Externally Funded :

PROJECT 1: NICRA (National Innovations in Climate Resilient Agriculture) [ICAR]

- Identified heat-tolerant tomato hybrids (VRNTH-20126: 569.69 q/ha) yielding 75-90% higher than checks; SNP 25 µM and Proline 10 µM enhanced yield under high temperature (35±3°C); grafting on *S. torvum* produced 7.3% higher yield under moisture stress.
- Disseminated 4,800+ grafted seedlings, trained 525 farmers, and supported 764 SCSP farmers with agricultural inputs in Varanasi villages.

PROJECT 2: CRP on Hybrid Technology (Tomato) [ICAR]

- Identified processing tomato hybrids with high TSS (5.63-5.95 °Brix); Kashi Shreshth (dual purpose) and Kashi Daksh (moisture stress tolerant) identified for SVRC-UP release.
- Screened 50 lines for ToLCV resistance (Ty-2, Ty-3 genes) and identified three germplasm (AVTO-1424, AVTO-1906, AVTO-0102) resistant to root-knot nematode.

PROJECT 3: CRP on Agro Biodiversity [ICAR]

- Characterized 430 brinjal accessions with 8 fruit colors and 5 shapes; evaluated 160 cucumber genotypes for downy mildew resistance (IC-345573 moderately resistant).
- In okra, 175 wild accessions screened; *A. tuberculatus* showed fruit borer resistance; 10 amphidiploids characterized for multiple pest resistance.

PROJECT 4: Agri-Business Incubator (ABI)-IIVR [NAIF]

- Enrolled 9 incubatees (6 entrepreneurs + 3 FPOs); 4 graduated incubatees established businesses including Kashiraj Agro Producer Company (Rs. 50 lakh annual turnover).
- Promoted controlled-condition mushroom production generating Rs. 40 lakh annual turnover through agri-entrepreneurship development.

PROJECT 5: Zonal Technology Management Unit (ZTMU)-IIVR [NAIF]

Externally Funded :

- IIVR logo trademark registered (No. 6349407); licensed 7 technologies (Kashi Manohar, Kashi Bahar, Kashi Aman, etc.) generating Rs. 17.31 lakh revenue.
- Coordinated IP management for 11 ICAR horticultural institutes; organized IPR awareness programs reaching 200+ participants.

PROJECT 6: Discovery of Novel Genes for ToLCNDV Resistance in Cucurbits [NASF-ICAR]

- Screened 128 muskmelon $F_{2:3}$ populations and 95 genotypes for ToLCNDV; identified 51 resistant genotypes from muskmelon germplasm.
- In cucumber, evaluated 113 genotypes and 164 mapping populations; identified 11 resistant and 20 resistant accessions respectively for QTL mapping.

PROJECT 7: Proteomic and Metabolomic Studies in Tomato [CABIN-ICAR]

- Wild tomato showed 321 differentially expressed proteins vs. 183 in cultivated types under *Alternaria* challenge; identified defense-related proteins (t-SNARE, glucan endo-1,3-β-D-glucosidase).
- Heat-tolerant hybrid VRNTH18283 showed 11,453 metabolite features with 22 discriminatory biomarkers (lycopene, chlorogenic acid, α-tocotrienol) linked to stress tolerance.

PROJECT 8-15: DUS Testing [PPV&FRA]

- Maintained reference collections: Pointed gourd (18 varieties), Okra (42), Brinjal (evaluated 16-20 entries), Tomato (32-53 entries), Cucumber (24), Pumpkin (25), Bottle gourd (25), Bitter gourd (23), Pea (42), French bean (27).
- Evaluated candidate hybrids, farmer varieties, and typical varieties for distinctiveness, uniformity, and stability as per PPV&FRA guidelines.

PROJECT 16: SNP Discovery for QTL Mapping in Pea [DST-SERB]

- Developed two RIL populations (180 and 125 individuals) for multi-flowering trait mapping at ICAR-IIVR and RRS Kushinagar.

Externally Funded :

- Synthesized 307 SSR markers; identified 39 and 24 polymorphic primers in MF-02W (15.2%) and MF-01P (9.4%) populations respectively.

PROJECT 17: ICAR-LBS Award

- Transformed CRISPR/Cas9 construct (pOREO4-Cas9-TSS) into tomato cv. Kashi Aman for enhanced TSS through *Agrobacterium*-mediated transformation.
- Standardized transformation protocol using cotyledonary leaf explants with successful calli regeneration for SDN1 gene editing.

PROJECT 18: CRP on Molecular Breeding (Cucumber)

- Initiated marker-assisted introgression of downy mildew resistance (QTLs dm5.1, dm5.2, dm5.3) from PI-197088 into Kalyanpur Green and PCUC-9.
- Generated F_1 crosses between susceptible varieties and resistant donor for backcross breeding program.

PROJECT 19: CRP on Molecular Breeding (Tomato)

- Confirmed Ty2, Ty3 (ToLCV), Ph3 (late blight), and Mi1 (nematode) resistance genes in AVTO1914/1915 donors using molecular markers.
- Developed 4 F_1 hybrids crossing Kashi Aman and Kashi Adarsh with resistant donors for pyramiding multiple resistance genes.

PROJECT 20: FIELD HEAT - Tomato Heat Tolerance [DBT]

- Screened 78 tomato genotypes (including 22 wild species) under dry heat and 127 genotypes under humid heat conditions.
- Identified heat-tolerant genotypes using MGIDI (Multi-trait Genotype-Ideotype Distance Index) for adaptation to Indian monsoonal climate.

PROJECT 21: AINP (Transgenic Vegetables)

Externally Funded :

- Advanced Bt brinjal (Cry1Aa3, Cry1Ac) to T12-T15 generation; transgenic lines showed high BSFB larval mortality in shoot and fruit bioassays.
- Transgenic tomato expressing AtDREB1A (drought/salt/cold) and BcZAT12 (drought/salt/heat) genes advanced to T14 generation.

PROJECT 22: Horti-based Integrated Farming System [UP State]

- Validated 5 IFS models integrating horticulture, poultry, fisheries, goatery, and apiary for marginal farmers in Uttar Pradesh.
- Multi-tier cropping with short-duration vegetables resulted in 20-30% income increase; improved nutritional security and year-round employment.

PROJECT 23: CRP on Hybrid Technology (Cauliflower)

- Evaluated 21 early cauliflower hybrids; VRCFH-301 (202 q/ha) and S-1522 (185 q/ha) identified as most promising with good curd compactness.
- Advanced 5 CMS lines (white and orange curd); developed 12 hybrids using stable CMS lines for early maturity segment.