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Research Accomplishments and Recommendations

2018

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RESEARCH ACCOMPLISHMENTS AND RECOMMENDATIONS

2018

Editors
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Dr. N. C. Patel

VICE CHANCELLOR
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ANAND - 388 110

MESSAGE

It is heartening to note that "Research Accomplishments and Recommendations 2018" covering multi disciplinary technologies developed by the team of scientists of Anand Agricultural University for the benefits of farming and scientific community of the state and nation is being published. Anand Agricultural University has made a significant dent in agricultural research and has been the nerve centre for researchers and academicians. It is apt that as a reflection of their research endeavor, this publication is being released. I am sure that this booklet will be a very useful source of information to all those concerned for the welfare of agriculture and related sectors. I congratulate all the scientists and others concerned with research activity in the university for the valuable work done by them, which will not only help to increase the agricultural production, but also improve the quality of the farm produce and other related activities in the state.

I compliment Dr. K. B. Kathiria, Director of Research and Dean PG studies and his team for their sincere efforts in bringing out this valuable publication covering the new technologies developed by Anand Agricultural University. My best wishes to all the scientists of AAU for their continuing efforts in upscaling the research output of the university through their scientific endeavor.

N Patel

(N. C. Patel)

ANAND AGRICULTURAL UNIVERSITY
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Director of Research and Dean PG Studies

FOREWORD

It is indeed a matter of pride and pleasure for me to put forward the 13th annual publication of "Research Accomplishments and Recommendations 2018" of Anand Agricultural University. The publication contains technologies developed by the scientists of Anand Agricultural University for the benefits of farmers, scientists, veterinary / dairy professionals, extension workers, entrepreneurs and others associated with human and animal welfare through input of agricultural and related technologies. I appreciate the zeal and enthusiasm of our scientific team and congratulate them for the untiring efforts in developing these technologies. I am sure that this will help not only in boosting the progress in agriculture and allied sectors, but will also result in quality produce and solutions to many problems and challenges being faced at present.

I take this opportunity to express my sincere thanks to Dr. N. C. Patel, Hon'ble Vice Chancellor of Anand Agricultural University for his constant valuable guidance and inspiration for improving research activities of the university and for bringing out this publication. I am also thankful to all the conveners of AGRESCO subcommittees and Deans of various faculties and Unit Heads for their support in the process of monitoring, scrutinizing and executing the research projects of the university by conducting AGRESCO meetings smoothly and meaningfully. The staff of the Directorate of Research deserves special appreciation for their untiring support to me so as to justify the mandate of my office.

(K. B. Kathiria)

SUMMARY

The research work carried out in different fields of agricultural sciences during the year 2017-18 has been discussed by different AGRESCO sub-committees for bringing out useful and beneficial recommendations for farmers, scientific community, entrepreneurs and other stake holders.

The numbers of recommendations made by different committees are listed below.

Name of the sub-committee / faculty	No. of recommendations	
	For farmers/ entrepreneurs	For scientific community
Crop Improvement & Basic Science	06+01	02+03
Crop Production	21	-
Plant Protection	07	32
Dairy Science and FPT & BE	25	03
Agri. Engineering & AIT	07	08
Animal Production	07	05
Animal Health	-	05
Social Science	-	02
Total	**74**	**60**

RECOMMENDATIONS FOR FARMING COMMUNITY

CROP IMPROVEMENT

PLANT BREEDING

1. Crop : Goundnut

Variety : Gujarat Groundnut 34 (GG 34)

The summer groundnut variety "Gujarat Groundnut 34" (GG 34) which has recorded 3715 kg/ha pod yield. This was 22.40, 21.69, 12.14 and 5.62 % higher in pod yield than check varieties GG 6, GJG 31, TG 26 and TG 37A, respectively. This variety gave higher kernel yield (2525 kg/ha), oil yield (1334 kg/ha) and oil content (52.8 %) than check varieties. It showed lower infestation of thrips and jassids as compared to all the checks. In this variety tikka and rust diseases did not appear during summer season. The variety is recommended for release in summer groundnut growing areas of Gujarat state.

(Research Scientist, RRS, AAU, Anand)

2. Crop : Tomato

Variety : Gujarat Anand Cherry Tomato 1 (GACT 1)

This cherry tomato variety Gujarat Anand Cherry Tomato 1 (GACT 1) gave 114.7 q/ha fruit yield, which is 52.6 % higher than the local check ACTL 10-06 (75.2 q/ha) at Anand. This variety has indeterminate growth habit with dark intensity of green colour and less serrated leaves. The fruits are red in colour, ovoid in shape, less number of the seeds with good pericarp thickness, firmness and shelf life. The variety showed less incidence of ToLCD, leaf miner damage and fruit borer as compared to the local check. The fruits contain higher total soluble solid, lycopene and total soluble sugar as compared to the local check. This cherry tomato variety, GACT 1 is recommended for release in middle Gujarat for late *kharif-rabi* season under irrigated conditions.

(Research Scientist (Veg.), MVRS, AAU, Anand)

3. Crop : Maize

Variety: Gujarat Anand Yellow Maize Hybrid 3 (GAYMH 3)

This maize single cross hybrid Gujarat Anand Yellow Maize Hybrid 3 (GAYMH 3) recorded 6656 kg/ha grain yield in *rabi* season. It showed 35.6, 34.9 and 29.2 % yield superiority over checks GM 2, GAYMH 1 and GAWMH 2, respectively. It has medium maturity, orange flint grains, high test weight (350 g) and high yield. From the quality point of view, this hybrid contains 66.32 % starch, 13.53 % protein, 4.42 % oil, 0.54 % tryptophan in protein and 2.64 % lysine in protein. The hybrid is moderately resistant to Turcicum leaf blight, sorghum downy mildew and resistant against common rust. It is highly resistant against stem borer under field conditions. This maize single cross hybrid GAYMH 3 is recommended for release in middle Gujarat for *rabi* season.

(Associate Research Scientist, MMRS, AAU, Godhra)

4. Crop : Castor

Variety: Gujarat Anand Castor 11 (GAC 11)

This castor variety Gujarat Anand Castor 11 (GAC 11) has recorded 3230 kg/ha seed yield. It exhibited 26.3 % yield advantage over check variety GC 3 under irrigated conditions in Middle Gujarat Agro-climatic Zone. Under rainfed conditions of middle Gujarat, it also recorded seed yield of 2366 kg/ha, which is 35.6 % higher than check GC 3. It is early maturing than all the check hybrids. This variety found wilt resistant. The infestation of thrips, leaf hopper and whitefly were comparable in the proposed variety under field conditions as compared to checks. This castor variety GAC 11 is recommended for release in castor growing areas of middle Gujarat under irrigated and rainfed conditions.

(Associate Research Scientist, ARS, AAU, Sansoli)

5. Crop : Forage Bajra

Variety: Gujarat Anand Forage Bajra 4 (GAFB 4)

This Gujarat Anand Forage Bajra 4 (GAFB 4) recorded green forage yield of 580.8 q/ha, which is 17.8 and 13.2 % higher over the checks GFB 1 (LC) and Giant Bajra (NC), respectively. GAFB 4 also recorded 120.3 q/ha dry fodder yield which is 20.4 and 13.9 % higher than the check varieties GFB 1 (LC) and Giant Bajra (NC), respectively. The crude protein yield of the proposed variety GAFB 4 is 9.66 q/ha which is 31.3 and 33.4 % higher than the check varieties GFB 1 (LC) and Giant Bajra (NC), respectively. On quality point of view, this variety contains 20.9 % dry matter, 7.7 % crude protein, 80.5 % neutral detergent fiber, 30.8 % crude fiber and 42.3 % acid detergent fiber content. It has higher plant height (240.1 cm), more number of tillers per plant (3.7), higher

number of leaves per plant (29.5) and high leaf stem ratio (0.9) than checks. This variety has single cut nature, light green foliage and thin stem. This variety Gujarat Anand Forage Bajra 4 (GAFB 4) is recommended for release in forage bajra growing areas of the middle Gujarat during *kharif* season.

(Research Scientist, MFRS, AAU, Anand)

6. Effect of seed priming treatment in chickpea (*Cicer arietinum* L.)

The farmers cultivating chickpea varieties GG 1 and GJG 3 are advised for priming of seeds with KNO_3 100 ppm solution (100 mg in 1000 ml water) for eight hours, followed by shade drying before sowing for maximum germination per cent and seedling vigour.

(Prof. & Head, Dept. of Seed Science & Technology, BACA, AAU, Anand)

CROP PRODUCTION

CULTURAL PRACTICES

1. Effect of sowing dates and spacing on semi-*rabi* green gram (*Vigna radiata* L.)

The farmers of Middle Gujarat Agro-climatic Zone growing semi-*rabi* green gram are recommended to sow the crop during 3rd week of September at 30 cm spacing for obtaining higher yield and net return.

(Research Scientist, Pulse Research Station, AAU, Vadodara)

2. Response of seed rates on different soybean varieties in *kharif* season

The farmers of Middle Gujarat Agro-climatic Zone growing

soybean in *kharif* season are recommended to grow either NRC 37 or JS 335 variety keeping 80 kg/ha seed rate to get higher yield and net return.

(Research Scientist, TRTC, AAU, Devgadh Baria)

3. Response of spacing on different soybean varieties in *kharif* season

The farmers of Middle Gujarat Agro-climatic Zone growing soybean in *kharif* season are recommended to grow either NRC 37 or JS 335 variety at the spacing of 45 cm to get higher yield and net return.

(Research Scientist, TRTC, AAU, Devgadh Baria)

4. Effect of sowing time and spacing on growth and yield of chickpea for green pod

The farmers of Middle Gujarat Agro-climatic Zone growing chickpea (cv. GG 2) for green pod are recommended to sow the crop during first week of October keeping 45 x 10 cm spacing for securing higher yield and net return.

(Associate Research Scientist, ARS, AAU, Derol)

5. Standardization of crop geometry and its effect on yield and fibre quality of *desi* cotton under rainfed conditions

The farmers of *Bhal* and Coastal Agro-climatic Zone growing rainfed *desi* cotton are recommended to sow cotton variety Gujarat Cotton 21 at 60 x 30 cm spacing to get higher seed cotton yield.

(Associate Research Scientist, RCRS, AAU, Viramgam)

6. Determination of effective planting time for potato cultivars under middle Gujarat conditions

The farmers of Middle Gujarat Agro-climatic Zone growing potato (cv. Kufri Pukhraj, Kufri Badshah and Kufri Laukar) are advised to plant the potato in 2nd week of November to 4th week of November to get higher income and net realization.

(Research Scientist, MVRS, AAU, Anand)

7. Effect of topping and nitrogen levels on growth, yield attributes and yield of *Bt* cotton under drip irrigation

The farmers of Middle Gujarat Agro-climatic Zone growing *Bt* cotton in heavy black soil under drip irrigation system are recommended to practice detopping of cotton plant (removal of apex) at 100 days after sowing and fertilize the crop with 240 kg N/ha in four equal splits i.e. 60 kg N/ha in basal and remaining 180 kg N/ha in three equal splits at one-month interval through fertigation to get higher yield at minimum cost.

(Asstt. Research Scientist, NIRS, AAU, Khandha)

NUTRIENT MANAGEMENT

8. Efficacy of methylotrophic bacterial consortium on rice (*Oryza sativa* L.) cv. Gurjari in field

The farmers of Middle Gujarat Agro-climatic Zone growing transplanted paddy cv. Gurjari in *kharif* are recommended to apply 80 kg N/ha, 20 kg P_2O_5/ha and give treatment of methylotrophic bacterial consortium 5 ml/L water through seedling dip for 15 minutes before transplanting and foliar spray at 30 DATP for obtaining higher yield and net return. The practice saves 20 % N, 20 % P and reduces methane gas emission from paddy field in atmosphere.

Sampling Time at ARS Thasra

- 8 AM
- 11 AM
- 2 PM
- 5 PM

Sampling Time at RRS, Anand

- 7 AM
- 10 AM
- 1 PM
- 4 PM
- 7 PM
- 10 PM
- 1 AM
- 4 AM

(Research Scientist & Head, Dept. of Microbiology, BACA, AAU, Anand)

9. Effect of boron and cutting management in seed production of lucerne

The farmers of Middle Gujarat Agro-climatic Zone growing Lucerne (Anand 2) are advised to take last cut of green forage in 3rd or 4th week of February and leave it for seed production. Thereafter, foliar spray of 0.02 % boron is given at flower initiation stage and 2nd spray at 10 days after 1st spray along with all recommended practices to get higher seed yield and net return.

(Research Scientist, MFRS, AAU, Anand)

10. Influence of nitrogen levels on yield and quality of guinea grass

The farmers of Middle Gujarat Agro-climatic Zone growing guinea grass are advised to grow variety Co (GG) 3 and apply 50 kg N/ha after each cut upto three years to obtain higher green forage yield, quality and net return. (Basal

dose of FYM 10 t/ha, 50 kg N/ha and 40 kg P_2O_5/ha should also be applied).

(Research Scientist, MFRS, AAU, Anand)

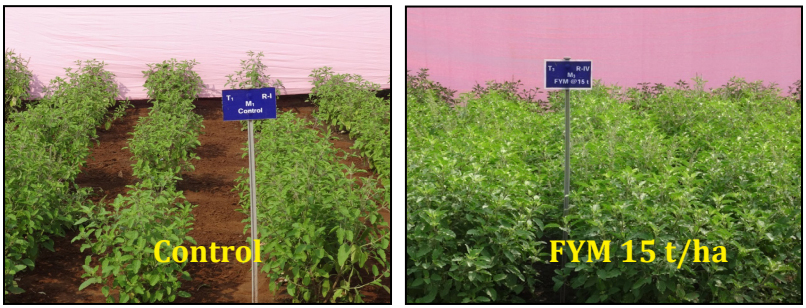
11. Effect of different levels of nitrogen and phosphorus on dry biomass yield of *dodi* [*Leptadenia reticulata* (Retz.) Wight & Arn.] under middle Gujarat conditions

The farmers of Middle Gujarat Agro-climatic Zone growing *dodi* crop in *kharif* season are advised to apply 200 kg N/ha, of 50 kg N and 25 kg P_2O_5 are to be applied as basal and apply 150 kg N in three equal splits each at 45 DAP, at 90 DAP (i.e., 1st cutting) and at 180 DAP (i.e., 2nd cutting) for securing higher dry biomass yield (dry plant excluding root) and net return.

(Research Scientist, M&APRS, AAU, Anand)

12. Effect of organic manures on yield and quality of tulsi *Ocimum tenuiflorum* L. (*Ocimum sanctum* L.) under middle Gujarat conditions

The farmers of Middle Gujarat Agro-climatic Zone interested in growing green tulsi in *kharif* season only through organic manures are recommended to apply FYM 15 t/ha for securing higher dry biomass yield and net return.



(Research Scientist, M & APRS, AAU, Anand)

13. Performance of hybrid maize under different levels of nitrogen and phosphorus in *rabi* season

The farmers of Panchmahal district of Middle Gujarat Agro-climatic Zone growing *rabi* hybrid maize GAYMH 1 and GAWMH 2 are advised to fertilize the crop with 150 kg N/ha and 40 kg P_2O_5/ha (soil having medium phosphorus status) for securing higher grain yield and higher net return.

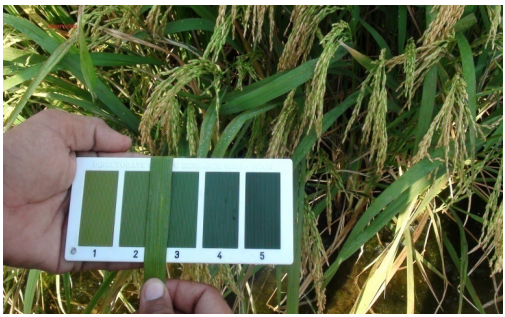
The farmers of Anand district of Middle Gujarat Agro-climate Zone growing maize hybrid GAYMH 1 are advised to fertilize the crop with 150 kg N/ha and 60 kg P_2O_5/ha (soil having low phosphorus status) for securing higher grain yield and higher net return.

Note: The nitrogen should be applied in four equal splits i.e., at basal, 4 leaves, 8 leaves and tasselling stage, while P_2O_5 as basal.

(Associate Research Scientist, MMRS, AAU, Godhra)

14. Nitrogen management through need based application by using Leaf Colour Chart (LCC) in rice varieties with different maturity groups

The farmers of Middle Gujarat Agro-climatic Zone growing mid-late maturing rice variety (GAR 13) are recommended to apply P_2O_5 and $ZnSO_4$ as per soil test along with N fertilizer schedule through leaf colour chart so as to apply 100 kg N/ha in equal split of 20 kg N when leaf colour chart (LCC), score reaches at 4 or less than 4 to get higher yield and net return.



(Research Scientist, MRRS, AAU, Nawagam)

15. Effect of nutrient management in *Bt* cotton to break the yield stagnation

The farmers of Middle Gujarat Agro-climatic Zone growing *Bt* cotton (cv. GCH 6) crop are recommended to apply 240 kg N/ha, of which 60 kg as basal and remaining 180 kg as top dressing in three equal splits at monthly interval for securing higher yield and net return.

(Associate Research Scientist, ARS for Irrigated Crops, AAU, Thasra)

16. Effect of plant growth regulators on growth, flowering and flower yield of *desi* Red Rose (*Rosa damascena* L.)

The farmers of Middle Gujarat Agro-climatic Zone growing *desi* red rose are advised to spray gibberellic acid @ 150 mg per L at 30 and 60 days after pruning (in October month) along with recommended dose of manure and fertilizers(FYM 3 kg/plant as basal dose after pruning and 40:40:25 g N:P:K alongwith 1 ml *Azospirillum* and 1 ml PSB/L water each per plant as soil application in three equal splits during June, October and January) for getting higher yield, net realization and better shelf life.

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

17. Effect of integrated nutrient management on growth, flowering and flower yield of annual white chrysanthemum (*Chrysanthemum coronarium* L.) cv. Local

The farmers of Middle Gujarat Agro-climatic Zone growing annual chrysanthemum are advised to apply 5 ton FYM along with 75: 100: 50 kg NPK/ha as basal dose. Prior to transplanting of seedlings should be dipped in 5 ml/L of water Bio NPK consortium. The remaining 75 kg nitrogen per hectare should be applied as top dressing at 30 days after transplanting to obtain higher yield and net realization.

100% RDN (200: 100: 50 NPK kg/ha) (Control)

75 % RDN+12.5% N from FYM

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

18. Nitrogen management in tomato cv. AT 3

The farmers of Middle Gujarat Agro-climatic Zone growing

tomato (AT 3) are advised to apply 62.5 kg N (in the form of ammonium sulphate), 50 kg P_2O_5 and 50 kg K_2O per hectare as basal dose and remaining 62.5 kg N apply in two equal splits at 30 and 60 DATP to get higher yield and net return.

(Research Scientist, MVRS, AAU, Anand)

19. Nitrogen management in chilli cv. GAVCH 1

The farmers of Middle Gujarat Agro-climatic Zone growing hybrid chilli are advised to apply 70 kg N, 50 kg P_2O_5 and 50 kg K_2O as basal and remaining 70 kg N apply in two equal splits at 30 and 60 DATP to get higher yield and net return.

(Research Scientist, MVRS, AAU, Anand)

20. Nutrient management through fertigation in guava

The farmers of Middle Gujarat Agro-climatic Zone growing guava under drip irrigation system are advised to apply 375 : 188 : 188 g NPK/tree (apply water soluble NP grade 310 g/tree, Urea 740 g/tree and MOP 315 g/tree) in four equal splits during 2nd and 4th week of June and September through fertigation to save 25 per cent fertilizers.

(Associate Research Scientist, ARS for Irrigated Crops, AAU, Thasra)

WEED MANAGEMENT

21. Effect of manures on efficiency of atrazine applied for weed management in summer pearl millet

The farmers of Middle Gujarat Agro-climatic Zone growing summer pearl millet are advised to carry out IC and HW at 20 and 40 DAS or apply recommended atrazine 500 g/ha as pre-emergence for weed management. For minimizing phytotoxic effect of atrazine, better yield and nutrient

status of soil, apply 10 t FYM/ha at the time of sowing in furrows.

HW at 20 & 40 DAS Without manure

Atrazine 1000 g/ha without manure

Atrazine 500 g/ha with 1.5 t Vermi/ha

HW at 20 & 40 DAS with 10 t FYM/ha

(Professor & Head, Dept. of Soil Sci. & Ag. Chem., BACA, AAU, Anand)

PLANT PROTECTION

AGRICULTURAL ENTOMOLOGY

1. Standardization of pheromone traps required for mass trapping of pink bollworm in *Bt* cotton

The farmers of Middle Gujarat Agro-climatic Zone are recommended to set up 40 pheromone traps/ha, 30 cm above crop height at equidistantly one week prior to flowering and change the lure at one-month interval till last picking of *Bt* cotton for effective and economical management of pink bollworm in *Bt* cotton.

(Professor and Head, Dept. of Ento., BACA, AAU, Anand)

2. Integrated pest management in okra

The farmers of Middle Gujarat Agro-climatic Zone are recommended to follow below mentioned module for effective and economical management of shoot and fruit borer of okra

I. Seed treatment with imidacloprid 600 FS, 9.0 ml/ kg seeds using equal quantity of water before 12 hours of sowing.

II. Removal and destruction of the shoot and fruit borer affected shoots and fruits along with larvae at weekly interval.

III. Installation of pheromone traps of *Earias vittella* @ 60/ha at three week after germination and replace the lures every 21 days interval.

IV. Spraying of chlorantraniliprole 18.5 SC, 0.006% (3 ml in 10 L of water) at 25 DAS (30 g a.i./ha).

V. Spraying of NSKE 5% at 35 DAS.

VI. Spraying of emamectin benzoate 5 SG 0.0025% (5 g in 10 L of water) at 45 DAS (12.5 g a.i./ha).

VII. Spraying of *Bacillus thuringiensis* var. kurstaki 5 WP(10 g in 10 L of water) at 55 DAS

VIII. Spraying of NSKE 5% at 65 DAS.

Year	Crop	Pest	Pesticides with formulation	Dosage				Appl. Schedule at DAS	Waiting period / PHI (Days)	Remarks
				g.a.i./ha	Quantity of formulation per ha	Conc. (%)	Dilution in water (10 L)			
2018	Okra	Shoot & fruit borer	Imidacloprid 600 FS	54	9 ml/ kg seeds	--	--	Seed treatment with imidacloprid 600 FS, 9 ml/ kg seeds with equal water quantity	--	--
			Chlorantraniliprole 18.5 SC	30	150 g	0.006	3 ml	25	5	
			NSKE	--	25 kg	5	500 g	35	--	
			Emamectin benzoate 5 SG	12.5	250 g	0.0025	5 g	45	5	
			Bacillus thuringiensis var. kurstaki 5 WP	--	500 g	--	10 g	55	--	
			NSKE	--	25 kg	5	500 g	35	--	

(Assistant Research Scientist (Ento.), MVRS, AAU, Anand)

3. Impact of sowing period on the pest complex of pigeonpea

For the management of pod fly, farmers of Middle Gujarat Agro-climatic Zone growing pigeonpea are recommended to adopt Vaishali variety and sow the crop during third week of June to first week of July to minimize the incidence of the pest.

(Assistant Research Scientist (Ento.), ARS, AAU, Derol)

4. Evaluation of insecticides for the control of stem borer and wireworm infesting un-irrigated fodder sorghum

The farmers of *Bhal* and Costal Agro-climatic Zone growing un-irrigated fodder sorghum in *rabi* season are recommended to treat seeds with thiamethoxam 30 FS, 8 ml/ kg seeds using 8 ml of water before 12 hours of sowing followed by drying under shade for preventing stem borer and wireworm infestation.

Year	Crop	Pest(s)	Pesti-cide(s) with formula-tion	Dosage				Application schedule	waiting period/ PHI (days)	Re-mark
				a. i./ha	Quantity of formula-tion/ha	Conc. (%)	Dilution in water			
1	2	3	4	5	6	7	8	9	10	11
2018	Fodder Sorghum	Stem borer and wire-worm	Thiame-thoxam 30 FS	0.144	8 ml/ kg seeds	--	--	Before sowing seed treatment with thiame-thoxam 30 FS, 8 ml/ kg seeds with equal water quantity	Being a seed treat-ment, it is not required	--

(Associate Research Scientist (Ento.)., ARS, AAU, Arnej)

5. Evaluation of different insecticidal application strategies against stem borer, *Chilo partellus* Swinhoe infesting maize

Maize growers of Middle Gujarat Agro-climatic Zone are recommended to treat the seeds with thiamethoxam 30 FS, 8 ml/ kg using 8 ml of water before 12 hours of sowing for preventing stem borer infestation. The treated seeds should be dried under shade condition before sowing.

Year	Crop	Pest	Pesticides with formulation	Dosage				Appl. schedule	Waiting period /PHI (Days)	Remark
				kg a.i./ ha	Quantity of formulation per hectare	Conc. (%)	Dilution in water (10 lit)			
2018	Maize	Stem borer	Thiamethoxam 30 FS	0.48	8 ml/ kg seeds	--	--	Before sowing seed treatment with thiamethoxam 30 FS, 8 ml/ kg seeds with equal quantity of water	Being a seed treatment, it is not required	-

(Assistant Research Scientist (Ento.), ARS, AAU, Sansoli)

PLANT PATHOLOGYAND NEMATOLOGY

6. Management of cumin blight through fungicides

The farmers of Middle Gujarat Agro-climatic Zone growing cumin are recommanded to apply three sprays of azoxystrobin 23 SC, 0.023% (10 ml/10 L water) first at the initiation of disease and remaining sprays at 10 days interval for effective and economical management of blight.

Year	Crop	Pest	Pesticides with formulation	Dosage/ha				Application schedule	Waiting period/ PHI (Days)
				g. a.i.	Quantity of formulation (g/ml)	Conc. (%)	Dilution in water (L)		
2018	Cumin (*Rabi*)	Blight	Azoxystrobin 23 SC	115	500	0.023	500	First spray at the appearance of the disease and remaining two sprays at 10 days interval	28 days

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

7. Management of *Meloidogyne* spp. in okra through bioagents

The farmers of Middle Gujarat Agro-climatic Zone growing okra crop in *kharif* are recommended to treat seeds with *Purpureocillium lilacinum* ($2x10^6$ cfu/ml), 5 ml/kg and soil application of vermicompost before sowing @ 2.5 t/ha enriched with *P. lilacinum*, 10 ml/kg for effective and economical management of root-knot nematodes (*Meloidogyne* spp.).

Year	Crop	Pest	Bio-nematicide with formulation	Dosage/ha				Application schedule	Waiting period/ PHI (Days)
				cfu	Quantity of formulation (g/ml)	Conc. (%)	Dilution in water (L)		
2018	Okra (kharif)	Root-knot nematodes (*Meloidogyne* spp.)	Seed treatment of *Purpureocillium lilacinum*	2×10^6 /ml	50 ml	NA	NA	At the time of sowing: Seed treatment of *Purpureocillium lilacinum*, 5 ml/kg seed	NA
			Soil application of Vermicompost @ 2.5 t/ha enriched with *P. lilacinum*, 10 ml/kg		Vermi-compost @ 2.5 t/ha + P. *lilacnum*, 10 ml/kg	NA	NA	Soil application: Soil application of vermicompost @ 2.5 t/ha enriched with P. *lilacinum*, 10 ml/kg	NA

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

BASIC SCIENCES

PLANT PHYSIOLOGY

1. Sustaining the yield of un-irrigated durum wheat in *Bhal* region through PGRs and chemicals

The farmers of *Bhal* and Coastal Agro- climatic Zone growing rainfed durum wheat are advised to apply first spray of thiourea 500 ppm (5 g /10 L water) at tillering stage (35-40 DAS) and second spray at ear emergence stage (60-65 DAS) to get maximum grain yield and net return.

T_0 (Control) T_8 (Thiourea Spray 500ppm)

(Assistant Research Scientist, ARS, AAU, Dhandhuka)

DAIRY SCIENCE / FPT&BE

DAIRY SCIENCE

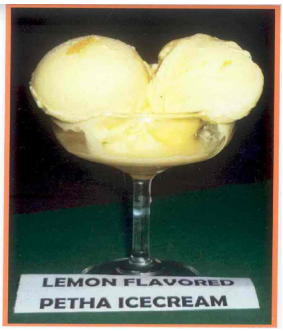
1. Development of technology for Carbonated Lime Whey Beverage

A technology for preparing carbonated lime whey beverage has been developed by Anand Agricultural University, Anand using de-fatted, lactose hydrolyzed paneer whey through addition of 4.5% lime juice (Brix/Acid ratio of 1.3), 8-10 % sugar and subjected to carbonation at 1.5 kg/cm^2. Table salt @ 0.5 % and ginger powder @ 0.5 % served as flavour enhancers. The carbonated lime whey beverage added with 100 ppm of sodium benzoate, packed in PET bottles had a shelf life of 75 days and 21 days when stored at 7±2°C and 37±2°C, respectively.

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

2. Development of *Petha* (Ash gourd sweetmeat) ice cream

A technology has been developed by Anand Agricultural University, Anand for preparing value added novel 'Lemon flavoured *Petha* ice cream' in which it is recommended to utilize sucrose @ 13.0 %, lemon flavouring @ 0.7 ml/L of mix and disc shaped *Petha* particulates @ of 8.0 % by weight of ice cream mix.



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

3. Development of cereal based *burfi*

A method for preparing *rava burfi* has been standardized at Anand Agricultural University, Anand. *Rava burfi* prepared using small particle grade *rava* of durum wheat, khoa and liquid glucose contains about 1.0 % fiber, 9.5 % protein and 18.5 % fat and has calorific value of 404 kcal/100 g. The shelf life of *rava burfi* when packed in polyethylene box and placed in pre-sterilized composite polyethylene terephthalate /low density polyethylene film (50 µm) pouch is 9 and 35 days when stored at 30±2 °C and 7±2 °C, respectively.

Rava burfi

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

4. Development of a nutri-rich *Chakka* based dip fortified with *Moringa*

A method is developed by Anand Agricultural University for manufacturing *chakka* based *Moringa* dip fortified with 5 % *Moringa* pod powder (100 mesh). The taste of the product

could be improved by addition of spice blend (mixture of mango powder, mint, dry ginger and pepper powder) added @ 0.5 % by weight of dip. The product has a shelf life of 15 days when stored at 4±2 °C in re-closable polypropylene co-polymer cups.

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

5. **Evaluation of selected additives for the manufacture of low fat chhana**

The production of reduced fat chhana developed at Anand Agricultural University, Anand is beneficial in obtaining chhana having 33 % lower fat, 20 % higher protein in which addition of 0.2 % WPC and 0.05 % lecithin is recommended. The product is affordably priced as compared to regular chhana. The developed reduced-fat chhana is comparable with regular chhana with respect to its sensory characteristics.

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

6. **Evaluation of common culinary spices as natural antioxidant for *ghee***

Among the common culinary spices (black pepper, cardamom, cinnamon, clove, coriander, cumin, fennel, fenugreek, ginger, nutmeg and turmeric), addition of nutmeg in melted butter @ 0.5 % of the expected yield of *ghee* or @ 0.4 % in butter containing 80% fat is most effective in reducing oxidative deterioration of *ghee.*

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

7. Development of whey based medium for biomass production of lactic acid bacteria

Cheddar cheese whey based medium for producing biomass of lactic acid bacteria (*Lactobacillus helveticus* MTCC 5463 and *Streptococcus thermophilus* MTCC 5461) has been developed. This medium yields biomass of 5.51 and 2.56 g/L of *Lactobacillus helveticus* MTCC 5463 and *Streptococcus thermophiles* MTCC 5461, respectively when fermented for 12 h at 37 ºC in a 5 L capacity fermenter. The performance of the said biomass is found satisfactory in preparation of *dahi* and butter milk. The developed process for preparation of whey based medium is given in the flow chart.

Cheddar cheese whey is heated at 75 ºC for 10 min.

↓

WPC-70 is added @ 0.5 %.

↓

Proteolysis by papain @ 0.5 % at 50 ºC for 4 h

↓

Heated to 95 ºC for 10 min.

↓

Addition of $MnSO_4$ (0.01 %) and oleic acid (0.1 %)

↓

Medium is sterilized by autoclaving.

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

8. Optimization of selected qualitative tests for detection of common adulterants in milk

Qualitative tests modified by Anand Agricultural University, Anand are recommended for detection of common adulterants in milk. The use of such tests have advantages like ease in judgment about result of the test, improved sensitivity (limit of detection), reduction in risk of health hazards as well as environmental pollution and/or elimination of certain prohibited chemicals. The adulterants and tests for their detection are listed in the table below.

Sr. No.	Adulterants	Test modified at Anand Agricultural University
1.	Detergent	Methylene blue test Paradkar *et al.* (2000)
2.	Urea	DMAB test (FSSAI, 2015)
3.	Ammonium salts	Phenol test (FSSAI, 2015)
4.	Sucrose	Seliwanoff test (Srivastava, 2010)
5.	Glucose	Barfoed test (Barfoed, 1873)
6.	Maltodextrin	Iodine test (Sharma *et al*., 2012)
7.	Starch	Iodine test (BIS, 1960)
8.	Gelatin	Picric acid test (DGHS, 2005)
9.	Salt	Chromate test (FSSAI, 2015)
10.	Nitrate	Diphenylamine test (FAO, 1986)
11.	Sulphate	Barium chloride test (FSSAI, 2015)
12.	Hydrogen peroxide	p-Phenylenediamine (Draaiyer *et al.*, 2009)
13.	Formaldehyde	(1) Leach test (BIS, 1961) (2) Hehner test (Draaiyer *et al*., 2009)
14.	Neutralizers	(1) Rosolic acid test (DGHS, 2005) (2) Methanol test (Davies, 1938)

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

9. Utilization of paneer whey in synbiotic *Sherbet candy*

Anand Agricultural University has developed a method for the preparation of synbiotic *sherbet candy* using 44 % of paneer whey, 4 % fructo oligosacaharide, 15 % sucrose, 10 % liquid glucose, 3 % fructose, 0.07 % carrageenan, 0.10 % locust bean gum, 0.13 % pectin, 15 % mango pulp and probiotic culture *Lactobacillus rhamnosus* and *Lactobacillus paracasei* (in 1:1 ratio) added @ of 0.03 % mix. The product packed in biaxially oriented polypropylene material has shelf life of 4 months when stored at -18±2 °C.

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

10. Development of value added fermented milk containing drumstick

Moringa based lassi, prepared from standardized milk added with 1.63 % *Moringa* pod powder as an ingredient, has been developed at Anand Agricultural University, Anand. The product was found to contain Vitamin A, Vitamin C, calcium, iron, fiber and potassium. The product had a shelf life of 30 days when stored under refrigerated (7±2 °C) conditions in pre-sterilized PET bottles.

(Professor & Head, Dept. of Dairy Microbiology, DSC, AAU, Anand)

11. Engineering interventions for commercial production of *Doodhpak*

Dairy Industry and Entrepreneurs are recommended to adopt method developed by Anand Agricultural University for manufacture of in-container sterilised (121 ˚C for 15 min) *Doodhpak*. It is made from standardized milk (4.5 %

fat & 8.5 % SNF) concentrated to 1.6 times concentration level using scraped surface heat exchanger (SSHE) and added with scented rice and sugar at the rate of 2.2 % and 11 % of concentrated milk respectively. The product has a shelf life of 75 days at room temperature (35±2 °C) and 105 days at refrigeration temperature (5±2 °C).

(Professor & Head, Dept. of Dairy Engineering, DSC, AAU, Anand)

12. Technology for manufacture of extended shelf-life *Basundi*

A commercial process technology to manufacture extended shelf-life *Basundi* has been developed by Anand Agricultural University, Anand. The standardized process involves manufacture of *Basundi* by vacuum (60 mm HG) concentration followed by in-bottle heat processing using rotary sterilizer at 110 °C for 15 minutes. The heat processed *Basundi* has a shelf life of 90 days when stored at 37±2 °C.

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

FOOD PROCESSING TECHNOLOGY

13. Eco-friendly Mobile Vending cum Storage System for Fruits and Vegetables

Fruits & vegetables vendors are advised to use "Eco-friendly Solar Powered Vending Cart" developed by the Anand Agricultural University. The average temperature and RH inside the storage chamber (14.12 cu.ft.) is maintained at 22±2.86 °C and 82 ±3.28 %, respectively, during summer months. This cart is useful to reduce the losses at retailer

level, increases the shelf-life and also preserve the freshness of fruits and vegetables.

(Professor & Head, Dept. of PHE, FPT & BE, AAU, Anand)

14. Development of whey based RTS beverage from muskmelon and lime

The entrepreneurs interested in the production of dairy whey based ready to serve (RTS) beverage from muskmelon and lime are recommended to adopt processing technology developed by the Anand Agricultural University. The technology involves formulation of ingredients (milk whey 51.35 ml, musk melon juice 40 ml and lemon juice 6.19 ml) and thermal processing (hot filled at 85 C in 200 ml glass bottle, crown corked and processed at 95 C for 15 min) of prepared beverage. The developed beverage can be stored safely for 3 months at the ambient temperature.

(Professor & Head, Dept. of PHE, FPT & BE, AAU, Anand)

15. **Production of high quality powder with maximum retention of essential oil using cryogenic grinding of cardamom**

Entrepreneurs and agro-processing units involved in grinding of cardamom seed are recommended to use the technology of cryogenic grinding developed by the Anand Agricultural University for the production of superior quality cardamom powder with higher retention of volatile oil as compared to conventional grinding. The operating parameters were kept as temperature -40 °C, feed rate 7 kg/h and sieve size 1.5 mm.

(Professor & Head, Dept. of PHE, FPT & BE, AAU, Anand)

16. **Standardization of drying technique for *Moringa oleifera* leaves**

The entrepreneurs and food processors interested in production of dried *Moringa* leaves with the maximum retention of beta-carotene and Vitamin C can utilize the drying technique standardized by the Anand Agricultural University. The *moringa* leaves can be dried using vacuum dryer operated at 45 °C for 3½ hour and vacuum as 450 mm of Hg. The product retained 93.6 % of Beta-carotene and 22 % of Vitamin C.

(Professor & Head, Dept. of PHE, FPT & BE, AAU, Anand)

17. **Accelerated drying of *Aonla* using pulsed osmotic microwave vacuum dehydration**

The entrepreneurs and fruit processors interested in production of osmotically dehydrated *aonla* segments are recommended to use the processing technology developed by the Anand Agricultural University. The technology

involves microwave vacuum (400 mmHg) assisted osmotic dehydration of *aonla* segments in sugar syrup (50 °Brix) followed by microwave vacuum (500 mmHg) drying. It results in good quality sweetened dehydrated *aonla* segments which retains more than 80 % of the ascorbic acid present in the fresh sample.

(Professor & Head, Dept. of Food Engineering, FPT & BE, AAU, Anand)

18. **Design and development of SSHE for *kajukatli* manufacturing**

Entrepreneurs interested in manufacture of *Kajukatli* production are recommended to use the SSHE machine for continuous cooking and cooling developed by the Anand Agricultural University. The operating conditions for the SSHE required are 5 kg/cm^2 steam pressure, 14 rpm scrapper speed and 10 kg/h feed rate. The steam and electricity consumption during manufacturing of *Kajukatli* is 1.52 kg/kg of water evaporated and 0.14 kWh/kg of product, respectively. The cost of SSHE is about ₹ 76,125/- while the processing cost of *Kajukatli* is ₹ 9.21/kg.

(Professor & Head, Dept. of Food Engineering, FPT & BE, AAU, Anand)

19. **Development and performance evaluation of continuous rolling, sheeting and cutting system for *Kajukatli* production**

Entrepreneurs interested in manufacturing of continuous rolling, sheeting and cutting system for *Kajukatli* production are recommended to use the machine developed by the Anand Agricultural University. This machine can

continuously roll, sheet and cut the produce in diamond shaped (30x30x5 mm) *Kajukatli.* The fabrication cost of the machine is about ₹ 1,10,100/- while the operating cost is ₹ 5.46/- per kg.

(Professor & Head, Dept. of Food Engineering, FPT & BE, AAU, Anand)

20. Development of juice extraction process of wood apple fruit

The entrepreneurs and food processors interested in production of juice from wood apple fruits are recommended to use the technology developed by the Anand Agricultural University. This technology involves steaming (6 min), enzymatic treatment [with mixture of pectinase: cellulase (7:3) at the rate of 30 mg/100 g pulp for 6 h at 40 °C] and juice extraction with maximum recovery with maximum total soluble solid in juice from wood apple fruit. Thermally processed (80 °C for 9 min) wood apple juice is microbiologically stable and acceptable on sensory basis for 5 months storage at ambient temperature (37±2 °C).

(Professor & Head, Dept. of FPT, FPT & BE, AAU, Anand)

21. Utilization of pumpkin carotenoid in food products

The entrepreneurs and food processors interested in production of carotenoid fortified ice cream and low fat spread are recommended to use the technology developed by the Anand Agricultural University.

(1) The ice cream can be fortified by carotenoid extract obtained by Super Critical Fluid Extraction of vacuum dried pumpkin powder @ 450 mg/100 g of ice cream mix. The ice

cream thus obtained, contained 93.22 mg of β-carotene per 100 g of product.

(2) The low fat spread can be fortified by carotenoid extract obtained By Super Critical Fluid Extraction of vacuum dried pumpkin powder @ 150 mg/100 g of spread. The low fat spread thus obtained contained 35.26 mg of β-carotene per 100 g of product.

(Professor & Head, Dept. of FPT, FPT & BE, AAU, Anand)

22. Development of preservation technique for idli batter for enhanced shelf life

The entrepreneurs and food processers interested to store idli batter are recommended to use preservation technique developed by Anand Agricultural University. The packaging of idli batter prepared with selective cultures under controlled condition in 60 µm poly laminated pouch with N_2 flushing and stored at 7±2 °C is recommended for its shelf-life of upto 8 days. The sonication treatment (100 µm amplitude exposure for 15 minute) of the idli batter packed in 60µm poly laminated pouch with N_2 flushing and stored at 7±2 °C is recommended for its shelf-life upto 15 days.

(Professor & Head, Dept. of FQA, FPT & BE, AAU, Anand)

23. Bioethanol production from potato processing starch waste by thermo tolerant strain of *Saccharomyces cerevisiae* ETGS1

Entrepreneurs interested in bioconversion of potato processing waste into ethanol are advised to use amylolytic *Sacharomyces cerevisiae* ETGS1 strain and process developed by the Anand Agricultural University. This technology enables ethanol production with 0.45 g product

per g substrate yield and 88.53 % fermentation efficiency from potato processing effluent and gelatinised potato waste with minimum input by consolidated bioprocessing.

(Professor & Head, Dept. of FQA, FPT & BE, AAU, Anand)

24. **Development of technology for production of bio-manure granules from digested slurry of biogas plant**

Small capacity biogas plant owners are recommended to adopt a simple technology using jute sack with stand for separation of liquid from digested slurry developed at Anand Agricultural University for easy handing and transportation. With 70 % separated sludge, 20 % dried poultry manure and 10 % wood ash combination bio manure granules prepared are safe for storage and further use as manure.

Bio-manure Granules

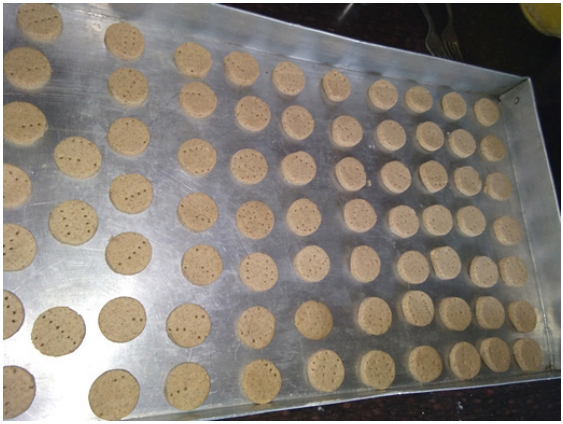
(Professor & Head, Dept. of Bio Energy, FPT & BE, AAU, Anand)

25. Development of high fiber bakery products using *aonla* and carrot pomace after juice extraction

(1) A satisfactory high fiber bread can be prepared by adding 2.5 % *aonla* pomace powder replacing the refind wheat flour. The bakery industry and entrepreneurs interested in production of high fiber bread are recommended to use the technology developed by Anand Agricultural University.

(2) A satisfactory high fiber biscuit can be prepared by adding 12 % *aonla* pomace powder using technology developed by the Anand Agricultural University. The product duly packed in aluminum foil will have safe storage life of about two months. The bakery industry and entrepreneurs interested in production of high fiber biscuit are recommended to follow the same.

(3) A satisfactory high fiber bread can be prepared by adding 4% carrot pomace powder using technology developed by the Anand Agricultural University. The bakery industry and entrepreneurs interested in production of high fiber bread are recommended to follow the same.



(4) A satisfactory high fiber biscuit can be prepared by adding 20% carrot pomace powder using technology developed by the Anand Agricultural University. The product duly packed in plastic container and aluminum foil will have safe storage life of about two and half months. The bakery industry and entrepreneurs interested in production of high fiber biscuit are recommended to follow the same.

(Professor & Head, Dept. of Horticulture, AAU, Anand)

AGRICULTURAL ENGINEERING AND AIT

AGRICULTURAL ENGINEERING

1. Development of a low cost planting unit for conventional plough

A low cost multi crop planting unit for bullock drawn conventional plough developed by Anand Agricultural University is recommended for farmers of the region for sowing of maize, pigeon pea, soybean and gram crops. It saves about 94 % time and 76 % cost of sowing operation for maize crop as compared to dibbling method. Also this method saves about 57 % seeds as compared to maize sowing by dropping seeds into funnel type seeding device connected to conventional plough.

(Principal, College of Agril. Engineering & Tech., AAU, Godhra)

2. Development of modified manual twin wheel weeder

The adjustable manual twin wheel weeder developed by Anand Agricultural University is recommended for farmers because of affordable cost and convenient operation. Field efficiency and weeding efficiency of the weeder were 97.81 % and 78.90 %, respectively. Effective field capacity was 0.093 ha/h. The approximate cost of the weeder was ₹ 1500.

(Principal, College of Agril. Engineering & Tech., AAU, Godhra)

3. Modifications in existing hand operated Paddy thresher

It is recommended for farmers to use electric operated paddy thresher developed by Anand Agricultural University for stripping of pigeon pea plants. It can easily separate

pods from pigeon pea plants. The stripping capacity of pods is found to be 183.32 kg/h, which is 3.62 times higher than manual beating. The stripping efficiency of the developed machine is 94.44 per cent.

(Principal, College of Agril. Engineering & Tech., AAU, Godhra)

4. Determination and analysis of vibration levels on mini farm tractors

All stake holders associated with single cylinder mini tractors are recommended to place the vibration isolation elastomeric pad with lining of rubber sheet below the tractor seat to reduce the longitudinal, lateral and vertical vibrations as a whole. Further it is recommended to use cork pad for getting maximum reduction in the vertical vibrations caused by engine operation.

(Principal, College of Agril. Engineering & Tech., AAU, Godhra)

5. Development of appropriate harvest and post-harvest technology for custard apple for tribal area of Gujarat

It is recommended to store the matured harvested custard apple fruit in 100 gauge polypropylene bags (15.24 mm x 20.32 mm and 3-fruits in each bag) at 13 °C temperature for increasing the shelf life up to 8-10 days for maximum overall acceptability with minimum weight lossand higher retention of vitamin-C.

(Principal, College of Agril. Engineering & Tech., AAU, Godhra)

6. Development of biomass combustion based drying systems for ginger and turmeric

The agro processors and entrepreneurs are recommended to use the biomasscombustor based dryerof 100 kg capacity developed by Anand Agricultural Universityfor drying of ginger and turmeric. The dryer should be operated with fuel consumption rate of 1 kg/h and air flow rate of 400 m3/h to dry ginger and turmeric using saw dust briquettes to attain maximum combustor efficiency 73.50 %.

The drying takes 276min (for ginger from initial 81.41 to 8 % wb final moisture content) and 807 min (for turmeric from initial 94.60 to 9 % wb final moisture content) drying time with a hot air temperature of 47-48 ºC generated using saw dust briquettes.

(Principal, College of Agril. Engineering & Tech., AAU, Godhra)

AGRICULTURAL INFORMATION TECHNOLOGY

7. Decision support system for plant protection

Web based Decision Support System for plant protection developed by Anand Agricultural University provides the use of insecticides, fungicides and herbicides and plant growth regulator as per the Insecticide act 1968 in gujarati language. It is recommended to be used by the farmers of Gujarat state.

(Director, DIT, AAU, Anand)

ANIMAL PRODUCTION AND FISHERIES

1. Development of feeding strategy to enhance body weight gain in Surti kids

The surti goat keepers are recommended to feed high protein (14 % CP) and high energy (69 % TDN) total mixed ration (TMR) to growing surti male kids during seven months to one year of age and thereafter 11.5 % CP and 69 % TDN TMR for two months to improve daily gain and feed conversion efficiency with 24 % reduction in feed cost per kg gain.

Sr. No.	Name of the ingredient	T_2 (Grower) Phase-I	T_2 (Finisher) Phase-II
1.	Jowar hay (%)	45.00	45.00
2.	Soybean meal (%)	15.00	9.50
3.	Maize grain (%)	24.00	29.00
4.	De-oiled rice bran (%)	0.00	5.00
5.	Rice polish (%)	4.50	0.00
6.	Molasses (%)	10.00	10.00
7.	Mineral mixture (%)	1.00	1.00
8.	Common salt (%)	0.50	0.50
9.	Vitamin AD3 supplement (g/100 kg TMR)	0.06	0.06

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

2. Effect of methane mitigation on growth performance of crossbred calves through feeding legume straw based TMR

It is recommended that replacing wheat straw with 25 % groundnut straw in TMR with 50:50 roughage to concentrate ratio increases growth rate by 20 % and decreases daily methane emission by 13 % in growing crossbred calves.

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

3. **Study of nutritional status of dairy animals of Chhota Udepur district**

Farmers of Chhota Udepur district are recommended to feed daily additional 1.0 kg compound concentrate mixture to cows producing less than 10 kg milk and 1.5 kg to cows producing 11-14 kg milk during summer and winter season, while additional 0.5 kg during monsoon season in order to fulfill their nutrient requirement.

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

4. **Study of nutritional status of dairy animals of Chhota Udepur district**

The farmers of Chhota Udepur district are recommended to feed daily additional 1.5 kg compound concentrate mixture during summer, while 1.0 kg during monsoon and winter season to buffaloes producing less than 10 kg milk in order to fulfill their nutrient requirement.

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

5. **Effect of supplementing *Jivanti* (*Leptadenia reticulata*) and bypass fat in total mixed rations on nutrient utilization and milk production of Surti goats**

It is recommended that supplementation of *Jivanti/Dodi* (*Leptadenia reticulata*) and bypass fat at 1 and 2 % level, respectively, in total mixed ration for lactating Surti goats increased milk production by 22 %, milk fat by 10 % and return over feed cost by ₹ 2.00/goat/day as compared to total mixed ration without supplementation.

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

6. Development of area-specific mineral mixture formulations for Botad district

Based on the prioritization of limiting minerals in Botad district, the area specific mineral mixture has been formulated as follows, which would make up the deficiency when fed @ 30g/head/day to dairy animals in addition to the current feeding practices.

Sr. No.	Mineral Element	Requirement (%)
1	Calcium	20.00
2	Phosphorus	12.00
3	Magnesium	5.00
4	Sulphur	1.80
5	Copper	0.10
6	Zinc	1.78
7	Manganese	0.12
8	Iron	0.40
9	Cobalt	0.012
10	Iodine	0.026

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

7. Evaluation of optimum stocking density for nursery raising of *Labeo rohita* Spawn under Hapa system (Multi-location trial) in village ponds of middle Gujarat

Fish farmers are recommended to stock Rohu (*Labeo rohita*) spawn @ 750 No./m^3 for achieving high fry production with higher net benefits under Hapa system in village ponds.

(Chief Scientist, KVK, AAU, Devataj and RRC of ICAR-CIFA, Anand)

RECOMMENDATIONS FOR SCIENTIFIC COMMUNITY

CROP IMPROVEMENT

1. **Effect of different seed materials, plant growth regulators and chemicals on germinability and vigour of cotton (*Gossypium hirsutum* L)**

   It is recommended that polymer coating treated seed or delinted seed material alongwith GA_3 20 mg/L is beneficial for increasing the germination and other seed quality parameters under storage period (180 days) maintaining seed standard as compared to linted seed (120 days) in cotton.

   (Research Scientist, RRS, AAU, Anand)

2. **Standardization of CGMS based hybrid seed production in chilli**

   In chilli crop, it is recommended to use the ratio of 1:1 or 2:1 A:R lines for CGMS based hybrid seed production for higher hybrid seed yield during *kharif-rabi* season in open field condition at Anand location.

   (Research Scientist, MVRS,AAU, Anand)

PLANT PROTECTION

AGRICULTURAL ENTOMOLOGY

1. **Bio-efficacy of newer insecticides against Spodoptera litura (Fabricius) infesting castor**

For effective and economical management of leaf eating caterpillar, *Spodoptera litura* (Fabricius) in castor, spray any one of the following insecticides at initiation of pest.

I. Emamectin benzoate 5 SG, 0.002 %, 4 g/10 L of water (ICBR: 1:26.46).

II. Chlorantraniliprole 18.5 SC, 0.006 %, 3 ml/10 L of water (ICBR: 1:16.35).

III. Spinosad 45 SC 0.009 %, 2 ml/10 L of water (ICBR: 1:10.27).

(Prof.& Head, Dept. of Entomology, BACA, AAU, Anand)

2. **Evaluation of root dip treatment and foliar spray of insecticides against aphid infesting gaillardia (var. Lorenziana)**

Diping the roots of gaillardia for two hours in the solution of thiamethoxam 25 WG, 0.0125 % (5 g/10 L of water) coupled with foliar spray of dimethoate 30 EC, 0.03 %, (10 ml/l0 L of water) at initiation of aphid and second spray after 15 days of first spray give effective and economical control of the pest.

(Prof.& Head, Dept. of Entomology, BACA, AAU, Anand)

3. Bio-efficacy of different insecticides against capsule borer, *Dichocrosis punctiferalis* Guenee infesting castor

For effective and economical control of capsule borer in castor, spray any one of the following insecticides at initiation of the pest damage and second at 15 days of the first spray.

1. Chlorantraniliprole 20 SC, 0.006 %, 3ml /10 L of water (1:9.30).
2. Flubendiamide 48 SC, 0.015 %, 3 ml /10 L of water (1: 7.93).
3. Indoxacarb 15.8 EC, 0.0079 %, 5 ml /10 L of water (1: 18.55).
4. Emamectin benzoate 5 SG, 0.0025 %, 5 g/10 L of water (1:12.24).

(Prof.& Head, Dept. of Entomology, BACA, AAU, Anand)

4. Bio-efficacy of insecticides against aphid in cumin

For effective and economical control of cumin aphid, spray any one of the following insecticides, first spray at initiation of aphid and if required, second spray at 15 days after first spray.

1. Flonicamid 50 WG, 0.015 %, 3 g/ 10 L of water (ICBR: 1:34.50).
2. Clothianidin 50 WDG, 0.02 %, 4 g/ 10 L of water (ICBR: 1:19.05).
3. Carbosulfan 25 EC, 0.04 %, 16 ml/ 10 L of water (ICBR: 1:46.00).

4. Thiacloprid 24 SC, 0.024 %, 10 ml/ 10 L of water (ICBR: 1: 34.25).

(Prof.& Head, Dept. of Entomology, BACA, AAU, Anand)

5. **Evaluation of insecticidal toxicity against tobacco mealy bug *Phenacoccus solenopsis* tinsley and its parasites and predators under laboratory conditions.**

The insecticides viz., triazophos 40 EC, 0.06 %, imidacloprid 17.8 SL, 0.004 %, thiamethoxam 25 WG, 0.005 %, buprofezin 25SC, 0.005 % and azadirachtin 1 EC, 0.003 % effectively killed the mealybug, *Phenacoccus solenopsis* Tinsley under controlled conditions. However, these insecticides are highly toxic to its parasitoid, *Aenasius bambawalei* Hayat in laboratory conditions.

(Associate Research Scientist, (Ento), BTRS, AAU, Anand)

6. **Residue and persistence of lambda- cyhalothrin 5 EC in/on cucumber**

Two foliar sprays of lambda-cyhalothrin 5 EC in cucumber at 10-day interval @ 15 g a.i./ha at fruiting stage resulted in its residue below the Codex MRL of 0.05 µg/g in cucumber fruits if harvested from 1st day after the last application. Therefore, PHI of 1-day could be suggested if lambda-cyhalothrin 5 EC recommended in cucumber.

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

7. **Residue and persistence of acephate 75 SP in/on cucumber**

Two foliar sprays of acephate 75 SP in cucumber at 10-day interval @ 560 g a.i./ha at fruiting stage resulted in

its residue below the limit of quantitation of 0.05 µg/g in cucumber fruits if harvested from 20th day after the last application. Therefore, PHI of 20-day could be suggested if acephate 75 SP recommended in cucumber.

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

8. **Residue and persistence of imidacloprid 17.8 SL in/on cucumber**

Two foliar sprays of imidacloprid 17.8 SL in cucumber at 10-day interval @ 20 g a.i./ha at fruiting stage resulted in its residue below the Codex MRL of 1.0 µg/g in cucumber fruits if harvested immediately after the last spray. Therefore, PHI of 1-day could be suggested if imidacloprid 17.8 SL recommended in cucumber.

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

9. **Residue and persistence of spiromesifen 22.9 SC in/on cucumber**

Two foliar sprays of spiromesifen 22.9 SC in cucumber at 10-day interval @ 96 g a.i./ha at fruiting stage resulted in its residue below the limit of quantitation of 0.05 µg/g in cucumber fruits if harvested from 10th day after the last application. Therefore, PHI of 10-day could be suggested if spiromesifen 22.9 SC recommended in cucumber.

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

10. **Residue and persistence of lambda-cyhalothrin 5 EC in/on cauliflower**

Two foliar sprays of lambda-cyhalothrin 5 EC in cauliflower at 10-day interval @ 15 g a.i./ha at curd formation resulted in its residue below the Codex MRL of 0.5 µg/gin

cauliflower heads if harvested immediately after the last spray. Therefore, PHI of 1-day could be suggested if lambda-cyhalothrin 5 EC recommended in cauliflower.

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

11. **Residue and persistence of Imidacloprid 17.8 SL in/on cauliflower**

Two foliar sprays of imidacloprid 17.8 SL in cauliflower at 10-day interval @ 20 g a.i./ha at curd formation resulted in its residue below the limit of quantitation of 0.05 µg/g in cauliflower curds if harvested from 7th day after the last application. Therefore, PHI of 7-day could be suggested if imidacloprid 17.8 SL recommended in cauliflower.

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

12. **Residue and persistence of spiromesifen 22.9 SC in/on cauliflower**

Two foliar sprays of spiromesifen 22.9 SC in cauliflower at 10-day interval @ 96 g a.i./ha at curd formation resulted in its residue below the limit of quantitation of 0.05 µg/g in cauliflower curds if harvested from 10th day after the last application. Therefore, PHI of 10-day could be suggested if spiromesifen 22.9 SC recommended in cauliflower.

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

13. **Residue and persistence of cypermethrin 25 EC in/on capsicum**

Two foliar sprays of cypermethrin 25 EC in capsicum at 10-day interval @ 50 g a.i./ha at fruiting stage resulted in its residue below the Codex MRL of 0.10 µg/g in capsicum fruits if harvested from 15th day after the last application.

Therefore, PHI of 15-day could be suggested if cypermethrin 25 EC recommended in capsicum.

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

14. **Residue and persistence of ethion 50 EC in/on capsicum**

Two foliar sprays of ethion 50 EC in capsicum at 10-day interval @ 500 g a.i./ha at fruiting stage resulted in its residue below the FSSAI MRL of 1.0 µg/g in capsicum fruits if harvested from 1st day after the last application. Therefore, PHI of 1-day could be suggested if ethion 50 EC recommended in capsicum.

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

15. **Residue and persistence of lambda-cyhalothrin 5 EC in/on capsicum**

Two foliar sprays of lambda-cyhalothrin 5 EC in capsicum at 10-day interval @ 15 g a.i./ha at fruiting stage resulted in its residue below the Codex MRL of 0.30 µg/g in capsicum fruits if harvested immediately after the last spray. Therefore, PHI of 1-day could be suggested if lambda-cyhalothrin 5 EC recommended in capsicum.

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

16. **Residue and persistence of imidacloprid 17.8 SL in/on capsicum**

Two foliar sprays of imidacloprid 17.8 SL in capsicum at 10-day interval @ 20 g a.i./ha at fruiting stage resulted in its residue below the limit of quantitation of 0.05 µg/g in capsicum fruits if harvested from 1st day after the spray. Therefore, PHI of 1-day could be suggested if imidacloprid 17.8 SL recommended in capsicum.

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

17. **Residue and persistence of spiromesifen 22.9 SC in/on capsicum**

Two foliar sprays of spiromesifen 22.9 SC in capsicum at 10-day interval @ 96 g a.i./ha at fruiting stage resulted in its residue below the limit of quantitation of 0.05 µg/g in capsicum fruits if harvested from 15th day after the last application. Therefore, PHI of 15-day could be suggested if spiromesifen 22.9 SC recommended in capsicum.

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

18. **Residue and persistence of acephate 75 SP in/on tomato**

Two foliar sprays of acephate 75 SP in tomato at 10-day interval @ 560 g a.i./ha at fruiting stage resulted in its residue below the Codex MRL of 1.0 µg/g in tomato fruits if harvested immediately after the last spray. Therefore, PHI of 1-day could be suggested if acephate 75 SP recommended in tomato.

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

19. **Residue and persistence of lambda-cyhalothrin 5 EC in/on cabbage**

Two foliar sprays of lambda-cyhalothrin 5 EC in cabbage at 10-day interval @ 15 g a.i./ha at head formation resulted in its residue below the Codex MRL of 0.30 µg/g in cabbage heads if harvested immediately after the last spray. Therefore, PHI of 1-day could be suggested if lambda-cyhalothrin 5 EC recommended in cabbage.

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

20. Residue and persistence of spiromesifen 22.9 SC in/on cabbage

Two foliar sprays of spiromesifen 22.9 SC in cabbage at 10-day interval @ 96 g a.i./ha at head formation resulted in its residue below the limit of quantitation of 0.05 µg/g in cabbage heads if harvested from 10th day after the last application. Therefore, PHI of 10-day could be suggested if spiromesifen 22.9 SC recommended in cabbage.

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

21. Residue and persistence of imidacloprid 17.8 SL in/on cabbage

Two foliar sprays of imidacloprid 17.8 SL in cabbage at 10-day interval @ 20 g a.i./ha at head formation resulted in its residue below the Codex MRL of 0.50 µg/g in cabbage head if harvested immediately after the last spray. Therefore, PHI of 1-day could be suggested if imidacloprid 17.8 SL recommended in cabbage.

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

22. Residue and persistence of acephate 75 SP in/on bitter gourd

Two foliar sprays of acephate 75 SP in bitter gourd at 10-day interval @ 560 g a.i./ha at fruiting stage resulted in its residue below the limit of quantitation of 0.05 µg/g in bitter gourd fruits if harvested from 15th day after the last application. Therefore, PHI of 15-day could be suggested if acephate 75 SP recommended in bitter gourd.

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

23. **Residue and persistence of lambda-cyhalothrin 5 EC in/on bitter gourd**

Two foliar sprays of lambda-cyhalothrin in bitter gourd at 10-day interval @ 15 g a.i./ha at fruiting stage resulted in its residue below the Codex MRL of 0.3 µg/g in bitter gourd fruits if harvested immediately after the last application. Therefore, PHI of 1-day could be suggested if lambda-cyhalothrin recommended in bitter gourd.

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

24. **Residue and persistence of spiromesifen 22.9 SC in/on bitter gourd**

Two foliar sprays of spiromesifen 22.9 SC in bitter gourd at 10-day interval @ 96 g a.i./ha at fruiting stage resulted in its residue below the limit of quantitation of 0.05 µg/g in bitter gourd fruits if harvested from 10th day after the last application. Therefore, PHI of 10-day could be suggested if spiromesifen recommended on bitter gourd with MRL of 0.05 µg g-1.

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

25. **Evaluation of different insecticidal application strategies against stem borer, *Chilo partellus* Swinhoe infesting maize**

Treat the seeds of maize with imidacloprid 600 FS, 8 ml/ kg seed (0.96 kg. a.i./ ha; ICBR: 19.83) using equal quantity of water before 12 hours of sowing for preventing stem borer infestation. The treated seeds should be dried under shade condition before sowing.

(Assistant Research Scientist, ARS, AAU, Sansoli)

26. Biological control of chilli fruit rot/ anthracnose disease

Following treatments of either *Pichia guilliermondii* (Y12) or *Pseudomonas fluorescens* (Pf-1), in sequence found effective for management of chilli fruit rot/ anthracnose disease.

1. Seed treatment (10 g or ml/kg seeds).
2. Seedling root dip (20 g or ml/L water for 5 minutes).
3. Four foliar sprays (10 g or ml/L, 1 AS, 2x108 cfu/g) at fortnightly interval starting from the initiation of fruit ripening.

These bioagents could be included as components of IDM strategy.

(Principal Res. Sci., AICRP on Biological Control, AAU, Anand)

PLANT PATHOLOGY AND NEMATOLOGY

27. Field evaluation of fungicides for the management of Pyricularia leaf spot/ blast disease of pearl millet

Treat the seeds with thirum 75 WS, 3g/kg seed at the time of sowing and apply two sprays of tebuconazole (50%) + trifloxystrobin (25%) 75 WG, 0.075% (ICBR 1: 5.70) OR azoxystrobin (18.2%) + difenoconazole (11.4%) 29.6 SC, 0.03% (ICBR 1: 8.00) starting at the appearance of the disease and second at 15 days after first spray for effective management of Pyricularia leaf spot/ blast disease of pearl millet in *kharif* season.

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

28. **Evaluation of seed treatment of bioagents for management of soil borne diseases in mungbean**

Treat the seed with *Trichoderma viride* (10^8 cfu/g) 1 WP, 10 g/kg seeds and *Pseudomonas fluorescens* (10^8 cfu/ml) 1 WP, 10 ml/kg seeds (ICBR 1: 116.06) at the time of sowing for effective management of root rot disease of mungbean in *kharif* season.

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

29. **Identification of sources of resistance in mungbean against bean common mosaic disease**

Mungbean genotypes viz., GM-02-07 and LGG 460 found resistant, while GM-9917, GM-02-01, GM-02-02, GM-02-05, GM-02-08, GM-02-10, GM-02-13, GM-02-15, GM-02-20, GM-03-04, GM-03-07, GM-03-13 and GM-03-14 found moderately resistant against bean common mosaic disease under field conditions. These genotypes can be used in breeding programme for developing varieties resistant to bean common mosaic.

(Professor & Head, Dept. of Plant Pathology, BACA, AAU, Anand; Assistant Research Scientist (Ento.), ARS, AAU, Derol)

30. **Management of citrus gummosis (*Phytophthora citrophthora*)**

Pasting the stem with metalaxyl MZ 68 WP (50 g/L) followed by drenching of fenamidone 10% + mancozeb 50% WG, 0.2% (10 L/ tree) twice i.e. first at onset of monsoon and second at one month after first application found effective for management of citrus gummosis.

(Assistant Professor (Pl. Path.), College of Horticulture, AAU, Anand)

31. Screening of promising genotypes for resistance against bacterial blight disease in rice

Rice genotypes viz., IET-24486, IET-25400, IET-25421, *Chittimuthyalu* and *Sabita* found resistant against bacterial blight (*Xanthomonas oryzae* pv. oryzae) under artificial inoculation and high disease pressure conditions in the field. These genotypes can be used in breeding programme for developing varieties resistant to bacterial blight.

(Research Scientist (Rice), MMRS, AAU, Nawagam)

32. Efficacy of *Trichoderma viride* in management of banded leaf and sheath blight of maize under field conditions

Treating the seed with *Trichoderma viride* (10^8 cfu/g) 1 WP, 10 g/kg seeds, its soil application (10 kg/ tonne FYM/ ha) at the time of sowing and four foliar sprays of *T. viride* (60 g/10 L) (ICBR 1: 2.78), first spray at 30 days after germination and remaining at 10 days interval after first spray give effective management of banded leaf and sheath blight disease of maize in *kharif* season.

(Research Scientist (Maize), MMRS, AAU, Godhra;

Assistant Professor (Plant Pathology), College of Agriculture, AAU, Jabugam)

BASIC SCIENCE

1. **Seed hardening and its combined effect on seed germination and molecular characterization in greengram**

It is informed to scientific community that seed hardening of greengram variety GAM-5 with $Cacl_2$ 2 % or cycocel 1000 ppm (3 hours seed soaking and 18 hours shade drying) were found more effective for physiological and biochemical parameters.

(Professor & Head, Dept. of Plant Physiology, BACA, AAU, Anand)

2. **DNA fingerprinting of crop varieties and other bio-inputs developed by AAU, Anand using RAPD and SSR markers.**

It is informed to scientific community that two aroma specific primers viz., ESP and IFAP can be utilized to discriminate aromatic rice genotypes from non-aromatic rice genotypes and for selection of aromatic segregants among segregating generation.

Primer Code	Description	Sequence
ESP	External Sense Primer	TTGTTTGGAGCTTGCTGATG
IFAP	Internal Fragrant Antisense Primer	C A T A G G A G C A G C T - GAAATATATACC

(Research Scientist, Dept. of Agri. Biotechnology, BACA, AAU, Anand)

3. Development and validation of highly sensitive LC-MS/MS method for plant metabolite quantification and confirmation from medicinal and aromatic plants.

It is informed to scientific community that to ascertain the quality of medicinal plant products, LC-MS/MS protocol given below can be utilized to detect and quantify various active compounds.

Table 1: LC Parameters set for analysis of secondary metabolites

Time	Flow ml/ min	A(H_2O with 0.1 % formic acid)	B (50 % ACN + 50% Methanol with 0.1 % formic acid)
0.0	0.3	90	10
1.5	0.3	50	50
2.5	0.3	0	100
5.0	0.3	0	100
6.0	0.3	50	50
7.0	0.3	90	10
10	0.3	90	10

Table 2: MS/MS parameters for negatively ionized compounds

Q1	Q3	Compounds	DP	EP	CE	CXP
193	133.9	Ferrulicaicd	-29	-4.6	-13	-4.6
447	284.2	Kuromanin	-97	-9.7	-32	-10
137.1	92.8	B-Hydroxy_1	-90	-4	-45	-8.8
137.1	64.8	B-Hydroxy_2	-90	-4	-40.8	-4.4
359	197	Ros_1	-60	-10	-24.58	-19.05
359	159.9	Ros_1	-60	-10	-35.3	-33.2
359	178.8	Ros_2	-60	-10	-25.16	-7.05

Q1	Q3	Compounds	DP	EP	CE	CXP
359	132.8	Ros_2	-60	-10	-60.74	-9.2
285	184.6	Kampherol	-110	-8	-36	-12.12
285	238.3	Kampherol_2	-110	-8	-41	-15.74
109	90.6	Pyrocatechol	-109	-10	-30	-6.07
109	65	Pyrocate-chol_2	-109	-10	-31.96	-9.6
147.1	103.6	Cinnamic	-15	-12	-20	-8.8
473	178	Chicoric_1	-80	-11	-20	-10
473	310.2	Chicoric_2	-80	-11	-26.72	-10
311	178.7	Caftaric_1	-160	-10	-20	-10
311	134.7	Caftaric_2	-160	-10	-20.76	-10
178.9	135	Caffeic acid	-115	-10	-22	-9
178.9	107	Caffeic acid	-115	-10	-30	-7
206.9	177	Sinapalde-hyde	-20	-10	-26	-11
206.9	148.9	Sinapalde-hyde	-20	-10	-34	-9
223	163.9	Sinapic acid	-120	-10	-20	-9
223	192.9	Sinapic acid	-120	-10	-28	-11
166.9	137	Vanillicacid	-140	-10	-12	-9
166.9	109.1	Vanillic acid	-140	-10	-16	-7

Table 3: MS/MS parameters for positively ionized compounds

Q1	Q3	Compounds	DP	EP	CE	CXP
568.6	476.5	Zeaxanthin_1	28	10	19.12	11.83
568.6	209.1	Zeaxanthin_2	28	10	38.08	10.93
568.6	175.3	Zeaxanthin_3	28	10	36.33	9.15
568.6	476.6	Lutein_1	28	10	23.94	7.14
568.6	338.1	Lutein_2	28	10	24.74	5.82
568.6	145.1	Lutein_3	28	10	54.94	11.05

Q1	Q3	Compounds	DP	EP	CE	CXP
568.6	81.87	Luein_4	28	10	81.87	8.18
417.2	119	ApoBetaCarotene_1	20	7	53.57	11.05
417.2	121	ApoBetaCarotene_3	20	7	30.07	29.13
537.4	445.4	betacarotene	120	7.06	21.21	3.08
537.4	177	B_1	120	7.06	29.13	9.98
109	81	p-Cresol	65	11	15	5
109	66.9	p-Cresol_2	65	11	17.87	6.78
611.1	449	Cyanidin Chloride	65	11	30	24.82
611.1	287	Cyanidin Chloride_2	65	11	39.98	17.22
355.1	163	Chlorogenic acid	46	10	21	10
355.1	89	Chlorogenic acid	46	10	75	14
286.9	153	Kaempferol	111	10	43	10
286.9	68.9	Kaempferol	111	10	89	10
199	140	Syringic acid	16	10	21	10
199	155	Syringic acid	16	10	13	10

(Research Scientist, Dept. of Agri. Biotechnology, AAU, Anand)

DAIRY SCIENCE

1. **Development of technology for the production of ACE inhibitory bioactive peptides through fermentation of soy milk and bovine milk'**

   A technology is developed by Anand Agricultural University for the production of peptides from fermented skim milk and soy milk rich in ACE inhibitory activity by supplementing 2 % calcium caseinate in skim milk and 1.5 % whey protein concentrate in soy milk fermented by *Lactobacillus rhamnosus* MTCC5945 and *Streptococcus thermophilus* MTCC5460 at the rate of 2 % for 24 h at 37°C.

   (Prof. & Head, Dept. of Dairy Microbiology, DSC, AAU, Anand)

2. **Invitro evaluation of *Lactobacillus helveticus* MTCC 5463 against selected skin pathogens and potential effect on skin lightening**

   Anand Agricultural University's probiotic culture *Lactobacillus helveticus* MTCC 5463 was found to possess properties which can be explored to use it for cosmetic applications. It possesses anti-microbial ability towards skin pathogens viz., *Staphylococcus aureus, Staphylococcus epidermidis* and *Propionibacterium acnes*. It also possesses tyrosinase enzyme inhibition property and copper chelating ability needed for potential effect on skin lightening effect.

   (Prof. & Head, Dept. of Dairy Microbiology, DSC, AAU, Anand)

FOOD PROCESSING TECHNOLOGY

3. Design and development of Delta Robot for handling of food product

For the development of automation and robotic system for handling food products, the arduino powered delta robots using code developed by Anand Agricultural University is recommended to be used for higher accuracy and precision they may use high precision industrial grade actuators with the same code.

(Professor & Head, Dept. of Food Engineering, FPT & BE, AAU, Anand)

AGRICULTURAL ENGINEERING

1. Evaluating canal scheduling approaches for optimum productivity in Panam irrigation command area

Recommendation: I

The irrigation engineers, reservoir operators and planners of Panam Canal Command for three distributaries (27-R, 28-R and 29-R) of Panam Canal Command are recommended to promote 50% of CCA under cultivation and to follow full canal supply at least for 60 days with optimised cropping pattern (Table 1) given below to enhance WUE and canal performance to acceptable level (Table 2).

Table 1: Optimized Cropping Pattern (ha)

Crops	Distributary		
	27-R	28-R	29-R
Wheat	405.0	136.2	364.0
Maize	162.0	34.1	364.0
Fodder	81.0	13.6	36.4
Other	81.0	22.4	47.1
Castor	-	-	1.8
Cotton	-	-	1.8
Fallow Land	890.3	437.4	1004.9

Table 2: Canal Performance Indices

Performance Indicators	Existing	Acceptable
Adequacy	>0.57	>0.90
Efficiency	>0.91	>0.85
Dependability	>0.64	<0.10
Equity	>0.39	<0.10

Recommendation:II

The irrigation engineers, reservoir operators and planners of Panam Canal Command for three distributaries (27-R, 28-R and 29-R) of Panam Canal Command are recommended to promote the following cropping pattern and to allow full canal supply for 120 days for attaining higher profit.

Table 1: Optimized Cropping Pattern (ha)

Crops	Distributary		
	27-R	28-R	29-R
Wheat	810.0	374.6	728.0
Maize	324.0	102.2	819.0
Fodder	243.0	54.5	36.4
Other	243.0	8.8	36.4
Castor	-	-	145.0
Cotton	-	-	10.7
Fallow Land	0.0	141.1	44.5

(Principal, College of Agril. Engg. & Tech. , AAU, Godhra)

2. **Daily and monthly rainfall forecasting using Extreme Learning Machines (ELMs), ANN with genetic algorithm (GANN) in the middle region of Gujarat**

The Planners, NGOs, & irrigation specialists in Anand region are recommended to adopt a novel soft computing technique maximum overlap discrete wavelet transformation based extreme learning machine (MODWT-ELM) for daily and monthly rainfall forecasting with two lags of climatic inputs. For daily rainfall forecasting principal component based artificial neural network (PCA-ANN) or MODWT-ELM models with five lags of inputs are recommended.

(Principal, College of Agril. Engg. & Tech. , AAU, Godhra)

AGRICULTURAL INFORMATION TECHNOLOGY

3. **Development of Web Based AGRESCO Projects Information & Monitoring Management System**

Web based AGRESCO Projects Information & Tracking Management System developed by Anand Agricultural University automates and tracks the progress of the AGRESCO Projects. It is recommended to be used at SAU's of Gujarat.

(Director, IT, AAU, Anand)

4. **Web based Information Management System for Planning and Budget Processes**

Scientists of Anand Agricultural University are recommended to use Web Based Information System for Planning and Budget Processes which manages expenditure details of nonrecurring and recurring items.

(Director, IT, AAU, Anand)

5. **Web Based Complain Management System for IT Related Services at AAU**

Scientists and users of Anand Agricultural University are recommended to use Web Based Complain Management System for IT Related Services which provides a common platform for complain management and tracking of different live IT projects of AAU.

(Director, IT, AAU, Anand)

6. **Web Based System For Enrolment of Post Graduate Students(Campus Form) – Adding A New Module in Post Graduate Information System**

Web Based Module has been developed by Anand

Agricultural University for Enrolment of Post Graduate Students. The module provides Graphical User Interface (GUI) to store and manage PG Students' details for generation of campus form. This is integrated with PG Students' Information Management System.(URL : stud.aau.in)

(Director, IT, AAU, Anand)

7. **GEA – Mobile App – Emergency Alert Mobile Application for Hostelite Girl Students of SAU'S of Gujarat**

Hostelite girl Students of SAUs of Gujarat are recommended to use Android based GEA – Mobile App developed by AAU. The App which provides an emergency alerts and calling to the specified hierarchy and tracks the student current location via GPS technology.

(Director, IT, AAU, Anand)

8. **Develop attendance and result module for polytechnic courses and integrate in student corner**

Web based Polytechnic Module of Student Corner developed by Anand Agricultural University is useful for storing attendance, results and fees collection details of Polytechnic Colleges of Anand Agricultural University. The system is useful to Course Teachers, Academic in-charges, Principals, Registrar and Administrative Officers to carry out various academic activities of Anand Agricultural University and is recommended for use in SAUs.

(Principal, College of AIT, AAU, Anand)

ANIMAL PRODUCTION

1. **Association of body condition score with metabolic profile in cows**

   At calving average BCS (on 5-point scale) should be 3.50 to 3.75 for obtaining optimum milk production.

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

2. **Development of feeding strategy to enhance body weight gain in Surti Kids**

   It is recommended that TMR with 20 % higher protein and 15 % higher energy significantly improves feed efficiency, average daily gain (by 92 %) and decreases cost/kg gain (by 29 %) in Surti male kids during growing phase (7 to 12 months) compared to kids reared as per ICAR feeding standard.

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

3. **Development of feeding strategy to enhance body weight gain in Surti Kids**

   It is recommended that TMR with 15 % higher energy significantly improves feed efficiency, average daily gain (by 79 %) and decreases cost/kg gain (by 15 %) in Surti male kids during finishing phase (12-14 months) compared to kids reared as per ICAR feeding standard.

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

4. **Effect of methane mitigation on growth performance of crossbred calves through feeding legume straw based TMR**

   It is recommended that replacing wheat straw with 25

% groundnut straw in TMR with 50:50 roughages to concentrate ratio increases growth rate by 20 and 33 %, rumen microbial protein synthesis by 79 and 38 % while decreases methane emission (g/kg DDMI) by 26 and 32 % and dietary energy loss through methane by 30 and 35 %, respectively in mash and pellet form. This loss of dietary energy saved through methane mitigation was utilized by the crossbred calves for growth.

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

ANIMAL HEALTH

1. **Study on efficacy of inclusion body hepatitis vaccines in experimentally challenged IBH virus serotype 4 and 11 in broiler chicks**

The Inclusion Body Hepatitis- Hydro Pericardium Syndrome (IBH-HPS) vaccines having serotype-4 virus are also protective against serotype-11(IBH-HPS) virus prevalent in the commercial broilers. Hence the field veterinarians are advised to recommend serotype-4 IBH vaccines against prevalent serotype-11 IBH virus in the commercial broilers.

(Prof. and Head, Dept. of Veterinary Pathology, Vet. College, AAU, Anand)

2. **Study on relative merits of egg yolk and soyabean based extenders for cryo preservation of cattle and buffalo semen: Effect of Season on Semen Quality and Freezability**

It is recommended to harvest maximum frozen semen doses during winter season using soyabean based ready

to use extender for cryopreservation of buffalo semen in middle Gujarat.

(Prof. and Head, Dept. of Gynaecology and Obstetrics, Vet. College, AAU, Anand)

3. **Study of testicular biometry, sexual behavior, semen quality and blood biochemical profile during the period of adolescence in Surti male kids**

The growing male kids of Surti goats attained puberty at 27 weeks and sexual maturity with optimum libido at 38 weeks of age with stable body weight (19.61 ± 0.93 kg), scrotal circumference (20.14 ± 0.65 cm), scrotal volume (229.09 ± 15.91 cm3) and optimum semen quality. Hence, it is recommended to consider these criteria while selecting Surti bucks for breeding purpose.

(Prof. and Head, Dept. of Gynaecology and Obstetrics, Vet. College, AAU, Anand)

4. **Assessment of Doublesynch, Estradoublesynch and PRID + PMSG protocols for estrus synchronization and fertility in cyclic and acyclic dairy animals**

The estrus/ovulation synchronization protocols viz., CIDR/ PRID, PRID + PMSG, Doublesynch and Estradoublesynch used in true anestrus crossbred cows and buffaloes resulted into equally good estrus induction response (89-100 %), but the conception rates were much better with PRID and PRID+PMSG in both cattle (70 % each) and buffaloes (66 and 75 %, respectively) than with Doublesynch (55 %) and Estradoublesynch (35 %). In repeat breeding

cows and buffaloes, the conception rates were better with Doublesynch than Estradoublesynch protocol. It is therefore recommended for practicing veterinarians to use PRID alone or PRID+PMSG protocol in anestrus cows and buffaloes, and Doublesynch protocol in repeat breeder cows and buffaloes for higher conception rates.

(Prof. and Head, Dept. of Gynaecology and Obstetrics, Vet. College, AAU, Anand)

5. **Evaluation of role of hypothalamo-hypophyseal-ovarian axis in the onset of puberty in Surti buffalo and crossbred cattle**

HF X K crossbred heifers (6-9 months of age) on higher plane of nutrition (1 kg concentrate 24 % CP, 30 g min mix and ad lib dry fodder) showed significant increase in gain in body weight (25-35 kg) and reduction in the age of onset of puberty (20.40 ± 0.45 vs 22.23 ± 0.45 months) and sexual maturity (23.17 ± 0.60 vs 24.72 ± 0.89 months) as compared to routine farm fed heifers and had ovulatory follicles (>12 mm) or CLs (>10 mm) with concurrent elevated plasma estradiol and progesterone concentrations.

(Prof. and Head, Dept. of Gynaecology and Obstetrics, Vet. College, AAU, Anand)

SOCIAL SCIENCE

1. Scale to measure attitude of women towards Kitchen Gardening

Sr. No	Statements	SA	A	UD	DA	SDA
1	Kitchen garden provides an opportunity to make a positive environmental impact. (+)	5	4	3	2	1
2	I visualize limited scopes of kitchen gardening. (-)	1	2	3	4	5
3	Kitchen gardening provides opportunity to get fresh vegetables in all the seasons. (+)	5	4	3	2	1
4	I think kitchen gardening is tedious job. (-)	1	2	3	4	5
5	I think kitchen gardening helps in saving money. (+)	5	4	3	2	1
6	Kitchen gardening is hypocrisy than reality.(-)	1	2	3	4	5
7	Kitchen gardening is an ideal medium to give experience of nature to children. (+)	5	4	3	2	1
8	Kitchen gardening promotes inter-personal conflict among family members. (-)	1	2	3	4	5
9	Kitchen garden helps in promoting family fitness.(+)	5	4	3	2	1
10	Kitchen garden promotes greenery near residential areas. (+)	5	4	3	2	1
11	Kitchen gardening is constructive approach to convert leisure time in to productive one. (+)	5	4	3	2	1

Scoring technique: For application of the scale, the researcher can collect information against each 11 statements in five-point continuum viz., 'Strongly agree', 'Agree', 'Undecided', 'Disagree' and 'Strongly disagree' with weighted score of 5,4,3,2 and 1 for positive and reverse to negative statements.

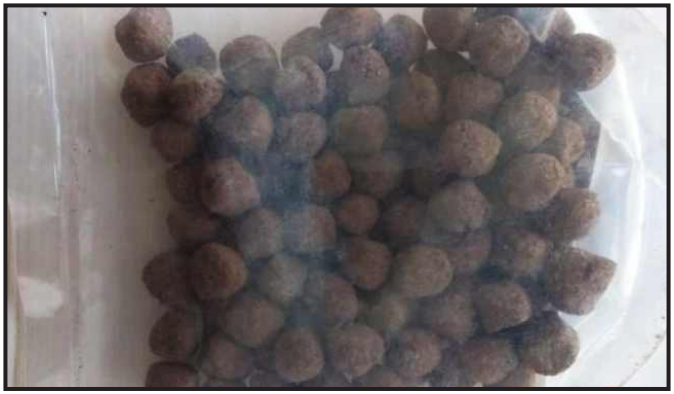
(Professor & Head, Dept. of Ext. Edu., BACA, AAU, Anand)

2. Scale to measure attitude of farmers towards Agricultural Produce Market Committee (APMC)

Sr. No.	Statements	SA	A	UD	DA	SDA
1	I endorse that APMC is farmers' friendly approach to sale farm products. (+)	5	4	3	2	1
2	APMC is inadequate system to help farmers to sale farm products appropriately. (-)	1	2	3	4	5
3	APMC is the best system to secure farmers exploited by intermediaries. (+)	5	4	3	2	1
4	Payment system of farm produces adopted under APMC is inappropriate. (-)	1	2	3	4	5
5	APMC serves as a system to stop harsh conditions created by traders for farmers. (+)	5	4	3	2	1
6	APMC does not help farmers in getting higher returns of produces when consumer prices are high. (-)	1	2	3	4	5
7	APMC ensures effective mode of payment for agricultural produce sold by farmers. (+)	5	4	3	2	1
8	APMC is not a long-term solution to the problems of price inflation. (-)	1	2	3	4	5
9	APMC prevents distress sale of farm produces. (+)	5	4	3	2	1
10	APMC does not give chance to the farmers to access larger markets to get benefits.(-)	1	2	3	4	5
11	APMC checks monopoly of agro-traders. (+)	5	4	3	2	1
12	APMC protects price-crash.(+)	5	4	3	2	1

Scoring Technique: For application of the scale, the researcher can collect information against each 12 statements in five-point continuum viz., 'Strongly agree', 'Agree', 'Undecided', 'Disagree' and 'Strongly disagree' with weighted score of 5,4,3,2 and 1 for positive and reverse to negative statements.

(Professor & Head, Dept. of Ext. Edu., BACA, AAU, Anand)



Bio-manure Granules

Rava burfi

Gujarat Anand Yellow Maize Hybrid 3 (GAYMH 3)

Gujarat Anand Castor 11 (GAC 11)

Gujarat Anand Forage Bajra 4 (GAFB 4)

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