

PANTNAGAR

Govind Ballabh Pant University of Agriculture & Technology (GBPUAT) Uttarakhand

AICRIP center was established in 1966 at Department of Genetics & Plant Breeding, College of Agriculture, GBPUAT, Pantnagar with an objective to develop varieties suitable for plains of Uttarakhand.



Major contributions

Crop Improvement

Plant Breeding

- Since 1969, 17 varieties of rice were released including 3 aromatic and 2 hybrids.

Varieties released

Sl. No.	Name of Variety	Year of Release	Duration (Days)	Yield (q/ha)	Area of adaptation
1	IR 24	1972	120-125	55-60	Plains of Uttarakhand Valleys upto 500 m & Uttar Pradesh
2	Prasad	1978	120-125	50-55	Plains of Uttarakhand & Uttar Pradesh
3	Govind	1982 SVRC, 1989 CVRC	95-100	30-35	U.P., Uttarakhand, M.P. Pondichery, Gujarat, Maharashtra
4	Pant Dhan 4	1983	126-130	55-60	Plains of Uttarakhand & Uttar Pradesh
5	Manhar	1985	115-120	50-55	Plains of Uttarakhand & Uttar Pradesh

Sl. No.	Name of Variety	Year of Release	Duration (Days)	Yield (q/ha)	Area of adaptation
6	Pant Dhan 6	1986	113-120	40-45	Transplanted Conditions of Uttarakhand Hills
7	Pant Dhan 10	1992	121-130	58-60	Transplanted Condition in Plains of Western Uttar Pradesh & Uttarakhand
8	Pant Dhan 11	1992	118-125	42-48	Transplanted Conditions of Uttarakhand hills
9	Pant Dhan 12	1994	113-122	55-58	Plains of Uttarakhand & Uttar Pradesh
10	Pant Sankar Dhan 1	1997	115-120	55-60	Plains of Uttarakhand & Uttar Pradesh
11	Pant Dhan 16	2001, CVRC	105-110	50-55	Bihar, West Bengal & Haryana
12	Pant Sugandh Dhan 15	2003	135-140	35-40	Plains of Uttarakhand & Uttar Pradesh
13	Pant Sankar Dhan 3	2004	130-135	65-70	Plains of Uttarakhand & Uttar Pradesh
14	Pant Sugandh Dhan 17	2004	135-140	35-40	Traditional basmati growing areas of Northern India
15	Pant Dhan 18	2007, CVRC	125-130	55-60	A.P.,Karnataka,Kerala, WB T.Nadu, Bihar, Chhattisgarh
16	Pant Dhan 19	2007, CVRC	120-125	55-60	Punjab, Haryana, Gujarat & Maharashtra
17	Pant Sugandh Dhan 21	2012	135-140	35-40	Plains of Uttarakhand & Uttar Pradesh



- Release proposals:** Release proposal of four rice cultures, two each for SVRC and CVRC were submitted in 2014. UPR 3425-11-1-1 (IET 22096) is named as Pant Dhan 24 and found suitable for Bihar and Orissa whereas UPR 3506-7-1-1 (IET 21953) named as Pant Basmati 2 is found suitable for basmati growing areas

of Punjab, Haryana, U.P. and Uttarakhand. However, UPR 2825-30-1-2 (Pant Sugandh Dhan 25) is an aromatic rice variety found suitable for Uttarakhand plain. Another culture UPR 2962-6-2-1 (Pant Dhan 23) will be a replacement of our popular variety Pant Dhan 12 for mid-early maturity group of irrigated ecosystem in the state.

Crop Production

Agronomy

- **Time and method of planting:** Based on a large number of dates of sowing trials, the plantings for varieties belonging to different durations were estimated and popularized. Broadcast transplanting yielded significantly on par with conventional transplanting with a labour economy of about 35-50% over conventional random planting.
- **Concept of System of Rice Intensification (SRI):** Package and practices like age of seedling, planting date, spacing, weed management practices, evaluation of varieties etc were developed for SRI cultivation.



Concept of direct seeding aerobic rice: Package and practices have been developed for direct seeded aerobic rice cultivation.

Soil fertility and fertilizer use: Numerous culture/varieties including national and local checks of early, mid-early and medium duration and basmati cultures were evaluated at low, optimum and high input mainly nitrogen (i.e. 50, 100 & 150 % recommended doses of N) and aerobic conditions.. Crop management experiments were conducted for the exploitation of production potential of hybrid rice and basmati type varieties

- **Slow release fertilizers to increase NUE:** The slow release fertilizers and urea super granule (USG) showed an economy of 25-30% in fertilizer use over urea in irrigated as well as rainfed lowland rice.
- **Zinc deficiency (Khaira disease) and its control:** Zn deficiency could be corrected by spraying with 0.5% ZnSO₄ mixed with 0.25% Calcium hydroxide in water in 1965 revived the cultivation of rice in Tarai.
- **Use of Bio-fertilizer:** Use of Azolla as green manuring with or without fertilizer N increased rice yield by about 25%.



Browning of *Sesbania aculeata* by 2,4-D

- **Nutritional requirement of rice in long term rice-wheat cropping system:** Yield decline of rice under rice-wheat cropping was found related with soil depletion of nutrients and could be arrested by the application of balance fertilization. In a long-term experiment of comparative study of using organic, chemical and integrated approach of nutrient management, sustainable nutritional packages were identified.



- **Water requirement and irrigation:** Water requirement of transplanted rice (from planting to maturity) in Tarai is around 1000 mm, 40-60 % of which is met through irrigation (10 to 20 irrigations of 50 mm each). Maintaining 1 cm water flooding to field capacity was also sufficient to meet the water requirement of rice instead of flooding 5 cm.
- **Weed control:** In transplanted rice, one pre-emergence application of herbicide followed by one hand weeding at 20-25 DAT was found most prominent in controlling weeds of transplanted rice and equally good with weed free check and two weeding.

Plant Physiology

- **Physiology of grain filling process:** Physiological studies have revealed that terminal stage of phenology decides the adversity on yield and yield components which is generated much earlier during the course of ontogeny. Relative water Content (RWC) did not show any significant relationship with yield component and grain yield.
- **Studies on nutritional genomics (Biofortification):** It was found that average content of Fe and Zn in the rice grain was 40-60 mg/kg and 20-30mg/kg respectively
- **Aerobic rice cultivation:** The study revealed that alternate wetting and drying treatment can save five irrigations with slightly reduced yield components and yield.
- **Studies on photothermic indexing:** By delaying sowings the number of days taken to attain PI stage was reduced by 6 days while the reproductive and grain filling (ripening) period got increased by one day. Several breeding lines were characterized.
- **Studies on nitrogen use efficiency:** Among the varieties tested for nitrogen use efficiency (NUE) PA 6444 was found to possess good responsiveness to N-levels

coupled with higher yield closely followed by KRH 2, Ajaya, and BPT 5204.

- **Effect of Boron on spikelet fertility:** Application of Boron at 0.4ppm resulted in significant increase in grain yield (4-8%).
- **Radiation use efficiency:** Radiation Use Efficiency was found to be highest at panicle initiation stage and lowest at flowering stage.
- **Heat tolerance in genotypes:** Screening of high temperature tolerance showed that IET 20734, IET 20893, IET 20907 and IET 20905 were least affected. The dry matter remobilization under high temperature was higher in rice genotypes IET 21577, IET 21415, IET 21404 Varadhan and PHB-71.
- **Silicon solubilizers:** The efficiency of silicon solubility and availability can be enhanced by addition of carrier molecules or by application of sodium potassium silicates. Silicon accumulated rice genotypes were found to be tolerant to biotic and abiotic stresses.

Crop Protection

Plant Pathology

Host plant resistance

- Each year, more than 500 entries under different nurseries viz. GSN, NSN, NSN-Hill, NHSN, DSN, IRBBN, false smut screening, etc. were planted and sources of resistance identified and reported.
- Bacterial leaf blight caused (BLB) by *Xanthomonas oryzae* pv. *oryzae* (Xoo) is the most serious biotic constraint of rice in the region. The existing population of Xoo in the region was highly virulent and genetically diverse.



BLB infested field

- Twenty one haplotypes were detected among a collection of 193 strains by each of the PCR technique used i.e. rep-PCR and IS-PCR. The high value of total haplotypic diversity (HT=0.79) reflected the genetic heterogeneity of Xoo population infecting popular varieties.
- Strains responsible for severe BLB outbreaks were grouped into 8 distinct lineages. Virulence assay revealed the presence of 11 pathotypes. The interaction of lines with strains was found significant ($P < 0.01$) confirming the pathogenic specialization of Xoo in U.S.Nagar. The potential of Xa21 alone or in combination

with xa13 and xa5 could be exploited for pyramiding into well adapted rice cultivars for the effective management of the pathogen in this region.

Disease Control Trials

Over the years, several new fungicides were evaluated against major diseases of rice in the region. The following were found effective:

- *Sheath blight* - Foliar sprays with Haxaconazole (Contaf) @ 2.0 ml/l, and Propiconazole 25 EC (Tilt) @ 1 ml/l were found highly effective. Foliar sprays with RIL 010 1.5 ml/l, @ Thiafluzamide 0.75 ml/l, Validamycin @ 2 ml/l, Contaf @ 2.0 ml/l, and Tilt @ 1 ml/l were found highly effective. Foliar sprays with Biotas @ 2.5 ml/l, Neem Azal @ 3ml/l were found effective. Foliar sprays with *Trichoderma harzianum* or *Pseudomonas fluorescence* (rice leaf isolates) were found best in reducing sheath blight. Soil amendments with neem cake, FYM or Dhaincha enhanced the effectivity of *P. fluorescence* in increasing seedling emergence, reducing sheath blight severity
- *False smut* - Propiconazole 25 EC (Tilt) @ 1.0 ml/l was found to be highly effective. Chlorothalonil @2.0 g/l, Propiconazole 25 EC @ 1.0 ml/l, Indofil M-45, @ 2.5 g/l and Copper hydroxide 3.g/l were found highly effective in controlling false smut.
- *Bacterial leafblight* - Kocide 2000 54 DF @2.5.g/l was found significantly effective. Higher rates of Streptocycline (20 g or 25 g/ha) + Copperoxychloride (1000g or 1500 g/ha) applied as foliar sprays significantly reduced disease index (BLB) and chaffy grains as well as increased grain yield/ha and 1000 grain weight. neem leaf extract followed by Neem Azal, Hing, Neem Gold and. Haldi help in reducing the disease index (BLB). Kasu B + Copper oxychloride or cow urine applied three days before Bacterinashak spray resulted in maximum reduction in disease index (BLB).
- **Effect of fertilizers on disease incidence:** Incidence of sheath rot was maximum in KRH-2 (47.07%) followed by Jaya (18.45%). The disease incidence increased with increase in the nitrogen level from 120 to 180 Kg. /ha. Application of neem coated urea resulted in minimum disease index. Application of zinc sulphate along with NPK significantly reduced sheath rot.

Entomology

- **Identification of resistant sources against major insect pests:** The centre has evaluated thousands of donors, elite breeding lines, cultures and varieties for resistance against major insect pests. The data generated is being used for the breeding of resistant varieties.
- **Assessment of losses due to insect pests:** Several experiments have been conducted to assess the losses due to Stem Borers and Leaf Folder under natural and simulated conditions. It has been estimated that each percentage of white ear caused by stem borers may result in 0.50-1.38 percent loss in yield in different varieties.
- **Compatibility of insecticides and fungicides:** Acephate + Hexaconazole, Acephate + Tricyclazole, Dinotofuran + Hexaconazole, Dinotofuran + Tricyclazole have been found compatible.
- **Monitoring of insect pests and their natural enemies:** Yellow Stem Borer, BPH, WBPH are the major pests of rice while leaf folder, rice hispa and rice bug are minor pests in *tarai* and plains of Uttarakhand. Pink stem borer and WBPH are major pests in Almora district. Among natural enemies, *Telenomus* sp., *Tetrasticus* sp. parasitize the egg mass of YSB while spiders feed on hoppers and leaf folder.
- **Effect of rice cultivation system on incidence of insect pests:** Influence of rice cultivation methods and cultivars on the incidence of rice stem borer indicated that damage of rice stem borer was significantly low in direct seeded rice as compared to normal transplanted rice. Population of BPH was higher in direct seeded rice as compared to transplanted rice. In case of WBPH mean population was higher in transplanted rice as compared to direct seeded rice and more hoppers were seen in KRH-2 as compared to HKR-47.
- **Effect of date of planting on incidence of insect pests:** Infestation of stem borer was significantly higher in normal and late planted crop as compared to early planted crop while mean population of BPH and WBPH remained more or less similar in different plantings.
- **Front line demonstrations on management of YSB through pheromone traps:** Front line demonstrations conducted in basmati rice at large scale in farmer's field revealed that sex pheromone mediated male annihilation technique is highly effective in managing yellow stem borer below economic injury level.



Hopper burn caused by BPH and WBPH