### PROJECT 28: AICRP on Biological Control of Crop Pests

This All India Coordinated Research Project focuses on developing and validating bio-intensive pest management strategies for vegetable crops using indigenous biocontrol agents. Under the project, a comprehensive BIPM module was evaluated in cabbage incorporating Indian mustard as trap crop, DBM pheromone traps, *Trichogramma chilonis* releases, *Bacillus thuringiensis* NBAIR BtG-4 spray, Azadirachtin applications, and *Lecanicillium lecanii* NBAIR VL-8 treatments. The module achieved significant reduction in diamondback moth and aphid populations compared to untreated control while maintaining beneficial fauna including ladybird beetles and spiders at par with untreated plots. The validated BIPM module offers farmers an effective, eco-friendly alternative to chemical-intensive pest management, supporting India's Natural Farming Mission and ensuring safer vegetable production with minimal environmental footprint.

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### PROJECT 29: Strengthening and Setting up of Nucleus Stock Development Centre in Existing Apiculture Unit and Development of Agri-Start-ups (National Beekeeping and Honey Mission)

This project under the National Beekeeping and Honey Mission aims to promote scientific beekeeping as a complementary enterprise for vegetable farmers while enhancing pollination services in cucurbit and solanaceous crops. Activities include establishment of nucleus stock development centre for quality bee colonies, capacity building through training programmes, and distribution of honeybee boxes with accessories among farmers. Training programmes conducted for beekeepers from Varanasi and Mirzapur districts covered advanced beekeeping practices, colony management, and honey extraction techniques. World Bee Day celebrations engaged youth in pollinator conservation awareness. The project creates additional income streams for farmers through honey production while simultaneously improving vegetable crop yields through enhanced pollination, representing a mutually beneficial integration of apiculture with vegetable farming systems.

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### PROJECT 30: Resistance Monitoring Studies in Tomato Early Blight (*Alternaria solani*) for Azoxystrobin Fungicide

This industry-collaborative project monitors sensitivity of *Alternaria solani*, the causal agent of tomato early blight, against Azoxystrobin 23% SC fungicide to detect any shifts in pathogen sensitivity. In vitro sensitivity testing demonstrated complete spore germination inhibition, indicating maintained efficacy of the fungicide against current pathogen populations. Comprehensive dissipation kinetics studies established first-order degradation patterns in tomato fruit, leaves, and soil. Half-life values ranged from approximately two to three days

across different plant matrices and dose rates, with residues declining to safe levels within the recommended pre-harvest interval. The data generated supports determination of safe waiting periods, ensures MRL compliance, and provides baseline reference for future resistance surveillance, thereby guiding sustainable fungicide stewardship and protecting this important disease management tool for farmers.

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### PROJECT 31: Baseline Study of Tomato Powdery Mildew Pathogen Against a Fungicide Molecule (Adepidyn)

This project establishes baseline sensitivity of tomato powdery mildew pathogen (*Leveillula taurica*) against the novel fungicide molecule Adepidyn before its widespread commercial deployment. Leaf samples exhibiting powdery mildew symptoms were collected from multiple locations to capture pathogen diversity. Standardized bioassay protocols were developed involving conidia collection, inoculation on water agar amended with benzimidazole, and incubation under controlled conditions to obtain abundant spores for testing. Biotests performed using discriminatory concentrations enabled classification of fungal growth into defined sensitivity classes. The baseline sensitivity data serves as a critical reference point for future resistance monitoring programmes, enabling early detection of sensitivity shifts in pathogen populations and informing fungicide rotation strategies to prolong product efficacy and protect farmer investments in crop protection.

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### PROJECT 32: Resistance Monitoring Studies in Tomato Early Blight (*Alternaria* spp.) Against Pydiflumetofen

This project evaluates sensitivity of *Alternaria* species causing tomato early blight against Pydiflumetofen, a newer generation SDHI fungicide, through standardized conidial germination bioassays. Sensitivity testing across a concentration gradient enabled calculation of $ED_{50}$ values representing the effective dose inhibiting fifty percent germination. In vivo preventative tests on tomato plants assessed protective efficacy under controlled conditions. The resistance monitoring data ensures early detection of any emerging resistance issues in pathogen populations, supports evidence-based recommendations for fungicide usage, and contributes to anti-resistance management strategies. The project outcomes guide farmers and extension personnel on optimal fungicide selection and rotation, thereby preserving the utility of this important disease management tool while ensuring effective early blight control in tomato production systems.

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### PROJECT 33: AICRP on Nematodes in Agriculture

This All India Coordinated Research Project addresses management of plant-parasitic nematodes, particularly root-knot nematode (*Meloidogyne incognita*), in vegetable crops through integrated approaches. Research activities encompass screening vegetable germplasm for nematode resistance, evaluation of biocontrol agents, and validation of management modules under field conditions. Resistant germplasm identified includes brinjal genotypes and rootstocks, as well as okra wild relatives showing high resistance levels suitable for use in breeding programmes or as rootstocks. Potent biocontrol agents including rhizobacterial strains and *Trichoderma* species demonstrated significant juvenile mortality and field efficacy. The project generates location-specific management recommendations, identifies resistance sources for breeding programmes, and validates eco-friendly management options reducing dependence on chemical nematicides, thereby supporting sustainable and organic vegetable production systems.

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### PROJECT 34: Establishment of a Referral Laboratory for Pesticide Residue Analysis in Vegetable Crops at ICAR-IIVR, Varanasi (RKVY)

This Rashtriya Krishi Vikas Yojana-funded project established a state-of-the-art pesticide residue analysis laboratory at the Division of Crop Protection equipped with sophisticated analytical instrumentation including LC-MS/MS, rotary evaporator, nitrogen evaporator, and ultrasonic extractor. The laboratory was inaugurated by Dr. Sanjay Kumar Singh, Deputy Director General (Horticultural Science), ICAR. The facility enables multi-residue analysis of pesticides in vegetables, supporting food safety monitoring, export certification, and research on residue dynamics and dissipation kinetics. Market surveillance studies detected pesticide residues in vegetables from local markets, highlighting the importance of monitoring and safe use practices. The laboratory also standardized household decontamination methods using sodium bicarbonate solution for effective pesticide residue removal from vegetables, providing practical solutions for consumer safety.

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### PROJECT 35: AICRP on Seeds

This All India Coordinated Research Project under ICAR-Indian Institute of Seed Science addresses seed health management, storage pest control, and seed quality maintenance in vegetable crops. Research studies evaluate efficacy of plant-based neutral silite against storage insects while assessing impacts on seed quality parameters. Insecticidal seed treatment effects on seed viability during ambient storage conditions are being investigated to optimize treatment protocols. Capacity building activities included training programmes on seed health and pest

management for farmers, covering scientific seed storage practices and integrated management of storage pests. Exposure visits to National Seed Corporation facilities provided practical insights into commercial seed handling and quality assurance. The project outcomes ensure availability of quality planting material, reduce storage losses, and strengthen vegetable seed systems benefiting both seed producers and farming communities.