 39.6, 36.9 and 36.4%, respectively as compared to uninoculated control with positive correlation. At farmers' field, casing incorporation of *Pseudomonas* strain NARs9 provided higher *Agaricus bisporus* fruiting body yield (850g per bag) with 85% biological efficiency.

Impact of mobile SMS advisory service in uptake of agriculture extension information was studied using ex-post-facto research design in which selected farmers were trained in identification of crop diseases in rice and advisories were sent through mKisan SMS portal regularly for two years. Mobile phones were found most suitable for collecting and disseminating advisory and market information. Information need assessment of farmers showed that seeds/planting materials, manure/fertilizer use, and credit facilities are the areas where more information is needed. Effectiveness of mKisan SMS advisory services in addressing the information need of the stakeholders was reflected with level of satisfaction (82%) and awareness created among the users on the potential use of ICTs (60%). An android based mobile application 'e-sanchar' has been developed and demonstrated among farmers to cater the information needs of the farmers. Attitude of the farmers towards "e-sanchar" mobile application shows that 71.8% of the respondents have favorable attitude towards 'e-sanchar' mobile application.

The drudgery scores derived for various activities in paddy cultivation indicate highest drudgery for transplanting activity closely followed by weeding, harvesting and uprooting tasks. Assessment of energy expenditure rate of farm women in various activities of paddy cultivation categorized transplanting as heavy activity. Improved sickle 'VL Sickle' with small bent and wide bent were tested for their feasibility and drudgery reduction over local sickle in wheat harvesting. VL Sickle with small bent performed better in terms of area covered (10.4% more) and energy expenditure rate (22.7% less) in comparison to local sickle. Use of VL Line Maker in finger millet decreased Body Part Discomfort (BPD) among farm women by 60%. Nutrition sensitive agriculture interventions were introduced among farm women of high hills for more diversified and nutritive dietary pattern along with enhanced agricultural productivity and securing health and nutrition of the target group. After the implementation of nutrition sensitive agricultural intervention, MDD-W score reached to 5.5 and more than 90 per cent of women achieved minimum dietary diversity.

A study was conducted with farmers of areas with and without intervention, to compare the differences between choices made by farmers under unconstrained condition and farmers actual (constrained) practices of recommended agricultural practices in finger millet cropping system. In the absence of constraints (unconstrained condition), almost all farmers choose to practice improved varieties, right sowing time, proper irrigation and right stage of harvesting in finger millet and lentil crops. Whereas, in case of seed treatment, seed rate, method of sowing, disease and pest management; farmers are still hesitant to adopt recommended agricultural practices. Number of farmers adopting improved agricultural practices increased due to the demonstrations of improved finger millet varieties along with package of practices. However, only 29% farmers adopted line sowing as mixed cropping of finger millet with pulses like horse gram and black gram is prevalent in the area.

Farmers Producer Organisation (FPO) "*Vivekananda Krishi Utapadan Swayatt Sahakarita*" registered under self reliant cooperative act and formed with more than 100 farmers marketed vegetables like tomato, cabbage, cauliflower, raddish, onion, brinjal, potato, ginger and cucumber in local and nearby markets with higher prices. The FPO is also instrumental in collective purchase of inputs and collective efforts to control and eradicate *Tuta absoluta* from the area.

Farm advisory services were provided regularly through toll-free Farmers' Helpline Service (Telephone No. 1800-180-2311), Need based SMS service, m-Kisan portal and Krishi Samridhi Radio programme. Presently more than 4000 farmers are registered in m-Kisan portal and 700 farmers are registered in the institute initiated need based SMS services. Information are sent to farmers on different contents like varieties, crop protection measures, nutrient management, farmers fairs/field days, seed production, government schemes etc benefiting registered farmers.

INTRODUCTION

ICAR-VPKAS, Almora Campus

Experimental Farm, ICAR-VPKAS, Hawalbag Campus


Inventory of ICAR-VPKAS Technologies
95 Years of Science and Technology for Hill Regions of India
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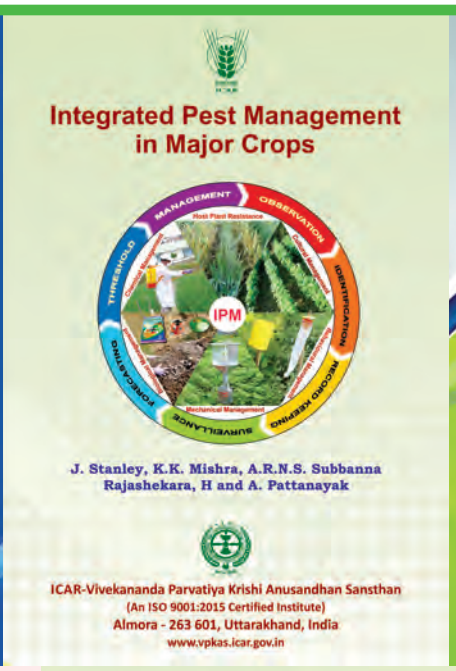
Integrated Pest Management in Major Crops
MANAGEMENT
OBSERVATION
IDENTIFICATION
RECORD KEEPING
SURVEILLANCE
FORECASTING
THRESHOLD
IPM
J. Stanley, K.K. Mishra, A.R.N.S. Subbanna
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(पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय, भारत सरकार)
भाकृअनुप-विवेकानन्द पर्वतीय कृषि अनुसंधान संस्थान
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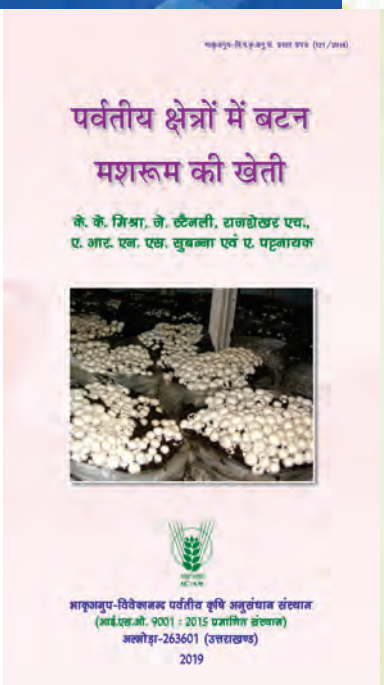
पर्वतीय क्षेत्रों में बटन मशरूम की खेती
के. के. मिश्रा, जे. स्टैनली, राजशेखर एच., ए. आर. एन. एस. सुबन्ना एवं ए. पट्टनायक
भाकृअनुप-विवेकानन्द पर्वतीय कृषि अनुसंधान संस्थान
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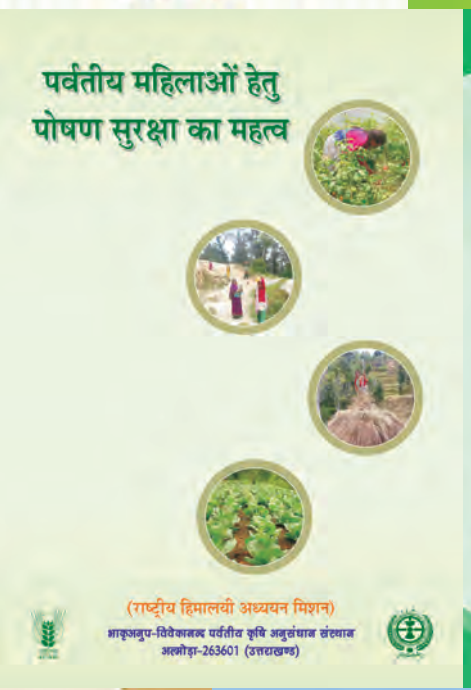
अल्मोड़ा-263601 (उत्तराखण्ड)
2019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(राष्ट्रीय हिमालयी अध्ययन मिशन)
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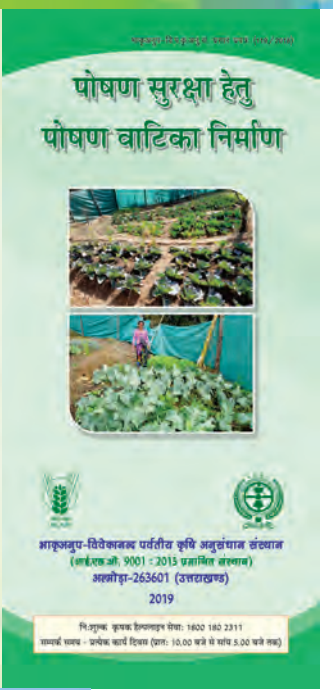
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अल्मोड़ा-263601 (उत्तराखण्ड)
2019
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2019
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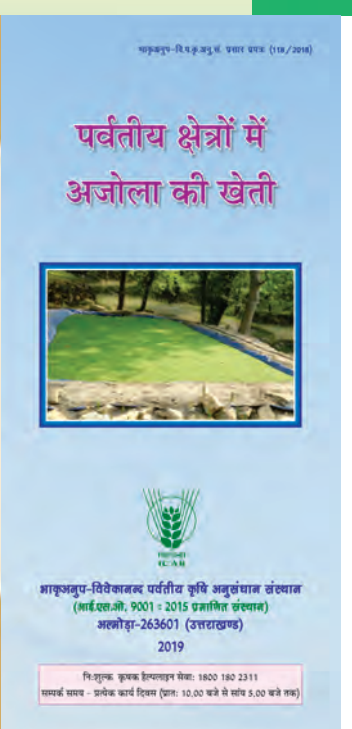
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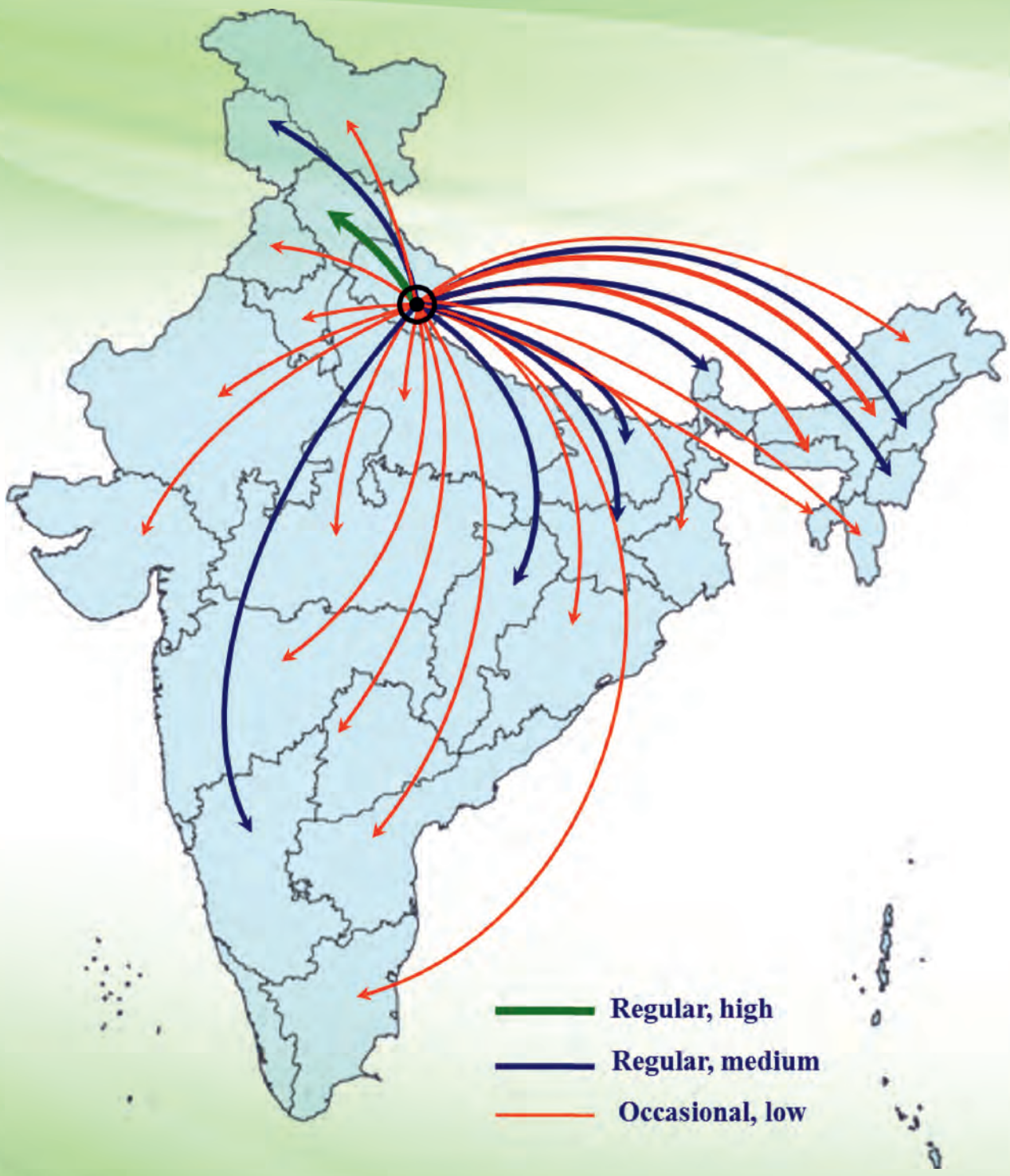
भाकृअनुप-विवेकानन्द पर्वतीय कृषि अनुसंधान संस्थान
(आई.एस.ओ. 9001 : 2015 प्रमाणित संस्थान)
अल्मोड़ा-263601 (उत्तराखण्ड)
2019
निःशुल्क कृषक हेल्पलाइन सेवा: 1800 180 2311
समर्पक समय - प्रत्येक कार्य दिवस (प्रातः 10.00 बजे से सांय 5.00 बजे तक)

Technology Delivery Map of ICAR-VPKAS



भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
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