

RESEARCH ACCOMPLISHMENTS AND RECOMMENDATIONS 2022



DIRECTORATE OF RESEARCH
JUNAGADH AGRICULTURAL UNIVERSITY
JUNAGADH -362001 (Gujarat)

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Dr. V. P. Chovatia
Vice Chancellor

MESSAGE

The Junagadh Agricultural University (JAU) is one of the four Agricultural Universities of Gujarat established with triple function of education, research and extension with advanced global learning environment to facilitate students, faculty and farmers. Alongwith basic research, JAU is excelling in adoptive research to come out with process of integrating science, management and agriculture for the service of the farming community.

Total 25 research stations of the University spread over 10 districts of Saurashtra are extensively engaged in multidisciplinary, farmer centric, demand driven research to make the farmers equipped with modern agricultural technology and development. The Scientists are exploiting the potential of the emerging new areas of specialization to fulfill the vision and mission of the University by matching the upcoming technologies according to local issues of farmers.

The research recommendations for crop improvement, crop production, plant protection, horticulture, mechanization and value addition by respective faculties were discussed at length in ZREAC, during AGRESKO and Combined AGRESKO meetings. I congratulate and appreciate the scientists for their efforts and contributions in the form of four new crop varieties, 34 technologies developed for farmers and 29 technologies for scientific community. I put on record for special contribution of Director of Research and his team for nicely compilation and publishing **“Research Accomplishment and Recommendations-2022”**. Hoping that all scientists, students, farmers, entrepreneurs and other stake holders will be benefitted from this publication.

Junagadh
June 01, 2023

(V. P. Chovatia)



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Dr. H. M. Gajipara

PREFACE

It is a matter of emance pleasure for me to put on record the research work carried out during 2021-22 in the Junagadh Agricultural University. The recommendations and new technical programmes were thouroughly discussed and approved in respective 18th Agresco Subcommittee Meetings of Junagadh Agricultural University. Same were presented in 18th Combined Agresco meeting of SAUs, which was organized by Junagadh Agricultural University, Junagadh during May 04-18, 2022 through virtual mode.

The Junagadh Agricultural University represents Saurashtra region of Gujarat and about 32.74 per cent area of the state. There are 25 research stations, which include multidisciplinary main research stations, sub research stations for various crops as well as testing centers spread over 10 districts. The eight different sub-committees have been constituted and conveners were nominated to plan and monitor the research work. All the sub-committees have successfully completed their responsibilities. The University has also arranged 19th Research Council meeting on January 17, 2022 for approval of new research projects and research activities to be under taken during this year. The university has also signed three MoU for research activities like PG Research, HRD, production and marketing of vegetable varieties during the year 2021-22. Total 20 new projects worth Rs. 136.95 lakh were sanctioned from ICAR and Private sectors in the University during the year 2021-22.

During the year 2021-22, total 9615 quintal breeder/ nucleus seeds of different crops were produced to fulfill the demand of private and public sectors as per the national and state indents. Under Megaseed

project, 8189 quintal of truthful/ foundation/ certified seeds of different crops were produced and supplied to the farmers & various farms of the University under the brand “Gir Sawaj”. Apart from these, 170354 planting material of different fruit crop graft, sapling, seedling, ornamental & medicinal plants were produced and provided to the farmers.

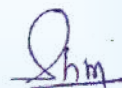
In the 18th AGRESCO Subcommittees Meeting of JAU, Four varieties viz., Groundnut [Gujarat Groundnut 39 (GG 39: Sorath Uttam), Indian Bean [Gujarat Indian Bean 3 (GIB 3: Sorath Harita)], Soybean [Gujarat Soybean 4 (G.Soy 4: Sorath Sonali) and cotton [Gujarat Cotton Hybrid-26 BG II (G.Cot.Hy-26 BG II: Sorath Swet Kanchan)] were recommended for release in the Gujarat state. Besides this, 34 technologies/ recommendations were made for farmers and 29 technologies were made for Scientific Community. In addition, as many as 56 new technical programmes were formulated to initiate the new research programmes for the solutions of the applied and basic problems of agriculture and allied fields.

Summary of 18th Combined AGRESCO meeting of SAUs

Sub Committee	No. of Recommendations		New Technical Programs
	Farmers	Scientific	
Crop Improvement	4*	-	01
Crop Production	14	04	13
Plant Protection	04	05	15
Horticulture & Forestry	03	-	04
Agricultural Engineering	07	04	06
Animal Science	06	08	06
Basic Science	-	06	04
Social Science	-	02	07
Total	04*+34	29	56

*No. of crop varieties released

Junagadh
June 01, 2023



(H. M. Gajipara)

RECOMMENDATIONS FOR FARMERS

I. CROPIMPROVEMENT

Four new crop varieties viz. Groundnut (GG 39), Indian bean (GIB 3) and Cotton (G.Cot.Hy.24-BG-II) were recommended for farmers during the year 2021-22.

VARIETIES RELEASED

Groundnut: Gujarat Groundnut 39 (GG 39: Sorath Uttam)

The farmers of Gujarat state growing groundnut during *kharif* season are recommended to grow Spanish bunch high oleic groundnut variety Gujarat Groundnut 39 (GG 39: Sorath Uttam). This variety has recorded mean pod yield of 2619 kg/ha, which was 34.43, 11.74 and 2.24 per cent higher than the check varieties, GJG 9 (1949 kg/ha), TG 37A (2248 kg/ha) and GJG 32 (2489 kg/ha), respectively. This variety has also recorded higher kernel yield, oil yield and oleic acid (>79 %) than the check varieties. Stem rot disease was lower in GG 39, while tikka, rust and collar rot diseases were comparable to the check varieties. The infestation due to leaf defoliators was lower than the check varieties.



[Main Oilseeds Research Station, JAU, Junagadh]

Indian bean: Gujarat Indian Bean 3 (GIB 3: Sorath Harita)

The farmers of Gujarat state except South Gujarat growing Indian bean (Papdi) crop during late *kharif*/ *rabi* season are recommended to grow Indian bean (Papdi) variety Gujarat Indian Bean 3 (GIB 3: Sorath Harita). It has recorded the mean green pod yield of 225.24 q/ha, which was 13.96, and 12.81 per cent higher over local check

varieties; Gujarat Papdi-1 (197.65 q/ha) and GJIB 2 (148.85 q/ha), respectively. The pods of GIB 3 are medium long in size with whitish green colour. This variety contains higher protein content. This variety has cluster pod bearing habit hence, it is suitable for easy pod picking. It is moderately resistance against leaf spot, mosaic diseases whereas, pod borer damage was found low as compare to check varieties.



[Vegetable Research Station, JAU, Junagadh]

Soybean: Gujarat Soybean 4 (G.Soy 4: Sorath Sonali)

The farmers of Gujarat state growing soybean during *khari* season are recommended to grow soybean variety Gujarat Soybean 4 (G.Soy 4: Sorath Sonali). This variety has recorded mean seed yield of 2160 kg/ha, which was 11.46, 43.05 and 9.87 per cent higher over the check varieties, JS 335 (1938 kg/ha), G.Soy 2 (1510 kg/ha) and GJS 3 (1966 kg/ha), respectively. This variety has also recorded 10.38 per cent high oil yield over the check variety GJS 3. This variety was found comparable to the check varieties against *Rhizoctonia* root rot and *Cercospora* leaf spot diseases. The damage due to sucking pest and leaf defoliators was also comparable in G.Soy 4 to the check varieties.



[Agricultural Research Station, JAU, Amreli]

Endorsement of Bt Cotton hybrid: Gujarat Cotton Hybrid-26 BG-II (G.Cot.Hy-26 BG-II: Sorath Swet Kanchan)

The farmers of Gujarat state growing Bt cotton hybrid (*Gossypium hirsutum* L.) are recommended to grow cotton hybrid Gujarat Cotton Hybrid-26 BG-II (G.Cot.Hy-26 BG-II: Sorath Swet Kanchan) under irrigated condition. This hybrid has recorded a 2798 kg/ha seed cotton yield, which was 1.8, 39.7, 21.0 and 5.4 per cent higher over BG-II check hybrids viz., GTHH-49 (2806 kg/ha), RCH-2 (2045 kg/ha), MRC-7351 (2255 kg/ha) and PCH-4599 (2589 kg/ha), respectively. This hybrid gave lint yield of 997 kg/ha, which was 1.1, 48.5, 28.1 and 12.0 per cent higher over BG-II check hybrids GTHH-49 (999 kg/ha), RCH-2 (680 kg/ha), MRC-7351 (767 kg/ha) and PCH-4599 (877 kg/ha), respectively. It possesses 35.3 per cent ginning outturn. This hybrid is medium in maturity. It is found resistant to alternaria leaf spot and bacterial leaf blight diseases and found moderately tolerance against sucking pests.



[Cotton Research Station, JAU, Junagadh]

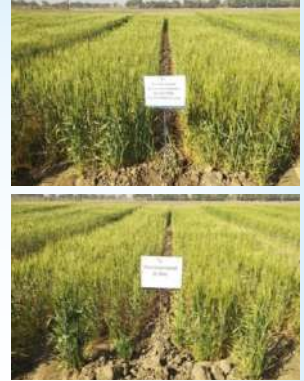
II. CROPPRODUCTION

Nutrient Management

Development and evaluation of microbial consortia enriched vermicompost formulation in wheat

The farmers of South Saurashtra Agro-climatic Zone growing wheat organically are recommended to apply FYM 5 t/ha along with vermicompost 2 t/ha enriched with *Azotobacter* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and

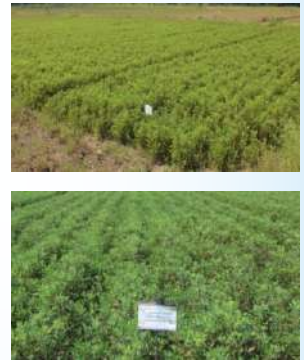
Beauveria bassiana (3 kg) to obtain higher yield and net return as well as to improve soil health. For enrichment of vermicompost, *Azotobacter* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and *Beauveria bassiana* (3 kg) should be mixed with vermicompost 2 tonne with little water sprinkled (Moisture content 20 %) and apply 10 days after incubation in the field.



(Department of Agronomy, CoA, JAU, Junagadh)

Evaluation of microbial consortia enriched vermicompost in kharif groundnut

The farmers of South Saurashtra Agro-climatic zone growing *kharif* groundnut organically are recommended to apply FYM 5 t/ha along with vermicompost 2 t/ha enriched with *Rhizobium* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and *Beauveria bassiana* (3 kg) to obtain higher yield and net return as well as to improve soil health. For enrichment of vermicompost, *Rhizobium* (2 L), PSB (2 L), KSB (2 L), *Trichoderma harzianum* (3 kg), *Pseudomonas fluorescens* (3 L) and *Beauveria bassiana* (3 kg) should be mixed with vermicompost 2 tonne with little water sprinkled (Moisture content 20 %) and apply 10 days after incubation in the field.



(Department of Agronomy, CoA, JAU, Junagadh)

Effect of different management practices on yellowing and yield of pre-monsoon groundnut

The farmers of South Saurashtra Agro-climatic Zone growing pre-monsoon groundnut (last week of May) are recommended to apply

foliar spray of 0.5 % FeSO₄ heptahydrate (50 g/10 L water) with 0.05 % citric acid at 25 DAS and 1 % FeSO₄ heptahydrate (100 g/10 L water) with 0.1 % citric acid at 35 and 45 DAS or foliar spray of 0.5 % FeSO₄ heptahydrate (50 g/10 L water) with 1 % cow urine at 25 DAS and 1 % FeSO₄ heptahydrate (100 g/10 L water) with 2 % cow urine at 35 and 45 DAS or foliar spray of 1.0 % micronutrient mixture grade IV at 45 and 60 DAS in addition to recommended dose of NPK fertilizers (12.5-25-50 N-P₂O₅-K₂O kg/ha) to obtain higher yield, net return and reduction in yellowness.



(Main Oilseeds Research Station and Department of Soil Sci. & Agril. Chem., CoA, JAU, Junagadh)

Identifying suitable crop geometry and nutrient dose for Spanish bunch *kharif* groundnut

The farmers of South Saurashtra Agro-climatic Zone growing bunch groundnut (GJG 32) during *kharif* season are recommended to sow at spacing of 30 cm x 10 cm and apply 100 % RDF (12.5-25-50 kg N-P₂O₅-K₂O/ha) + Biofertilizer [*Rhizobium* (*Rhizobium leguminosarum* and *Rhizobium meliloti* 1 x 10⁷ cfu/ml)] @ 15 ml/kg seed; PSM (*Bacillus subtilis* 1 x 10⁸ cfu/ml) & KMB (*Frateuria aurantia* 1 x 10⁸ cfu/ml) soil application each @ 3 L/ha) as a basal for obtaining higher yield and net return.



(Main Oilseeds Research Station, JAU, Junagadh)

Effect of nano boron on yield and nutrients uptake by summer groundnut

The farmers of Saurashtra region growing summer groundnut in medium black calcareous soil are recommended to apply three sprays of

0.2 % (20 ml/10 L water) nano boron OR 0.2 % (20 g/10 L water) boric acid at 30, 45 and 60 DAS in addition to



recommended dose of fertilizer (25-50-50 N-P₂O₅-K₂O kg/ha) to obtain higher yield and net return.

(Department of Soil Sci. & Agril. Chem., CoA and Main Oilseeds Research Station, JAU, Junagadh)

Effect of different levels of NPK and time of application on cucumber yield under protected condition

The farmers of Gujarat growing cucumber during *kharif* season under protected condition (Poly house) are recommended to apply 50-50-50 N-P₂O₅-K₂O kg/ha in form of water soluble fertilizer (19-19-19) and 30 kg/ha nitrogen in form of urea through fertigation in four equal splits *i.e.* basal, 30, 45 and 60 DAS along with *Azotobacter*, PSB and KSB @ 3 L/ha each through drenching to obtain higher yield and net return.



(Department of Soil Sci. & Agril. Chem., CoA and, Dept. of Horticulture, CoA, JAU, Junagadh)

Integrated management practices in groundnut under poorly drained medium black calcareous soil

The farmers of South Saurashtra Agro-climatic Zone growing *kharif* groundnut under poorly drained medium black calcareous soil are recommended to apply *tanch* 50 t/ha or FYM @ 10 t/ha to obtain higher yield and net return.



(Department of Soil Sci. & Agril. Chem., CoA, and Department of Agronomy, CoA, JAU, Junagadh)

Nutrient management in Bt. cotton under rainfed condition (Kukada)

The farmers of North Saurashtra Agro-climatic Zone (AES-VI) growing Bt. cotton are recommended to apply 100-30-60 N-P₂O₅-K₂O kg/ha for obtaining higher yield and net return as well as sustaining soil fertility under rainfed conditions. The phosphorus and potash should be applied as basal, while nitrogen should be applied in three splits *i.e.* 25 % as basal at the time of sowing, 50 and 25 % as top dressing at 35-40 and 60-65 days after sowing, respectively by drilling in 10 cm soil depth.



(Main Dry Farming Research Station, JAU, Targhadia and Cotton Research Station, JAU, Kukada)

Cultural Practices

Response of *rabi* castor based intercropping systems to drip irrigation

The farmers of South Saurashtra Agro-climatic Zone growing *rabi* castor based intercropping system are recommended to irrigate the castor and intercrops through drip irrigation at 0.8 PEF to obtain higher castor seed equivalent yield and net realization along with higher WUE. Farmers are also recommended to sow gram as an intercrop with *rabi* castor sown at 180 cm spacing in 1:3 row proportion to obtain higher castor seed equivalent yield and net realization.

System details:

Details	Operating Time	
	Month	Minutes
Lateral spacing: 60 cm	November	270
Dripper spacing: 40 cm	December	
Dripper discharge rate: 4 lph	January	216
Operating pressure: 1.2 kg/cm ²	February	
Operating frequency: Alternate day	March	300

(Department of Agronomy, CoA, JAU, Junagadh)

Evaluation of land configuration and intercropping system in Bt. Cotton

The farmers of South Saurashtra Agro-climatic Zone adopting Bt. cotton based intercropping system are recommended to sow cotton under broad bed and furrow system (Broad bed 210 cm wide, furrow 30 cm wide & 20 cm deep) to obtain higher seed cotton equivalent yield and net return along with soil moisture conservation. The farmers are also recommended to sow cotton + green gram or black gram in 1:2 row ratio for getting higher seed cotton equivalent yield and net realization.



(Department of Agronomy, CoA, JAU, Junagadh)

Productivity of different medium duration pigeon pea varieties under different row spacing

The farmers of South Saurashtra Agro-climatic Zone, growing *kharif* pigeon pea are recommended to grow medium duration pigeon pea variety GJP 1 with spacing of 120 cm x 25 cm to obtain higher seed yield and net realization.



(Pulses Research Station, JAU, Junagadh)

Reduction of chemical fertilizer by using biofertilizers and enriched compost in cotton crop

The farmers of South Saurashtra Agro-climatic Zone growing Bt. cotton are recommended that to obtain higher yield and net realization as well as saving 25 % fertilizer, apply 75 % RDF (180-37.5-112.5 N-P₂O₅-K₂O kg/ha) along with *Azotobacter* + PSB + KSB each 3 L or



Consortia (Bio NPK 5×10^8 cfu/ml) 1 L/ha. Full dose of phosphorus as basal, potash in two equal splits as basal and 30 DAS and nitrogen should be given in four equal splits *i.e.* as basal, 30, 60 and 90 DAS.



(Cotton Research Station and Department of Soil Sci.& Agril. Chem., CoA, JAU, Junagadh)

Ratoon management in sugarcane

The farmers of South Saurashtra Agro-climatic Zone growing sugarcane first ratoon crop are recommended to adopt stubble shaving (Shaving of stubbles above the ground level), off barring (by bullock drawn cultivator and blade harrow) and gap filling (Filling the gaps 60 cm or more) to obtain higher cane yield and net return.



(Main Sugarcane Research Station, JAU, Kodinar)

Irrigation Management

Performance of sesame cultivars/ genotypes under different levels of irrigation during summer season

The farmers of Saurashtra region growing sesame during summer season are recommended to grow sesame variety GJT 5 and apply total 12 irrigations scheduled as: first irrigation immediately after sowing, second irrigation at 21 days after sowing and remaining irrigation at 5 to 6 days interval during March-April and 4 to 5 days interval during May (1.0 IW: CPE) to obtain higher seed yield and net return.

(Agricultural Research Station, JAU, Amreli)

III. PLANT PROTECTION

Entomology

Bio-efficacy of different biocides against aphid in coriander

The farmers of Gujarat growing coriander are recommended to spray *Beauveria bassiana* 1.15 WP (Min. 1×10^8 cfu/g) 0.007 % (60 g/10 l of water) or *Lecanicillium lecanii* 1.15 WP (Min. 1×10^8 cfu/g) 0.009 % (80 g/10 l of water), first at ETL and subsequent three sprays at 10 days interval for effective and economical management of aphid.



As per CIB RC Format

Year	Crop	Pest	Pesticides with formulation	Dosage				Total Quantity of Chemical suspension required/ha	Application schedule
				a.i / ha	Quantity of formulation on Kg or ml/ha	Concen. (%)	Dilution in water (10 lit.)		
2021-22	Coriander	Aphid	<i>Beauveria bassiana</i> 1.15 WP	35	3 kg	0.007	60 g	500 litre	First spray at ETL and subsequent three sprays at 10 days interval after first spray
			<i>Lecanicillium lecanii</i> 1.15 WP	46	4 kg	0.009	80 g		

(Department of Entomology, CoA, JAU, Junagadh)

Bio-efficacy of *Beauveria bassiana* and different insecticides against insect pests of groundnut

The farmers of Gujarat growing *kharif* groundnut are recommended to apply five sprays of bio-pesticide, *Beauveria bassiana* 1.15 WP (Min. 1×10^8 cfu/g), 0.007 % (60 g/10 l of water) at 15 days interval after initiation of any pest infestation for effective and economical management of sucking pests (jassid, aphid and thrips) and

leaf eating caterpillars (*H. armigera* and *S. litura*).



As per CIB RC Format

Year	Crop	Pest	Pesticides with formulation	Dosage			Total Quantity of Chemical suspension required/ha	Application schedule	
				a.i./ha	Quantity of formulation kg or ml/ha	Conc. (%)			Dilution in water (10 lit.)
2022	Groundnut	Sucking pests (Jassid, aphid and thrips) and leaf eating caterpillars (<i>H. armigera</i> and <i>S. litura</i>)	Beauveria bassiana 1.15 WP	35	3.0 kg	0.007	60 g	500 litre	First spray at initiation of any pest infestation, subsequent four sprays at 15 day interval after first spray

(Department of Entomology, CoA, JAU, Junagadh)

Management of shoot fly and stem borer infesting pearl millet crop

The farmers of Gujarat growing pearl millet in *kharif* season are recommended to treat seed with imidacloprid 600 FS (8.75 ml/kg) followed by two sprays at 20 and 40 DAG either *Beauveria bassiana* 1.15 WP (Min. 1×10^8 cfu/g), 0.007 % (60 g/10 l of water) or *Panchgavya* 3 % (300 ml/10 l of water) for effective and economical management of shoot fly and stem borer.

As per CIB RC Format

Year	Crop	Pest	Pesticides with formulation	Dosage				Total qty. of chemical suspension required /ha	Application schedule
				g. a.i./ha	Qty. of formulation g, ml, kg or l/ha	Conc. (%)	Dilution in water (10 lit.)		
2021-2022	Pearl millet (Baira)	Shoot fly and stem borer	Imidacloprid 600 FS	16.8	35 ml	Seed trt.	--	--	Seed treatment
			B. bassiana 1.15 WP @ 1×10^8 cfu/g	34.5	3.0 kg	0.007	60 g	500 L	Two sprays, 20 & 40 DAG
			Panchgavya	--	15.0 L	3.0	300 ml	500 L	

(Department of Entomology, CoA, JAU, Junagadh)

Plant Pathology

Integrated management of root rot (*macrophomina phaseolina*) of castor

The farmers of Gujarat growing castor are recommended to apply 5 kg *Trichoderma harzianum* 1 % WP (Min. 2×10^6 cfu/g) enriched before one week in 500 kg FYM/ha at the time of sowing for effective and economical management of root rot.

As per CIB &RC Format

Year	Crop	Disease	Pesticides with formulation	Dosage				Application schedule	Remark (s)
				g.a.i./ha	Quantity of formulation g, ml, kg or l/ha	Concentration (%)	Dilution in water (10 lit)		
2022	Castor	Root rot	Trichoderma harzianum 1 % WP	-	5 kg	2×10^6 cfu/g	-	As soil application with 500 kg FYM at the time sowing	In Castor crop this bioagent is not registered

(Main Oilseeds Research Station, JAU, Junagadh)

IV. HORTICULTURE

Effect of biostimulants and micronutrients on growth, flower yield and quality of tuberose (*Polianthes tuberosa* L.) cv. Prajwal

The farmers of Saurashtra region growing tuberose are recommended to apply four foliar spray of *panchgavya* @ 3% (300 ml/10 lit of water) starting from 30, 60, 90 & 120 days after planting and spray of FeSO_4 @ 1 % (100 ml/10 lit. of water) + 0.1 % citric acid (10 ml/10 lit of water) at 45, 75, 105, 135 days after planting for getting higher yield and net return.



(Department of Horticulture, JAU, Junagadh)

Performance of different grafted variety and mulching in Brinjal

The farmers of Saurashtra region growing brinjal are recommended to use variety GJB3 side grafted on *Solanum torvum* (wild brinjal) with

25 micron silver black mulch for higher yield and net return.



(Department of Horticulture, JAU, Junagadh)

Effect of organic manures, biofertilizers and biostimulants on growth and yield of drumstick (*Moringa oleifera* Lam.) cv. PKM-1

The farmers of South Saurashtra Agro-Climatic Zone growing drumstick are recommended to apply FYM @ 20 kg/plant along with 20:20:20 NPK g/plant as a basal dose during *kharif* and remaining 20 g N/plant is given after withdrawal of monsoon for getting higher yield and net return.

(Department of Horticulture, JAU, Junagadh)

V. AGRICULTURAL ENGINEERING

Design, development and performance evaluation of battery operated pruner for horticultural crops

The farmers are recommended to use the “Battery operated rotary blade pruner for horticultural crops” developed by Junagadh Agricultural University, to prune horticultural crops like Lime, Guava, Jamun and Ornamental crops. The operator can prune in all directions up to height of 4 meters.



[Dept. of Farm Machinery & Power Engg., CAET, JAU, Junagadh]

Assessment and management planning of groundwater resources of Uben river basin

It is recommended to the farmers, NGOs and Government line departments that 50 % of rainfall as groundwater recharge including natural recharge is required for sustaining water resources in the Uben basin. The optimum groundwater recharge planning of Uben basin should be done by recharging through 2372 check dams, 15751 farm ponds, 5558 open wells and 1390 tube wells.



[Dept. of Soil & Water Conservation Engg., CAET, JAU, Junagadh]

Impact of irrigation regimes and fertigation scheduling on brinjal crop

Farmers of South Saurashtra Agro climatic Zone growing brinjal crop during *rabi* season are recommended to apply 100 % RDF of phosphorous and 25 % RDF of N and K (100:37.5:37.5 N: P₂O₅: K₂O) as a basal dose and remaining 75 % RDF of N and K through drip irrigation in 7 equal splits after 25 days of transplanting at 12 days interval to obtain higher yield, net return, water use efficiency and save up to 42 % irrigation water compared to furrow irrigation.



Details of drip system	Irrigation scheduling
Lateral spacing : 90 cm Dripper spacing: 60cm Dripper discharge: 4 lph Operating pressure: 1.2 kg/cm ²	At 0.8 ETc with 3 days interval a) November:47 min b) December: 50 min c) January: 1 hr. 15 min d) February: 1 hr. 50 min e) March : 2 hr. 20 min.

[Research, Testing & Training Centre, JAU, Junagadh]

Performance evaluation of farm yard manure applicator for wheat crop

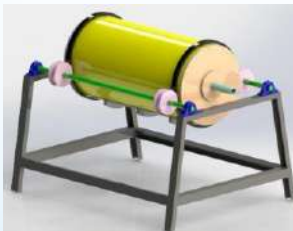
Farmers of South Saurashtra Agro-climatic Zone growing wheat are recommended to apply 7.5 t/ha. FYM in furrow in addition to RDF, using Junagadh Agricultural University developed FYM applicator to obtain higher net return and save 25 % of FYM.



[Research, Testing & Training Centre, JAU, Junagadh]

Design and development of grain treater for enzymatic pre-treatment to pigeon pea grains

The pulses processors are recommended to use the grain treater (capacity 100 kg/batch of 8 h) developed by Junagadh Agricultural University for efficient enzymatic pre-treatment to increase the hulling efficiency, reduce the processing cost and improve the benefit-cost ratio as compared to the traditional dhal processing.



[Dept. of Processing & Food Engg., CAET, JAU, Junagadh]

Low temperature grinding of spices (Turmeric)

The farmers and spice processors are recommended to use Junagadh Agricultural University developed grinding process for turmeric rhizome feed at low temperature ($-10\pm 2^{\circ}\text{C}$) using coolant (propylene glycol) circulation (15 lpm) through jacketed grinding mill for better retention of biochemical compounds (including curcumin) and volatile oil.



[Dept. of Processing & Food Engg., CAET, JAU, Junagadh]

Effect of protected structure and mulching on cauliflower cultivation during rainy season

The farmers of Gujarat are recommended to use Junagadh Agricultural University developed poly-cum-net house for off-season cauliflower cultivation during rainy season to achieve higher crop production and net return.



[Dept. of Renewable Energy Engg., CAET, JAU, Junagadh]

VI. ANIMAL SCIENCE

Animal Health

Clinical study on ultrasonographic morphology of healthy udder and teat in Gir cattle

Udder and teat disorders have major concerns in Gir milch cattle. Ultrasonography is one of the available diagnostic modalities for early and prompt diagnosis of such abnormalities. So, dairy farmers are recommended to visit the Veterinary clinic for the diagnosis of udder and teat disorder with ultrasonography as per the guidance of Veterinarian.

[Department of Veterinary Clinic Centre, College of Veterinary Science & A. H., KU, Junagadh]

Animal Production

Effect of feeding Moringa (*Moringa oleifera*) based calf starter on the performance of suckling Jaffarabadi buffalo calves

It is recommended to livestock owners rearing Jaffarabadi calves that Moringa leaf powder-based calf starter (46 kg Moringa leaves/100 kg calf starter) can be fed to increase growth rate at lower feed cost.



Composition of calf starter:-

1. Groundnut cake- 10 %
2. Maize – 25 %
3. Skim milk powder- 16 %
4. Moringa leaves- 46 %
5. Salt-1 %
6. Mineral mixture- 2 %

(Cattle Breeding Farm, JAU, Junagadh)

Fisheries Science

Maximum Sustainable Yield (MSY) estimation of fisheries resources of Gujarat coast with Surplus Production Model

This is recommended to the fishermen of Gujarat that Hilsa, Shark, Catfish, Eel, Seer fish and Lobster show signs of over exploitation; hence reduce fishing efforts of these species as they have slow growth rates, low fecundity for their sustainable harvest. The fishing effort can be reduced through increase in mesh size of fishing gear, releasing back brooders in the sea, extensive use of selective fishing gears like gill nets, long-line & traps and expanding fishing ban period voluntarily.

(Dept. of Fisheries Resource Management, College of Fisheries Sci., KU, Veraval)

Effect of oral administration of probiotic *Lactobacillus plantarum* on growth, survival, disease resistance and stress tolerance of *Litopenaeus vannamei* juveniles

Shrimp farmers are recommended to incorporate probiotic bacteria *Lactobacillus plantarum* @ 10^7 CFU in one gram feed of shrimp *Penaeus vannamei* for higher growth, survival and resistance against pathogenic *Vibrio harveyi*, reduce ammonia stress and hence increase profit.



Effect of dressing on quality parameters of dry salted Dhoma (*Otolithes cuvieri*) during storage

The dry fish processors/exporters are recommended to remove gill and gut from dry salted Dhoma fish (*Otolithes cuvieri*) packed in plastic bag for better quality and shelf-life up to nine months.

(Fisheries Research Station, JAU, Okha)

Supplementation of shrimp protein hydrolysate in practical diets of *Litopenaeus vannamei* (Boone, 1931)

Shrimp farmers growing *Penaeus vannamei* juvenile shrimps are recommended to use feed with 2 % shrimp protein hydrolysate at the rate of 5 % of body weight/day for better growth, survival rates and higher economic return.



(Fisheries Research & Training Center, JAU, Mahuva)

RECOMMENDATIONS FOR SCIENTIFIC COMMUNITY

I. CROPPRODUCTION

Evaluation of cowpea varieties for salinity tolerance

It is informed to the scientific community especially plant breeders that cowpea variety GC 1 recorded superior values of different salt tolerance criteria like higher mean salinity index (81.07 %), higher mean seed yield (15.81 g/plant), minimum yield decline (29.1 %) at 8.0 dS/m and for 50 % yield reduction at EC 7.68 dS/m as well as lower Na/K ratio in seed and stalk. Cowpea variety GC 1 was found more salt tolerance as compared to AVC 1, Pusa Falguni and GC 2 on the basis of salinity indices.



(Department of Soil Science & Agricultural Chemistry, CoA, JAU, Junagadh)

Effect of saline irrigation water on pearl millet

It is informed to the scientific community especially plant breeder that pearl millet hybrid GHB 1129 recorded superior values of different salt tolerance criteria like higher mean salinity index (79.25 %), higher mean grain yield (504.0 g/plot), minimum yield decline (32.49 %) at 8.0 dS/m and for 50 % yield reduction at 11.21 dS/m, as well as lower Na/K ratio in grain and fodder. Pearlmillet hybrid GHB 1129 was found more salt tolerant as compared to GHB 538, GHB 732 and GHB 558 on the basis of salinity indices.



(Department of Soil Science & Agricultural Chemistry, CoA, JAU, Junagadh)

Periodical evaluation of soil fertility status of Saurashtra region

It is informed to scientific community that, in periodical soil survey of third decade started from 1990, the range and mean value of physico-chemical properties of Saurashtra soil survey (2020) are as

below;

Year	pH	EC (dS/m)	CaCO ₃ (g/kg)	CEC [cmol (P+)/kg]	Clay (%)	ESP (%)
1990	7.5-8.9 (8.4)	0.10-1.65 (0.42)	2.0-50.0 (15.86)	15.9-84.4 (40.12)	9.76-67.91 (36.20)	1.64-47.62 (8.25)
2020	6.95-8.90 (7.92)	0.12-2.82 (0.60)	9.6-181.8 (38.8)	7.17-47.10 (24.56)	12.25-65.36 (37.63)	1.31-19.65 (7.36)

Year	OC (%)	Avail. N (kg/ha)	Avail. P ₂ O ₅ (kg/ha)	Avail. K ₂ O (kg/ha)	Heat soluble S (ppm)	Avail. Fe (ppm)	Avail. Mn (ppm)	Avail. Zn (ppm)	Avail. Cu (ppm)
1990	0.17- 1.20 (0.52)	109.8- 376.30 (195)	7.68- 184.32 (40.1)	67-1321 (595)	4.7-159.0 (25.6)	0.02- 20.14 (3.93)	1.50- 33.03 (6.13)	0.01- 10.53 (1.29)	0.29- 4.50 (1.22)
2020	0.21- 0.86 (0.46)	97- 442 (260)	4.6- 74.9 (32.5)	142- 597 (341)	4.3- 46.3 (17.7)	0.75- 19.9 (5.1)	3.3- 33.2 (14.3)	0.20- 2.01 (0.78)	0.47- 5.50 (1.94)

Nutrient index values for available N, P₂O₅, K₂O and S were 1.50, 1.68, 2.68 and 2.19, respectively. While, nutrient index values for DTPA extractable micronutrients were 1.47, 2.70, 2.07 and 3.00 for Fe, Mn, Zn and Cu, respectively. Based on nutrient index values, the soils of Saurashtra region categorized in low in available N and Fe, medium in available P₂O₅, S and Zn whereas, high in available K₂O, Mn and Cu.

(Department of Soil Science & Agricultural Chemistry, CoA, JAU, Junagadh)

Establishment of critical limit of zinc for soybean crop in medium black calcareous soils

While recommending Zn application to *kharif* soybean crop grown in medium black calcareous soils of Saurashtra, STL and government officials of Gujarat should consider the critical limit of Zn 0.55 ppm in soil and 42.44 ppm in soybean plant at 45 DAS.



(Department of Soil Science & Agricultural Chemistry, CoA, JAU, Junagadh)

II. PLANT PROTECTION

Entomology

Evaluation of ready mix insecticides against groundnut defoliators

Two sprays of chlorantraniliprole 10 % + lambda cyhalothrin 5 %, 15 % ZC @ 0.006 % (4 ml/10 l of water) or novaluron 5.25 % + emamectin benzoate 0.9 %, 6.15 % SC @ 0.009 % (15 ml/10 l of water), at 15 days interval starting from pest infestation, found effective for the management of groundnut defoliators (*Helicoverpa* & *Spodoptera*).

(Main Oilseeds Research Station, JAU, Junagadh)

Determination of economic threshold level of bajra stem borer, *Chilo partellus* (Swinhoe)

The 5 % plant damage by stem borer is considered as economic threshold level (ETL) in *kharif* pearl millet.

(Main Pearl millet Research Station, JAU, Jamnagar)

Integrated management of insect pests and diseases of green gram crop under rainfed condition

Application of two sprays of cartap hydrochloride 50 SP 0.075 % (15 g /10 l water) and hexaconazole 5 SC 0.0075 % (15 ml /10 l water) should be carried out, mixed in spray tank, first at initiation of flowering and second at pod setting for the effective management of pod borer and leaf spot disease of green gram under rainfed condition.

(Main Dry Farming Research Station, JAU, Targhadia)

Estimation of yield loss due to semilooper, *Achaea janata* Linnaeus in castor under rainfed condition

The avoidable average yield loss in castor is recorded up to 44 per cent (20 % to 95 %) by semilooper under rainfed condition.

(Main Dry Farming Research Station, JAU, Targhadia)

Plant Pathology

Viability of *trichoderma* under different storage conditions in nitrogen packing and commercial packing

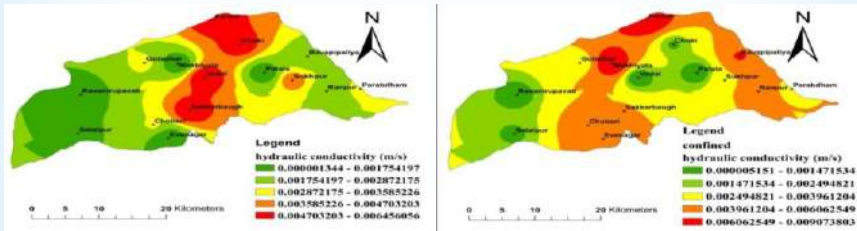
The JAU- isolate *Trichoderma harzianum* remains viable up to 18 months from date of packaging at ambient temperature, at 28°C and in refrigerator at 10°C.

(Department of Plant Pathology, JAU, Junagadh)

III. AGRICULTURAL ENGINEERING

Assessment and management planning of groundwater resources of Uben river basin

It is recommended to scientific community that the calibrated hydraulic conductivities for confined and unconfined aquifers of Uben river basin determined by electrical resistivity method are as:



Calibrated hydraulic conductivity of Uben basin			
SN	Location	Unconfined Aquifer K (m/s)	Confined Aquifer K (m/s)
1	Sakkarbaugh	0.006482947	0.00387976
2	Sukhpur	0.004538363	0.00363189
3	Ranpur	0.002018549	0.004539113
4	Parabdham	0.0030266	0.0034919
5	Ivnagar	1.00E-04	0.0051875
6	Patala	1.50E-04	3.00E-04
7	Choki	0.0060522	0.001398
8	Vadal	0.0064829	3.00E-04
9	Makhiyala	1.50E-04	0.0090752
10	Chobari	0.0030246	0.0052944
11	Satalpur	0.0013	0.0014
12	Goladhar	0.00303	0.00248
13	Ravani-Rupavati	2.63E-04	0.0009102
14	Fareni	0.0060486	0.0090752
15	Bava-Pipaliya	0.0018163	0.0060512

[Dept. of Soil & Water Conservation Engg., CAET, JAU, Junagadh]

Root growth study of Brinjal crop under different irrigation methods

The drip designers/ Irrigation water managers /Scientific communities are advised to adopt the following root growth models of exponential model of either Rasmussen and Hanks or Hanks and Hill for Brinjal crop grown in loamy soil as a decision support tool for drip operational parameters to get wetted bulb matching with depth and

spreading of root zone. Model efficiency was observed 99.79 %. The maximum number of lateral roots and length of the lateral roots found under drip irrigation with mulch resulted maximum moisture uptake (56.91 %) from first quarter of root zone (0-25 % from top) at all plant growth stages compared to other irrigation methods.



Root growth model	Horizontal root spreading	Vertical root zone
Rasmussen and Hanks, 1978	$L_t = L_0 + (L_m - L_0) / [1 + \text{Exp}\{A - B(t/t_m)\}]$ Where, A = 0.78 and B = 6.99	$RD_t = RD_0 + (RD_m - RD_0) / [1 + \text{Exp}\{A - B(t/t_m)\}]$ Where, A = 3.25, B = 13.14
Hanks and Hill, 1980; Arora et al., 1987	$L_t = L_m / [1 + \text{Exp}\{a - b(t/t_m)\}]$ Where, a = 0.64, b = 6.81	$RD_t = RD_m / [1 + \text{Exp}\{a - b(t/t_m)\}]$, Where, a = 3.25, b = 13.14

[Research, Testing & Training Centre, JAU, Junagadh]

Online university student fees receipt system

It is recommended to use Junagadh Agricultural University developed Web based “Online university student fees receipt system” by the State Agricultural Universities (SAU's) of Gujarat as a part of e-Governance initiatives in the Universities. It provides seamless digital interface to the students of the various colleges for making digital payment towards their educational fees such as semester fee, hostel fee, etc. and equips the staff for better governance.

[Information Technology Cell, JAU, Junagadh]

Development of online salary bill management for JAU, Junagadh

It is recommended to use Junagadh Agricultural University developed Web based “Online Salary Bill Management” by the State Agricultural Universities (SAUs) of Gujarat as a part of e-Governance initiatives. It is time and paper saving digital interface that provides administratively hierarchical salary bill processing system through which university employees' salary bills can be managed online. This

system provides various report generation facilities for the preparation of budget as well as monthly and periodic salary statement of each employee.

[Information Technology Cell, JAU, Junagadh]

IV. ANIMAL SCIENCE

Animal Health

Clinical study on Ultrasonographic morphology of healthy udder and teat in Gir cattle

In Gir cattle, ultrasonographic morphology of normal and healthy teat viz., streak canal length, streak canal diameter, teat diameter and teat wall thickness ranges between 3.7 to 4.7, 2.8 to 3.1, 19 to 20 and 4.4 to 5.4 mm, respectively, while normal and healthy udder shows hypoechoic uniform texture with round borders and normal shape. These baseline data of ultrasonographic morphology of healthy udder and teat can be used as reference values for diagnostic and prognostic features to confirm udder and teat abnormalities.

[Dept. of Vet. Clinic Complex, College of Vet. Science & A. H., KU, Junagadh]

Clinical studies on balanced anesthesia using different anesthetic protocols in horses

Combination of Inj. Butorphanol (0.02 mg/kg BW), Midazolam (0.1 mg/kg BW) and Xylazine (0.8 mg/kg BW) intravenously as preanaesthetics followed by Inj. Ketamine HCl (1.6-2.4 mg/kg BW, IV) induction and Isoflurane (2–3 %) maintenance can be used to produce balanced anaesthesia in horses.

[Dept. of Vet. Clinic Complex, College of Vet. Science & A. H., KU, Junagadh]

Evaluation of antioxidant and immunomodulatory effect of seeds of *Cassia absus* L. in rats

Daily oral administration of flavonoid rich fraction of *Cassia absus* L. (Chimed) seed at the rate of 200 mg/kg body weight for 21 days alleviates cyclophosphamide-induced immunosuppression and oxidative stress in rats.

[Dept. of VPT, College of Vet. Science & A. H., KU, Junagadh]

Ultrasonography, Uterine Swab Culture and Endometrial Cytology for diagnosis of Equine Endometritis

Ultrasonography along with endometrial cytology is effective diagnostic method for subclinical endometritis in infertile mares.

[Dept. of VGO, College of Vet. Science & A. H., KU, Junagadh]

Animal Production

Efficacy of Artificial Neural Network for milk Prediction in Jaffarabadi buffaloes

First lactation milk yield in Jaffarabadi buffaloes can be predicted using 2nd, 4th, 5th & 6th monthly test day milk records with 77.89 % accuracy. The optimum equation for prediction of FL305DMY using backward elimination method of Multiple Linear Regression is $\hat{Y}=198.69+ (32.77) TD2+ (39.36) TD4 + (45.23) TD5+ (109.31) TD6$. Furthermore, Artificial Neural Network using training and testing ratio of 80:20 with two hidden layers and 5 neurons can be used to predict the first lactation milk yield in Jaffarabadi buffaloes with accuracy of 86.49 percent.

[Dept. of AGB, College of Vet. Science & A. H., KU, Junagadh]

Effect of Feeding Moringa (*Moringa oleifera*) based calf starter on the performance of suckling Jaffarabadi buffalo calves

Moringa leaves (*Moringa oleifera*) are cheaper and economical source of good quality protein (25.19 %) to be used to meet out 50 % protein requirement in the formulation of calf starter to obtain a higher (36 %) growth rate in Jaffarabadi calves.

(Cattle Breeding Farm, JAU, Junagadh)

Fisheries Science

Analysis of condition factor of the ribbonfish *Lepturacanthus savala* and *Trichurus lepturus* off Veraval Coast

Condition factor obtained for *Trichurus lepturus* is 0.092 to 0.205 and 0.073 to 0.159 for male and female respectively. The condition factor obtained for *Lepturacanthus savala* is 0.058 to 0.251 and 0.063 to 0.136 for male and female respectively.

The length-weight relationship obtained for *Trichurus lepturus*

is $W=0.000013 L^{2.90}$ and $W=0.000014 L^{2.93}$ for male and female respectively. The length-weight relationship obtained for *Lepturacanthus savala* is $W=0.000010 L^{2.71}$ and $W=0.000013 L^{2.65}$ respectively for male and female.

The Ribbon fish *Trichurus lepturus* and *Lepturacanthus savala* shows similar condition factor and shows allometric growth.

(Dept. of Fisheries Resource Management, College of Fisheries Sci., KU, Veraval)

Seed production of mud spiny lobster *Panulirus polyphagus* (Herbst, 1793) in hatchery

Incubation and hatching of eggs and rearing of larvae up to phyllosoma-II stage of high value mud spiny lobster *Panulirus polyphagus* achieved at Fisheries Research Station, JAU, Okha. The average initial egg size was 496.07 μ and incubation period was 25.76 days. The average duration of phyllosoma-I (1525.18 μ) and phyllosoma-II (2239.67 μ) stage were 13.76 and 4.75 days respectively. Looking to its economic importance, further detailed studies are required using advanced hatchery system.

(Fisheries Research Station, JAU, Okha)

V. BASIC SCIENCE

Development and characterization of polymer based nanofertilizers and their response to wheat

Chitosan nanoparticles (CS-NPs) were synthesized and examined greater than 40 mV zeta potential indicating good stability. The urea, tricalcium phosphate and muriate of potash were used as sources for incorporation of N, P and K elements individually onto the CS-NPs and the elevation of size of the nanofertilizers, without aggregation of nanoparticles, were observed. Scanning electron micrograph illustrated spherical shape of the CS-NPs and gave the idea about the morphology of incorporated NPK nanofertilizers. The FTIR study indicated that there is an electrostatic interaction occurs between the charges of CS-NPs and the N P K elements, resulted to stretching of spectra (peak) at specific wavelength confirming the incorporation of N

P and K elements on to the CS-NPs. The application of 5 % NPK nanofertilizers (10 times less) on wheat suggested higher nutritional seed quality and maintained yield equivalent to chemical fertilizers. The cost-effective NPK-nanofertilizers thus developed may save the forex (subsidy) about 38.22 %. It has better controlled-release system in a liquid formulation to enhance nutrient use efficiency and sustained crop growth.



(Dept. of Biotechnology, CoA, JAU, Junagadh)

Biochemical appraisal of enzymatic activities from soils of permanent plot experiment at JAU, Junagadh

The soil enzyme activity studied *viz.*, urease, acid phosphatase, alkaline phosphatase, β -Galactosidase and nitrate reductase, from the plot having different fertilizer applications, remains higher during the mid-season and found to be lower before sowing and after harvest of the crop. Minimum variation of enzyme activity was observed in a plot of only FYM treatment (25 tons/ha). The activity of urease, β -Galactosidase and β -glucosidase as well as acid phosphatase and alkaline phosphatase was enhanced by balance fertilizer application (100 % NPK (25:50:50) as per soil test as well as 25 tons/ha FYM application. The pod yield of groundnut was remained highly positively correlated with urease, acid phosphatase and alkaline phosphatase enzyme activity.

(Dept. of Biotechnology, CoA, JAU, Junagadh)

Isolation and identification of entomopathogenic microorganisms from the soils of Junagadh district

The Scientific communities involved in microbial and entomological research are recommended to use native identified entomopathogenic microbes including *Pseudomonas putida* (MK415028.1), *P. monteilii* (KT881478.1), *P. knackmussii* (KY324901.1), *P. fulva* (KC293832.1), *Bacillus subtilis* (MH141058.1), *B. thuringiensis* (KY003094.1), *B. clausii* (AB251924.1), *Enterobacter asburiae* (MK467572.1), *E. cloacae* (JX514409.1), *Beauveria bassiana* (KC753382.1), *Metarhizium anisopliae* (KJ573520.1) and *Verticillium lecanii* (AJ292383.1) for the production of biofertilizer and biocontrol agent as they suppressed *Helicoverpa armigera*, and have PGPR activity.

(Dept. of Biotechnology, CoA, JAU, Junagadh)

Isolation and identification salt tolerant strains of beneficial microorganisms from the coastal soils of Saurashtra region.

Native halophilic bacterial strains isolated from agricultural soils of coastal regions of Saurashtra have potential for application in both industries and agriculture. The promising performance of these isolates in terms of plant growth promoting characteristics such as nitrogen fixing capacity, solubilization of phosphate and potash, production of IAA, siderophore along with production of biochemically important enzymes and bioactive compounds such as chitinase, cellulase, protease, carotene, ectoine, glycine betaine was observed.

Halophilic bacterial isolates were *Halomonas pacifica* strain_JAU_7B (MK955347), *H. pacifica* strain_JAU_20A (MK575078), *H. pacifica* strain_JAU_22A (MK042491), *H. pacifica* strain_JAU_22C (MK043087), *H. pacifica* strain_JAU_25A (MK116946), *H. pacifica* strain_JAU_29A (MK114047), *H. pacifica* strain_JAU_36A (MK114047), *H. pacifica* strain_JAU_36B (MK114047), *H. stenophila* strain_JAU_37A (MK961217), *Oceanobacillus aidingensis* strain_JAU_39B (MK148253), *H. pacifica*

strain_JAU_40B (MK114047), *Bacillus haynesii* strain_JAU_41A (MK157609), *B. licheniformis* strain_JAU_43A (MK118996), *B. haynesii* strain_JAU_43B (MK157608) and *B. haynesii* strain_JAU_45A (MK157609) which confirmed through molecular characterization by 16srRNA.

(Dept. of Biotechnology, CoA, JAU, Junagadh)

Diversity analysis of fresh water diatoms through SEM-EDX from surface microalgae of water bodies of Junagadh region

The scientific community involved in diatom study of fresh water in context to climate change and environment are recommended to use cataloguing of fresh water diatoms collection images from water bodies in and around JAU, Junagadh. Total 46 species of diatoms were identified from water bodies of Junagadh, out of which eleven genera viz., *Cyclotella*, *Melosira*, *Navicula*, *Achnanthes*, *Amphora*, *Synedra*, *Nitzschia*, *Gomphonema*, *Hantzschia*, *Pinnularia* and *Fragillaria* were predominant. The sizeable variation among the elements presents on freshwater algae through SEM EDAX showed the presence of all macro elements except phosphorus and nitrogen. All species of diatoms had higher amount of diversity indices including Shannon-Wiener diversity index (3.57) and Berger Parker Dominance (30.57). Morphometric analysis showed wider variability in location and species wise according to length (7.049 μm to 43.08 μm) and width (2.53 μm to 23.44 μm) as well as diversity indices too. Willington dam site showed maximum spp. variation of diatoms than the other location.

(Dept. of Biotechnology, CoA, JAU, Junagadh)

Evaluation of nano fertilizer in Bt. cotton (*Gossypium hirsutum* L.) under rainfed condition

In the North South Saurashtra Agro-climatic Zone (AES-IV), *Bt.* cotton fertilized with 80:40 N:P₂O₅ kg ha⁻¹ (Nitrogen in three splits i.e. 25 % as basal at the time of sowing and 50 and 25 % as top dressing at 35-40 and 60-65 days after sowing) to *Bt.* cotton recorded higher yield and net realization as well as sustained soil fertility under rainfed condition.

Application of nano nitrogen fertilizer as developed by JAU save 60 % conventional fertilizer dose.

[Main Dry Farming Research Station, JAU, Targhadia]

VI. SOCIAL SCIENCE

Analysing India's comparative advantage in world cumin (*Cuminum cyminum* L.) exports: An application of Gravity model

The comparative advantage of India, and particularly Gujarat, can be enhanced in cumin exports and the country can emerge as a price setter in the world cumin trade only when the issues around domestic yield and prices are addressed institutionally. Yield levels should be sustained at lower production costs for reducing export instability through competitive pricing and to cool down domestic prices. Large-scale pre-shipment quality checks and long-term contracts may be facilitated for better price negotiation. Above all, production and export incentives should also be channelized directly to the cumin farmers for generating a genuine market-driven exportable surplus.

(Dept. of Agricultural Economics, CoA, JAU, Junagadh)

Training needs of farmers with respect to scientific cultivation of cumin crop in Porbandar district

The cumin farmers of Porbandar district with social participation and mass media exposure may be focused for one-day training programs that are arranged continuously over a year in the areas of new variety, ploughing and value addition.

(College of Agriculture, JAU, Khapat)

Table-1: Production and distribution of “Gir Sawaj” brand quality seeds; planting materials of fruit crops/ ornamental plants; bio-agent and liquid bio-fertilizers during the year 2021-22

Sr. No.	Particular	Production
1	Nucleus and Breeder Seeds (q)	9615
2	Truthful, foundation and certified seeds (q)	8189
3	Fruit crop graft (Nos.)	7964
4	Fruit crops saplings (Nos.)	90242
5	Seedlings (Nos.)	35153
6	Ornamentals & Medicinal plants (Nos.)	36995
7	Liquid biofertilizer (litre) (<i>Rhizobium</i> , <i>Azotobacter</i> , PSB, KMB, HNPV, SNPV)	2433
8	Fruit fly traps (Nos.)	15166
9	Fruit fly lure for fruit and vegetable crops (Nos.)	23050
10	Pheromone Trap (Nos.)	7888
11	Pheromone Lure (Nos.) (Pink bollworm, <i>Heliothis</i> , Brinjal shoot & fruit borer, <i>Spodoptera</i> and Fall armyworm)	15718
12	MDP Technology for Pink bollworm and Brinjal shoot and fruit borer (100 gm Tube)	560
13	Honey (litre)	657
14	Chrysopa eggs (Nos.)	244000

Table-2: No. of Farm Machineries/ Implements/ equipments (category wise) tested at testing centre of FMPE, CAET during the year 2021-22

Category	Name of Equipment / Machine	Nos.
A	Land development, tillage & seedbed preparation equipment	61
B	Sowing and planting equipment	50
D	Plant protection equipment	22
E	Harvesting and threshing equipment	32
F	Equipment for residue management	12
	Total	177



Tech Walk on Cotton Quality Testing Laboratory Programme



Tree plantation programme at JAU Farm

