

RESEARCH ACCOMPLISHMENTS AND RECOMMENDATIONS

2009



**DIRECTORATE OF RESEARCH
ANAND AGRICULTURAL UNIVERSITY
ANAND 388 110**

Citation

Research Accomplishments and Recommendations, 2009
Anand Agricultural University
Anand- 388 110

Published by

Directorate of Research
Anand Agricultural University
Anand - 388 110

Compiled by

Sh. S. N. Shah
Sh. V. P. Usadadia
Sh. R. B. Chauhan
Dr. R. H. Patel
Dr. M. M. Pathak

Year of Publication

November, 2009



ANAND AGRICULTURAL UNIVERSITY
ANAND – 388110



MESSAGE

It is my pleasure to release "**Research Accomplishments and Recommendations of 2009**" covering multidisciplinary technologies developed by the scientists of Anand Agricultural University for the benefit of the farming community. I hope that the new technologies generated on various aspects viz.; crop improvement, natural resource management, plant protection, horticulture, animal science, agricultural engineering and dairy technology will serve as source to update the knowledge and useful for future research strategies.

I take this opportunity to congratulate all those scientists who directly or indirectly were involved in developing these technologies and Director of Research and his team for compilation, editing the information and bringing out this publication.

(M. C. VARSHNEYA)
VICE CHANCELLOR



**ANAND AGRICULTURAL UNIVERSITY
ANAND – 388110**



FOREWORD

It is indeed a great pleasure to put forward the publication on “Research Accomplishments and Recommendations of 2009” covering technologies developed and recommended by scientists of all the faculties of Anand Agricultural University for farming community.

The technologies developed will help to improved quality and quantity of agricultural produces for up-liftment of socio economics welfare of the farming community of the state as a whole and last men of rural areas as particular.

I complement and congratulate all the scientists, conveners of respective AGRESCO sub committees and co-workers of Anand Agricultural University for their sincere efforts, dedication and competent service in developing technologies for the field of agricultural and related areas.

I am highly indebted to Hon’ble Vice Chancellor Prof. M. C. Varshneya for his constant guidance and inspiration provided for bringing out this publication.

**(A. R. PATHAK)
DIRECTOR OF RESEARCH & DEAN
FACULTY OF P.G.STUDIES**

PREFACE

In the modern era of industrialization, agriculture is still important source of employment and livelihood as around 70% of national population depends on agriculture for their livelihood, so development of technologies in agriculture for the benefit of farmers is most important and holy duty of those who are connected with agriculture.

Sincere, dedicated and hard efforts of our scientists resulted into valuable recommendations for farmers and scientific communities which have been confirmed through exhaustive, critical, meaningful and healthy deliberations in various research sub-committees

Technologies developed should be popularized for adoption either by direct interaction with farmers or through extension workers. In this context scientists should avail the facility provided in adaptive trial project and disseminate the technology to farmer's through FLDs.

University has made good progress but there are many challenges before scientists. With respect to climate change and its effects on agriculture; a convention of VCs of all SAUs was organized which after thorough discussion, gave good suggestions on the subject which need to be adopted to formulate sound research programmes for combating the climatic change. Similarly, value addition, marketing be given due weightage.

Many technologies have been developed by the scientist but are still pending for patenting. In the competitive era of globalization, it is required to

make sincere efforts to patent them at the earliest to bring credit to the University.

The Research work conducted during the year 2008-09 has been very well discussed and churned through different AGRESCO Sub-committees for bringing out useful and beneficial recommendations for farmers, entrepreneurs, scientific community and stake holders. The AGRESCO sub-committees of various disciplines met to review the progress of research and scrutinized findings of experiments and finalized the new technical programmes.

The recommendations made by different committees for adoption by the farmers in agriculture are listed below.

Name of the Sub-committee	No. of recommendations	
	For farmers	For scientific community and entrepreneurs
Crop Improvement	4	-
Crop Production	15	1
Plant Protection	14	4
Basic Science	-	1
Dairy Science, Agri. Engineering & Processing	3	11
Animal Production	8	6
Animal Health	-	8
Social Science	-	3

Recommendations for farming community

I CROP IMPROVEMENT

1. Rice : Gujarat Anand Rice 13 (GAR 13)



A fine grained mid-late rice variety GAR 13 showed an overall yield increment of 18.4 % over check variety GR 11. The variety also showed superiority in its disease and pest reaction including WBPH.

(Research Scientist (Rice), Main Rice Research Station, AAU, Nawagam)

2. Pigeonpea : Anand Grain Tur 2 (AGT 2)



The variety Anand Grain Tur 2 (AGT 2) registered 24.6 % and 41.1% yield superiority over checks BDN 2 and ICPL 87119, respectively. The variety possesses white seed colour and bold seed size besides showing resistance to wilt. It was recommended for Middle Gujarat Agro Climatic Zone.

(Associate Research Scientist, Pulse Research Project, AAU, Vadodra)

3. **Pumpkin : Anand Pumpkin 1 (AP 1)**



The variety Anand Pumpkin 1 (AP 1) showed 48.95 % and 43.26 % higher fruit yield, respectively over checks and Pusa Vishwas. This variety also possessed better nutritional quality including higher carotene content. The variety is superior in disease and pest reaction than the checks. The variety was recommended for release in the middle Gujarat.

(Research Scientist, Main Vegetables Research Station, AAU, Anand)

4. **Marvel Grass : Gujarat Anand Marvel Grass 2 (GAMG 2)**



GAMG 2



GMG 1

The Pasture Grass variety Gujarat Anand Marvel Grass 2 (GAMG 2) showed 39.0 % and 41.6 % higher yield of green forage and dry matter yield over check variety GMG 1, respectively. It possesses better nutritional quality than GMG 1. It was recommended for release for the pasture lands of the Gujarat state.

(Research Scientist, Forage Research Station, AAU, Anand)

II CROP PRODUCTION

[A] CULTURAL PRACTICES

1. Crop growth simulation modelling and crop-weather relationship of wheat cv. GW-496

The farmers of middle Gujarat Agro Climatic Zone III (AES II) growing wheat (GW 496) are advised to sow the crop during November when mean air temperature approaches 24.5 ± 1.20 C with six irrigations i.e. at pre-sowing, crown root initiation, tillering, booting, flowering and milking stage to obtain higher yield and net return.

(Prof. & Head, Dept. of Agril. Meteorology, BACA, Anand)

[B] CROPPING SEQUENCE

2. Paddy based remunerative cropping sequence

The farmers of middle Gujarat Agro Climatic Zone III (AES II) growing kharif rice (GR 7) are advised to follow the crop sequence rice in kharif and lucerne (Anand 2) (Fodder + seed production) in rabi under irrigated conditions with application of RDF to both the crops for getting higher production and net realization.

Alternatively, farmers can also follow the next best rice-castor (GCH 5) sequence for securing more net income.

(Research Scientist, Main Rice Research Station AAU, Nawagam)

[C] NUTRIENT MANAGEMENT

3. Integrated Nutrient Management in castor

The farmers of middle Gujarat Agro Climatic Zone III (AES II) are advised to sow castor (GCH 5) during late kharif (last week of August to first week of September) after in situ sunnhemp green manuring and apply 100 % recommended dose of fertilizer ($75-50-0$ NPK kg ha⁻¹) or castor sown without green manuring should be fertilized 75 % with RDF + 25 % N through FYM to get higher seed yield of castor and net realization.

(Research Scientist, Regional Research Station AAU, Anand)

4. Effect of nitrogen, phosphorus and zinc on yield of wheat GW-1 under supplementary irrigation in Bhal condition

The farmers of Bhal and Coastal Zone (Agro climatic zone-VIII) growing wheat (GW 1) are advised to fertilize the crop with 20 kg N and 40 kg P₂O₅ and 25 kg ZnSO₄ ha⁻¹ as basal and 20 kg N ha⁻¹ at first irrigation to get higher grain yield and net return with two supplementary irrigations (first irrigation at CRI and second at 40-45 DAS).

(Research Scientist, Agricultural Research Station AAU, Arnej)

5. Effect of dates of sowing and levels of vermicompost on clusterbean

The farmers of middle Gujarat Agro Climatic Zone III (AES II) growing clusterbean (GC 1) are advised to sow their crop during the 2nd week of August and to apply 1.0 tonne vermicompost ha⁻¹ besides 18-46 NP kg ha⁻¹ in the crop row at the time of sowing for securing maximum yield with net return.

(Research Scientist, Agricultural Research Station AAU, Derol)

6. Integrated nutrient management in rabi sweet corn

The farmers of middle Gujarat Agro Climatic Zone III (AES II) growing rabi sweet corn (Madhuri) are advised to apply 100 % RDF (120-40-0 kg NPK ha⁻¹) along with castor cake @ 2 t ha⁻¹ for securing higher yield and net profit.

(Research Scientist, Pulse Research Station AAU, Vadodara)

7. Site specific nutrient management in onion-sorghum (F) sequence

The farmers of middle Gujarat Agro Climatic Zone III (AES II) adopting onion–sorghum (fodder) cropping sequence are advised to fertilize the onion (Pusa red) as per soil test value (NPK) along with 20 kg S ha⁻¹ through gypsum in S deficient soil to get the higher yield and net realization.

(Professor, IFFCO Project AAU, Anand)

[D] WEED MANAGEMENT

8. Weed Management in Soybean

The farmers of middle Gujarat Agro Climatic Zone III (AES II) growing soybean are advised to apply pre-emergence application of

pendimethalin @ 0.75 kg ha⁻¹ + HW at 30 DAS or post emergence application of quizalofop @ 50 g ha⁻¹ (In 500 lit. water per hectare) + HW at 30 DAS or interculturing and hand weeding at 20 & 40 days after sowing for effective weed management in soybean.

(Agronomist, AICRP on Weed Control, AAU, Anand)

[E] WATER MANAGEMENT

9. To study the performance of System of Rice Intensification (SRI)

The farmers of middle Gujarat Agro Climatic Zone III (AES II) having irrigation and drainage facility in their fields are advised to grow kharif paddy (GR 11) by adopting SRI technique for getting higher yield and net profit.

Details of SRI Technology

Land Preparation	: Apply 5 t FYM ha ⁻¹ and plough the field.
Age of seedling	: 10-12 days old seedling (Two leaves stage).
Transplanting	: Transplant one seedling per hill (25 cm x 25 cm). The root of the seedling should not be disturbed. Transplanting should be done a day after puddling the field having no standing water.
Nutrient Management	:
Fertilizer dose	: 50-12.5 NP kg ha ⁻¹
Basal	: 25 kg N + 12.5 kg P ₂ O ₅ ha ⁻¹
Split	: Remaining 25 kg N in two equal splits at 20 DAT and a week before panicle initiation stage
Bio-fertilizer	: Apply liquid biofertilizer @ one litre ha ⁻¹ (10 ⁹ cfu ml ⁻¹) each of <i>Azotobacter chroococcum</i> (ABA 1) and <i>Bacillus coagulans</i> (PBS 16) at the time of transplanting.
Weed Control	: Use cono-weeder 2 to 4 times for weed control.
Water Management	: Keep the soil moist i.e. standing water needs to be drained out up to PI stage; and maintain 5 cm depth of standing water from panicle initiation to dough stage

*(Research Scientist, Main Rice Research Station AAU, Nawagam and
Research Scientist, Microbiology, AAU, Anand)*

10. Response of chickpea to irrigation schedules and fertilization

The farmers of middle Gujarat Agro Climatic Zone III (AES II) growing chickpea (GG 1) are advised to irrigate their crop twice each of 50 mm depth; first at branching stage (30 DAS) and second at pod filling stage (70 DAS) with application of 40 kg P₂O₅ ha⁻¹ as basal at the time of sowing in the crop row for securing higher yield and net realization.

(Research Scientist, Agricultural Research Station AAU, DeroI)

11. Irrigation scheduling in semi rabi pigeonpea

The farmers of middle Gujarat Agro Climatic Zone III (AES II) growing semi rabi pigeonpea (BDN 2) are advised to apply two irrigations each of 60 mm at branching and pod development stage for higher yield. Moreover, under limited irrigation availability; farmers may apply only one irrigation at branching stage to get higher yield and net profit.

(Research Scientist, Pulse Research Station AAU, Vadodara)

12. Effect of spacing and irrigation levels on clusterbean seed production

The farmers of middle Gujarat agro climatic zone III (AES II) growing clusterbean for seed purpose are advised to sow clusterbean (GC 1) during first fortnight of September as late kharif at a spacing of 45 x 10 cm and give two irrigations at branching and flowering to get higher yield and net income.

Growing clusterbean (Pusa Navbahar) for seed purpose are advised to sow cluster bean during first fortnight of September as late kharif at spacing of 45 x 10 cm with two irrigation at branching and flowering to get higher net income.

They are further advised for growing vegetable clusterbean (Pusa navbahar) for seed production.

(Research Scientist, Regional Research Station AAU, Anand)

[F] HORTICULTURAL CROPS

13. Integrated nutrient management on growth, yield and quality of white onion cv. GWO-1:

The onion cv. GWO-1 growers of middle Gujarat Agro-climatic Zone-III (AES-II) are advised to apply recommended dose of fertilizer 20 t ha⁻¹ FYM + 75-60-50 NPK kg ha⁻¹ along with Azospirillum (*Azospirillum lipoferum* ASA 1) or Azatobactor (*Azotobacter chroococcum* ABA 1) @ 2.5 kg ha⁻¹ at the time of transplanting in morning or late evening hours to get higher yield with more “A” grade bulbs and net return with CBR 1:5.76 and 1:5.74, respectively.

14. Fertilizer requirement in drumstick cv. PKM - 1

The farmers of middle Gujarat Agro Climatic Zone III (AES - II) are advised to apply 5 kg FYM at transplanting and 10 kg FYM + 100 g nitrogen and 25 g potash per plant of drumstick variety PKM 1 from first year onward. Among them the half dose of nitrogen and full dose of potash and FYM should be given in first week of May after pruning at 90 cm above ground and remaining half dose of nitrogen in the month of October to obtain higher yield with net return and the highest CBR (1:7.61).

15. Effect of spacing and pruning on yield of drumstick cv.PKM 1.

Farmers of middle Gujarat Agro Climatic Zone III (AES -II) are advised to plant the drumstick variety PKM 1 at a spacing of 2.0 m X 2.0 m and prune the plants from second year and thereafter at 90 cm height from ground level during the month of May for obtaining higher yield and net return.

(Professor & Head, Deptt. of Horticulture, BACA, AAU, Anand)

III PLANT PROTECTION

[A] PLANT PATHOLOGY

1. Management of diseases in tomato

Farmers of middle Gujarat growing tomato are advised to adopt the following practices for effective and economical management of early blight (*Alternaria solani*) and leaf curl virus diseases.

- (i) Raise the tomato seedlings under 40 mesh nylon net.
- (ii) Apply carbofuran 3G @ 1.0 kg a.i. ha⁻¹ (1 g spot⁻¹) as spot application before transplanting.

(iii) Give alternate six sprays of deltamethrin (1 %) + triazophos (35%) @ 0.036% (10 ml in 10 lit. of water) and mancozeb 75 WP 0.2% (27 g in 10 lit.), starting from 20 days after transplanting and remaining sprays at 15 days interval.

OR

(iii) The marginal farmers, who can not afford the cost of insecticides are advised to apply alternate six sprays of neem leaf extract 10% (1 kg green leaves in 10 lit. of water) and mancozeb 0.2% (27 g in 10 lit.) at 15 days interval starting from 20 days after transplanting.

(Professor & Head, Deptt. of Plant Pathology, BACA, AAU, Anand)

2. Management of nematodes in cotton

Cotton growers of middle Gujarat Agro Climatic Zone III are advised to treat the seeds with a *proteobacteria*, *Gluconacetobacter diazotrophicus* strain 35-47 (2 x 10⁸ cfu) @ 20 g kg⁻¹ cotton seed for effective and economical management of root-knot nematodes (*Meloidogyne javanica* patho type-2).

(Professor & Head, Deptt. of Nematology, BACA, AAU, Anand)

3. Management of diseases in tobacco

For integrated management of root-knot nematodes (*Meloidogyne incognita* and *M. javanica*) and frog-eye spot (*Cercospora nicotianae*) diseases in bidi tobacco field, farmers of middle Gujarat are advised to plant their crop during first to third week of September to obtain higher gross realization.

(Research Scientist, Plant Pathology, BTRS, AAU, Anand)

4. Management of maydis leaf blight in maize

Farmers of the middle Gujarat growing maize in kharif are advised to treat the seeds with captan @ 3 g kg⁻¹ seed at the time of sowing followed by two sprays of tebuconazole 0.025 % (10 ml in 10 lit. of water) OR propiconazole 0.025 % (10 ml in 10 lit. of water) at 35 and 50 days after germination for the effective and economical management of maydis leaf blight (*Helminthosporium maydis*) disease.

5. Management of diseases in maize

Farmers of the middle Gujarat growing maize in kharif are advised to treat the seeds with carbosulfan 25 SD @ 30 g /kg and furrow application of carbofuran 3 G @ 0.5 kg a.i.ha⁻¹ (16.6 kg ha⁻¹) at the time of sowing to manage the stalk rot (*Fusarium moniliforme*) disease and phytonematodes i.e., stunt (*Tylenchorhynchus vulgaris*) and lesion (*Pratylenchus zaeae*) nematodes.

(Asstt. Res. Sci. (Pathology), Main Maize Res. Station, AAU, Godhra)

[B] AGRICULTURAL ENTOMOLOGY

6. Control of cotton mealy bug

The cotton growers are advised to apply methyl parathion 2% dust on the soil @ 25 kg ha⁻¹ one month after germination followed by spray application of profenophos 50 EC 0.1% (20 ml in 10 lit. water) OR carbaryl 50 WP 0.2% (40 g in 10 lit.) OR triazophos 40EC 0.1% (25 ml in 10 lit.) OR methyl-o-demeton 25 EC 0.05% (20 ml in 10 lit.) at appearance of mealy bug (*Phenacoccus solenopsis*) infestation in the field for its effective control. Add detergent powder @ 10 g in 10 litres of spray fluid.

7. Management of chickpea pod borer

The farmers of middle Gujarat growing chickpea are advised to install pheromone traps with *Helicoverpa armigera* lures @ 40 traps ha⁻¹ for effective and economical management of pod borer (*H. armigera*). The traps should be installed one month after sowing and at one feet height above the crop canopy covering the whole field uniformly. The lure should be changed after every 3 weeks.

8. Management of okra shoot and fruit borer

The farmers of middle Gujarat growing okra are advised to install pheromone traps with *Earias vittella* lures @ 60 traps ha⁻¹ for effective and economical management of shoot and fruit borer, *E. vittella*. The traps should be installed 3 weeks after germination and at one feet height above the crop canopy covering the whole field uniformly. The lure should be changed after every 3 weeks.

(Professor & Head, Deptt. of Entomology, BACA, AAU, Anand)

9. Conservation of biodiversity

The farmers of central Gujarat, north Gujarat, Kutch and Saurashtra are advised to retain / restore the Pilu tree (*Salvadora persica*) around their crop field for retaining insectivorous / beneficial birds and conservation of biodiversity. The birds retained in the landscape over a longer period consequently help in natural regulation of insect pests of agricultural crops.

(Ornithologist, AINP on Agril Ornithology, AAU, Anand)

10. Control of brinjal shoot and fruit borer

For effective and economical management of shoot and fruit borer, *Leucinodes orbonalis* in brinjal, the farmers of middle Gujarat are advised to adopt following modules.

- (i) Installation of sex pheromone traps @ 40 traps ha⁻¹ 20 days after transplanting.
- (ii) Clipping of terminal infested shoots at weekly interval 20 days after transplanting.
- (iii) Spray of neem seed kernel suspension 4% (400 g in 10 lit. water) at 15 days interval during flowering and fruit setting.

(Asstt. Res. Sci. (Ento.), Main Vegetable Research Station, AAU, Anand)

11. Control of brinjal shoot and fruit borer

The farmers of middle Gujarat growing green gram during kharif season are advised to treat the seed with thiamethoxam 70% WS @ 3 g kg⁻¹ seeds OR acetamiprid 20% SP @ 7g kg⁻¹ seed OR imidacloprid 70% WS @ 7.50 g kg⁻¹ seed for the effective and economical control of sucking pests like aphid, jassid, thrips and whitefly.

(Asstt. Res. Sci. (Ento.), Pulse Research Scheme, AAU, Vadodara)

12. Threshold levels of pod borer in chickpea

The farmers of Bhal and Coastal Agro Climatic Zone-VIII are advised to initiate the control measures for pod borer, *Helicoverpa armigera* in

chickpea considering the economic threshold levels i. e., 20 larvae /20 plants at vegetative stage and 15 larvae /20 plants at pod formation stage of the crop.

13. Control measures for pod borer in chickpea

The farmers of Bhal and Coastal Agro-climatic Zone-VIII are advised to practice following modules for effective and economical management of pod borer, *Helicoverpa armigera* infesting chickpea

- (i) Installation of bird perches @ 100 ha⁻¹ two weeks after germination.
- (ii) Spraying of neem seed kernel suspension @ 5% (500 g in 10 lit.) when first instar larvae are seen.
- (iii) Dusting of methyl parathion 2% dust @ 25 kg ha⁻¹ at the time of pod formation in 50% plants.

14. Botanical leaf extract for pod borer in chickpea

Farmers of Bhal & Coastal Agro-climatic Zone-VIII are advised to spray 5% leaf extract of naffatia (*Ipomoea carnea*) OR arduhi (*Adhatoda vasaca*) three times (add sticker @ 1 ml lit.⁻¹ of spray fluid), first at vegetative stage, second at flowering on 50% plants and third at pod formation on 50% plants for the effective and economical management of pod borer (*Helicoverpa armiger*) a in chickpea crop grown under conserved soil moisture.

(Assoc. Rese. Sci. (Ento.), Agricultural Research Station, AAU, Arnej)

IV DAIRY SCIENCE, AGRIL. ENGINEERING AND PROCESSING

[A] DAIRY SCIENCE

1. Annatto variety for pigment

The Pink Flower Red Pod variety of annatto (*Bixa orellana* L.) plant is recommended as seeds of this variety which contain higher amount of essential bixin pigment compared to white flower Green Pod variety.

(Professor & Head, Deptt. of Dairy Chemistry, DSC, AAU)

[B] AGRICULTURAL ENGINEERING

1. Design and development of Aonla pricking machine

The aonla pricking machine (capacity 30 kg h⁻¹ at 100 rpm) developed by Anand Agricultural University, Anand is recommended for the use of the farmers and entrepreneurs for pricking of aonla. The developed machine has higher capacity as compared to manual pricking and is efficient as well as economical in pricking aonla fruits.

2. **Earth Tube Heat Exchanger assisted low humidity seed storage system**

The Earth Tube Heat Exchanger (ETHE) assisted Storage System developed by Anand Agricultural University is recommended for safe storage of seeds and grains below 33 °C temperature and relative humidity below 65%, throughout the year. The system helps in minimizing the loss of germination and viability of the seeds.

(Dean, Faculty of FPT & BE, AAU, Anand)

V **ANIMAL PRODUCTION**

1. **Concentrate mixture with bypass protein**

- i. In Dahod district, buffaloes yielding 5-10 kg and 10.5 - 12.5 kg milk day⁻¹, respectively on an average feeding of 2.0 to 5.3 and 3.6 to 5.2 kg concentrate mixture daily. In order to fulfill their nutrient requirement, the farmers are advised to feed additional compound concentrate mixture 1.0, 1.5 and 2.0 kg to buffaloes producing 5-10 kg milk per day during monsoon, summer and winter, while buffaloes yielding daily 10.5 to 12.5 kg need to be given additional 1.5 and 2.5 kg compound concentrate mixture during summer and winter.
- ii. In Dahod district, the crossbred cows yielding 8-12 kg milk per day receive on an average 4.0 kg concentrate mixture during winter. To fulfill their nutrient requirement, the dairy farmers are advised to feed additional 1.5 kg compound concentrate mixture.
- iii. Inclusion of 900 g of formaldehyde treated rapeseed meal (bypass protein) replacing 1.6 kg compound concentrate mixture in mature pasture grass (*Dicanthium annulatum*) based ration of growing crossbred calves of 6-12

months results in 39% higher growth without any increment in the feed cost per kg gain.

- iv. Buffalo female calves of 6-12 months age when fed concentrate mixture with bypass protein (formaldehyde treated Guar bhardo, 16.0 %; Groundnut extraction 5 % and Rapeseed extraction, 5.0 %) attain 35 % higher body weight gain with a reduction in the feed cost by 19 percent.
- v. Supplementation of 1.0 kg of formaldehyde treated Guar meal (bypass protein) replacing 2.5 kg concentrate in the ration of crossbred cows yielding 15-17 kg milk increases milk fat % and fat yield and results in higher return.
- vi. Supplementation of 1.0 kg of formaldehyde treated rapeseed meal (bypass protein) replacing 2.0 kg of home made concentrate mixture in the ration of cross-bred cows yielding daily 20 kg milk results in increased milk fat and higher return.

(Research Scientist, Animal Nutrition Research Station, AAU, Anand)

2. Calving calendar

The calving prediction calendar prepared by Anand Agricultural University can be used to predict calving date with good accuracy hence the pre-calving care can be taken two months in advance to avoid post-partum complications.

(Research Scientist, Reproductive Biology Research Unit, AAU, Anand)

3. Supplementation of bypass fat in concentrate mixture

Supplementation of bypass fat (Calcium salts of long chain fatty acids) @ 200 – 250 g daily in concentrate mixture to early lactating crossbred cows yielding 10 – 12 kg milk per day increases milk production (8.8%) and fat (0.5%) and reduces service period (23 days) which is economically beneficial.

(Research Scientist, LRS and ANRS, AAU, Anand)

Recommendations for scientific community and entrepreneurs

I CROP PRODUCTION

1. Crop growth simulation modeling and crop-weather relationship of wheat cv. GW-496

- Minimum temperature is found most effective and influencing weather parameter in wheat grain yield. Minimum temperature more than 12.5 °C during December and 11.0 °C during January are unfavourable for optimum grain yield of wheat.
- The regression model ($Y=12014.11-432.373T_{\min}(\text{Jan})-206.133T_{\min}(\text{Dec})$ $R^2 :0.90$) can be used to predict the wheat yield under normal sown condition.
- An increase in the minimum temperature during January by 1 °C there is reduction of yield by 432 kg ha⁻¹, while increase in minimum temperature by 1 °C during December reduces the yield by 206 kg ha⁻¹.
- Growing degree days (GDD) requirement for wheat crop were found 1815 ± 57.
- CERES-wheat model of DSSAT can be used satisfactorily for predicting, phenology and yield of wheat cv. GW-496 under normal sown condition

(Professor and Head, Deptt. of Agril. Meteorology, BACA, AAU, Anand)

II PLANT PROTECTION

[A] PLANT PATHOLOGY

1. Paddy genotypes resistant against diseases

The paddy genotypes, IET- 19026, IET- 19045, IET -19046, IET- 19590, IET- 19346, IET-18628, IET-18643, CB 01-001 and TP-1028 were identified as multiple resistance against bacterial blight (*Xanthomonas oryzae* pv. *oryzae*), blast (*Pyricularia grisea*) and sheath rot (*Sarocladium oryzae*) diseases under artificial inoculation and high disease pressure in field conditions. They can be used in breeding programme for developing multiple resistant varieties.

(Action: Res. Sci.(Pl. Path) Main Rice Research Station, AAU, Nawagam)

[A] AGRICULTURAL ENTOMOLOGY

2. Pesticide residue in tomato

Three sprays of emamectin benzoate in *rabi* tomato @ 11 g a. i. ha⁻¹ at 10-day interval starting from fruiting stage do not pose residue problem in tomato fruits harvested third day onward after third application.

3. Pesticide residue in tomato

Two sprays of emamectin benzoate in *kharif* okra @ 11 g a. i. ha⁻¹ at 10-day interval starting from fruiting stage do not pose residue problem in okra fruits harvested 24 hours after second application.

(Residue Analyst, AINP on Pesticide Residues, AAU, Anand)

4. Paddy genotypes resistant to insect pest

The paddy genotypes, NWGR-2006, NWGR-99126 and NWGR-1045 were resistant and NWGR-99022 and Masuri moderately resistant to leaf folder (*Cnaphalocrocis medinalis*); while NWGR 2006, NWGR 99022 and Masuri and NWGR 99126 and NWGR 1045 were identified as moderately resistant to stem borer (*Scirpophaga incertulas*) under high pest pressure in field conditions. These genotypes can be used in breeding programme for developing resistant varieties.

(Assoc. Res. Sci. (Ento.), Main Rice Research Station, AAU, Nawagam)

III BASIC SCIENCE

1. Salt tolerance rice varieties/genotypes

It is recommended to the scientific community that four rice varieties, namely Jaya, Gurjari, IET-15429 and IET-13428 exhibited higher salt tolerance at germination and seedling growth at the both levels of salinity (20 & 24 mmhos cm⁻¹).

(Professor & Head, Deptt. of Ag. Botany & Biotechnology, AAU, Anand)

IV DAIRY SCIENCE

1. Mozzarella cheese

A technology is developed for making good quality Mozzarella cheese analogue using rennet casein, plastic cream, maltodextrin, emulsifying salt, acidifying and flavouring agents, common salt and water.

2. Whey Protein for ice-cream

A technology is developed by incorporating whey protein concentrate in the ice cream mix to manufacture good quality medium fat (6.5% fat) ice-cream, having 42% less calories and 35% more protein than standard ice cream (11% fat).

3. Gulabjamun

A process of making quality Gulabjamun from buffalo milk fortified with whey protein concentrate is developed.

4. Vacuum tray drying for drying of Cheddar cheese

A technology of vacuum tray drying is developed for drying of Cheddar cheese, mature Cheddar cheese and Mozzarella cheese (< 5% moisture).

Before using this dried cheese for pizza topping, it is to be ground and rehydrated (to – 60% moisture) with water containing emulsifying salts in specific proportion and common salt.

5. Sugar free Rasagolla

A technology is developed for making sugar free Rasagolla with acceptable quality using cow milk Chhana (2% fat and 8.5% SNF).

Cook Chhana balls and soak in Sorbitol solution added with aspartame to make sugar free Rasagolla with shelf life of about 40 days under refrigerated storage ($7 \pm 2^{\circ}\text{C}$).

6. Low fat Rasagolla

A technology is developed for making Low fat Rasagolla with acceptable quality using cow milk Chhana (2% fat and 8.5% SNF).

Cook Chhana balls and soak in double refined sugar solution to obtain Low-fat Rasagolla which has shelf life of about 40 days under refrigerated storage ($7 \pm 2^{\circ}\text{C}$).

7. **Reduced-fat mozzarella cheese**

A technology is developed for manufacture of good quality reduced-fat Mozzarella cheese by alteration in casein; fat ratio of cheese milk, addition of whey protein concentrate to milk, homogenization of cheese milk and reduction in cooking temperature without affecting overall performance on Pizza pie.

(Professor & Head, Deptt. of Dairy Technology, DSC, AAU, Anand)

8. **Malai kulfi**

A technology is developed to make good quality Malai kulfi with traditional rich taste and greater acceptability.

The process involves standardization of milk, concentration by open pan, addition of sugar, spices and condiments, cooling, freezing in candy mould and hardening.

9. **Sugar free malai kulfi**

A process for preparation of sugar free Malai kulfi is developed.

(Professor & Head, Deptt. of Dairy Processing and Operations, DSC, Anand)

10. **Symbiotic dahi**

The formulation and process for manufacturing symbiotic dahi with mango pulp or onion shreds is developed.

(Professor & Head, Deptt. of Dairy Microbiology, AAU)

11. **Annatto colour for butter**

Seeds of Pink Flower Red Pod variety of Annatto (*Bixa orellana* L.) plants are recommended for manufacture of oil soluble annatto colour for butter.

(Professor & Head, Deptt. of Dairy Chemistry, AAU)

V **Animal Production**

1. **Milking time for triple cross and kankrej cow**

As compared to cold-dry season, milk let down time and total milking time is more in hot- humid season in triple cross ($\frac{1}{4}$ HF x $\frac{1}{4}$ Jersey x $\frac{1}{2}$ Kankrej) and Kankrej cows .

(Research Scientist, LPM, Vety. College, AAU, Anand)

2. Gene of mehsani buffalo

Mehsani buffalo is monomorphic with respect to *NmuCI* RFLP at PPARGCIA gene, *Hinf I* RFLP at PIT1 gene, *Sfa N I* RFLP at PI gene and *Hph I* RFLP at Leptin gene with B alleles fixed at all these loci.

(Professor & Head, Deptt. of AGB, Vety. College, AAU, Anand)

3. Mineral mixture

In Anand district, supplementation of mineral mixture as per BIS (2002) or the appropriate mineral mixture with Zinc in chelated form to repeat breeder buffaloes does not affect pregnancy rates or blood plasma profile (concentration of Cu, Mn, Zn and Co).

4. Bacteria in rumen fluid of buffalo

Population of total bacteria per ml in rumen fluid of buffalo is 109 while that of fibrolytic and non-fibrolytic bacteria is 108 and 106 per ml respectively. *Ruminococcus albus*, *Ruminococcus flavifaciens* and *Fibrobacter succinogenes* are the dominant fibrolytic bacteria and contribute 5.1, 4.2 and 1.7 per cent to total bacterial density. *Streptococcus bovis* and *Selenomonas ruminantium* are the dominant nonfibrolytic bacteria but are less than 1 % of total bacteria.

5. Gene sequences of buffalo rumen

The sequence similarity of 16S rRNA gene sequences of buffalo rumen uncultured methanogens revealed archaea belonging to three major classes viz., *Methanomicrobia* (41.22 % clones), *Thermoplasmata* (13.6 % clones) and *Methanomicrobiales* (12.12 % clones) while 33 % clones remained unidentified and formed a novel group. The sequences are available at NCBI, USA with accession No EU794740-EU794854, EU814699-EU814714.

(Research Scientist, ANRS, Vety. College, AAU, Anand)

6. Ovum pick up

Initiation of ovum pick up (OPU) during first and second follicular wave does not affect the follicular aspiration, oocyte recovery and cleavage rate up to morulla stage in HF X Sahiwal cows.

(Research Scientist, RBRU, Vety. College, AAU, Anand)

VI Animal Health

1. Oral administration of cypermethrin and acephate

Oral administration of Cypermethrin (6.25, 8.33 and 12.50 mg/kg b.wt.) and Acephate (23.62, 32.5 and 47.45 mg/kg b.wt.) daily for 28 days cause dose dependent genotoxicity in Wistar rats.

2. Treatment for inflammatory conditions

Ketroprofen @ 3.0 kg/kg b.wt. administered intramuscularly and repeated at 18 hrs. interval in sheep and calves (crossbred and Kankrej) gives satisfactory result in the treatment of inflammatory conditions.

3. Oral administration of levofloxacin

Oral administration of Levofloxacin @ mg/kg body weight repeated at 12 hrs interval is satisfactory in the treatment of infectious disease of layer and broiler birds.

(Professor & Head, Deptt. of Vet. Pharmacology & Toxicology, Vety. College, AAU, Anand)

4. A herbal gel for bovine subclinical mastitis

A herbal gel containing Devdaru oil 1.0 g, Nilgiri oil 0.20 g, Harida Ghansatva 0.04 g., Gandhaprasarinee Ghansatva 0.04 g, Madhuyashti Ghansatva 0.01 g and Shudh Gandhaka 1.0 g per 10 gram of drug in emulsifier gel base is an effective treatment for bovine subclinical mastitis by administering topically on affected quarter(s) after each milking for 5 consecutive days.

(Professor & Head, Deptt. of Vet. Medicine, Vety. College, AAU, Anand)

5. Use of combinatorial PCR for identification of pathogenic *Brucella* spp.

Combinatorial PCR can be used for identification of pathogenic *Brucella* spp. using following primer sets.

- I. B4 (F) Tgg CTC ggT TgC CAA TAT CAA
B5 (R) CgC gCT TgC CTT TCA ggT CTg
- II. JPF (F) gCg CTC Agg CTg CCg ACg CAA
JPR-ab (R) CAT TgC ggT Cgg TAC Cgg Ag
- III. JPF (F) gCg CTC Agg CTg CCg ACg CAA
JPR-ca(R) CCT TTA CgA TCC gAg CCg gTA
- IV. 1S(F) gTT CgC TCg ACg TAA CAg CTg
1AS(R) gAC CgC Cgg TAC CAT AAA CCA

6. PCR based serotype detection

PCR based serotype detection of pathogenic *Listeria monocytogenes* isolates can be done using following primers sets.

- I. lmo0737 (F) Agg gCT TCA Agg ACT TAC CC
(R) ACg ATT TCT gCT TgC CAT TC
- II. ORF2819 (F) AgC AAA ATg CCA AAA CTC gT
(R) CAT CAC TAA AgC CTC CCA TTg
- III. ORF2110 (F) AgT ggA CAA TTg ATT ggT gAA
(R) CAT CCA TCC CTT ACT TTg gAC
- IV. prs (F) gCT gAA gAg ATT gCg AAA gAA g
(R) CAA AgA AAC CTT ggA TTT gCg g

7. Use of sulphonamides in Hemorrhagic septicaemia cases

Based on *in vitro* sensitivity studies and PCR assay, use of *sulphonamides* in Hemorrhagic septicaemia cases should be discouraged.

(Professor & Head, Deptt. of Vet. Microbiology, Vety. College, AAU, Anand)

8. Hard milker

Hard milker cases in animal can be successfully operated with B.P. blade No. 15 by cruciate incision.

(Professor & Head, Deptt. of Surgery and Radiology, Vety. College, Anand)

VII Social Science

1. The yardstick of CV for accepting the results of forage crop

The yardstick of CV for accepting the results of forage crop experiment is 14 percent for green and dry fodder yield character.

(Professor & Head, Deptt. of Ag. Statistics, BACA, AAU, Anand)

2. The scale to measure Entrepreneurial attitude of Youth

No	Statement
1.	Agro based Enterprise helps in creating job opportunities. (+)
2.	The creation of new agro based enterprise is very risky. (-)
3.	I like to start agro based enterprise understanding the creation of self employment. (+)
4.	It is not advisable to spend money on agro based enterprise. (-)
5.	I feel that there is not a good future of agro based enterprise in our country.(-)
6.	Agro based Enterprise is useful in solving unemployment problem. (+)
7.	I prefer to have service but not own agro based enterprise. (-)
8.	I don't like to advise any one to become entrepreneur. (-)
9.	I prefer to be apart of agro based enterprise than other enterprise. (+)
10.	Agro based enterprise is a best source of employment for irrespective level of educated rural youth(+)
11.	I feel that establishment of agro based enterprise is unproductive. (-)
12.	I think that agro based enterprise can be a good source of Income for low invertors. (+)
13.	Agro based enterprise is a best option to earn money for landless rural people.(+)
14.	I think that it is difficult to follow legal procedure for agro based enterprise(-)

The attitude shall be measured against each statement on five point quantum viz. strongly agree, agree, neutral, disagree and strongly disagree with a score of 5, 4, 3, 2 and 1, respectively for positive statements. The scoring procedure for the negative statements will reverse.

3. The scale to measure business anxiety of youth

No.	Statements
1	I feel tension to start business. -
2	I am able to manage funding for business. +
3	In my opinion it is better to employ as serviceman rather than businessman.-
4	I think without any experience, no one can start new business successfully. +
5	I feel myself competent to work with other business competitor. +
6	I am able to do hard work in business. +
7	I think I am not competent to be a businessman because I dislike interacting with other.
8	I am not able to follow legal procedure of business.-
9	In my opinion one should always think over secondary sector of business. +
10	I would like to establish business if given opportunities. +
11	I think I am capable to manage credit required to start business. +
12	I think that I am not able to diversify the business. -
13	I retard to employ in business because of labor problem. -
14	Business is the best opportunity for unemployed youth. +
15	In my opinion business-ship is not a prestigious job -
16	I dislike establishing business because it does not permit person to live social life.-
17	I like business to fulfill family demand. +
18	I think business is not my cup of tea. -

The attitude shall be measured against each statement on five point quantum viz. strongly agree, agree, neutral, disagree and strongly disagree with a score of 5, 4, 3, 2 and 1, respectively for negative statements. The scoring procedure for the positive statements stands reverse.

(Asstt. Ext. Edn., School of Baking, FPT & BE, AAU, Anand)