

**RESEARCH ACCOMPLISHMENTS
AND
RECOMMENDATIONS
2019**



**DIRECTORATE OF RESEARCH
JUNAGADH AGRICULTURAL UNIVERSITY**

JUNAGADH-362 001 (Gujarat)

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Edited & Published by:

**Director of Research & Dean, PG Studies
"University Bhavan"
Junagadh Agricultural University,
Junagadh-362001(Gujarat)
Phone: (0285) 2670131
Fax: (0285) 2674064
E-mail: dr@jau.in**

Compiled by:

**Dr. V. P. Chovatia
Dr. Pramod Mohnot
Er. D. B. Barad
Dr. K. B. Parmar
Sh. S. J. Vekariya
Dr. S. P. Kachhadiya**

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Junagadh Agricultural University
Junagadh - 362 001 (Gujarat)



Dr. V. P. Chovatia
Vice Chancellor (I/c)

MESSAGE

Junagadh Agricultural University represents four Agro-climatic Zones having 31 different research stations which is highly biodiversified region of Gujarat inclusive of all activities of rainfed, dry land agriculture as well as horticulture coupled with animal husbandry and fisheries in some areas. JAU is excelling triple function of education, research and extension in the interest of mankind. Devoted scientists are working hard to develop new varieties and technologies for quality and higher production fetching good remuneration from market helping farmers for their better livelihood.

The research outcome under various faculties for crop improvement crop production, plant protection, horticulture, mechanization, animal & fisheries science, social science *etc.* have been discussed using three tire system under ZREAC, AGRESCO and Combined Joint AGRESCO.

I appreciate the contribution made by scientists for developing six new crop varieties and 49 new technologies developed for farmers and 29 technologies developed for scientific community. I also congratulate the Director of Research and his team for nicely compilation and publishing **“Research Accomplishments and Recommendations-2019”**. Hope all stakeholders will be benefitted from information provided in the form of booklet for sustainable development and future action needed.

Junagadh
December 02, 2019

(V. P. Chovatia)



Director of Research & Dean, PG Studies
Junagadh Agricultural University
Junagadh - 362 001 (Gujarat)
Phone (O.) : +91 (0285) 2670131
Fax : +91 (0285) 2674064
Email : dr@jau.in



Dr. V. P. Chovatia

PREFACE

It is a matter of great pleasure for me to highlight the research work carried out during 2018-19 in the University. The recommendations and new technical programmes were critically discussed and approved in respective 15th AGRESKO meetings of various sub-committees of Junagadh Agricultural University. Same was presented in 15th Combined Joint AGRESKO meeting which was held at Anand Agricultural University, Anand, during April 29-May 01, 2019.

The Junagadh Agricultural University represents ten districts and about 32.74 per cent area of the state. There are eight colleges, seven polytechnic colleges and 31 research stations, which include multidisciplinary main research stations, sub research stations for various crops as well as testing centers in the University. 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 16th Research Council meeting on January 21, 2019 for approval of new research projects and research activities to be under taken during this year.

Total 44 new projects worth of Rs. 1278.81 lakh were sanctioned from Government of India, ICAR and Private sectors in the University. The main sanctioned projects are:

1. Product testing for pesticides residue to promote organic farming and export of agriculture produce.
2. To identify the candidate biocontrol agent putatively involved in biological control of plant disease.
3. Mapping and valuation of economics, social and environmental benefits of conserving Gir forest ecosystem.
4. Insecticides Resistant Management: Dissemination of pink bollworm management strategies.
5. Creation of Seed-Hubs for enhancing quality seed availability of major oilseeds

crops - Groundnut under NFSM - Oilseed Mission.

The breeder seeds of different crops were produced successfully to fulfill the demand of private and public sectors as per the national and state indents. The truthful/ foundation/ certified seeds of different crops were also produced and distributed to the farmers along with subsidy in seedhub project.

During the year 2018-19, under HRD component of the University, 137 scientists/ teachers were deputed to attend winter/ summer school, training; 331 attended seminar/ symposium/ conference; 197 attended the workshops and group meet of their respective projects and 156 scientists/ teachers were deputed to attend AICRP monitoring, visit of other centers *etc.* at national as well as state level. The University has also organized seven national level programs like winter school & seminar as well as two state level seminars/ training/ workshops *etc.*

In the 15th Combined Joint AGRESCO Meeting, six varieties *viz.*, Groundnut-Gujarat Groundnut 41 (GG 41), Pearl millet-Gujarat Hybrid Bajra 1129 (GHB 1129) and Gujarat Hybrid Bajra 1225 (GHB 1225), Cotton-Gujarat Cotton-38 (G.Cot.-38), Uradbean-Gujarat URD 2 (GU 2) and Ridge Gourd-Gujarat Ridge Gourd-2 (GRG-2) were recommended for release in the state. Besides this, 49 technologies/ recommendations were made for farmers and 29 recommendations were made for Scientific Community. In addition, as many as 131 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 the recommendations approved in 15th Combined Joint Agresco

Sub Committee	No. of Recommendations		New Technical Programs
	Farmers	Scientific	
Crop Improvement	06*+01	-	06
Crop Production	13	10	31
Plant Protection	18	05	29
Horticulture & Agro Forestry	05	-	06
Agricultural Engineering	06	01	18
Animal Science	03	06	13
Fisheries Science	01	03	03
Basic Science	02	01	03
Social Science	-	03	22
Total	06*+49	29	131

*Variety released

Junagadh

December 02, 2019



(V. P. Chovatia)

RECOMMENDATIONS FOR FARMERS

I. CROP IMPROVEMENT

Six varieties viz. Groundnut (GG 41), Pearl millet (GHB 1129 and GHB 1225) Cotton (G. Cot 38), Uradbean (GU 2) and Ridge Gourd 2 (GRG 2) were recommended for farmers of the state during the year 2018-19.

VARIETIES RELEASED

Groundnut: Gujarat Groundnut 41 (GG 41)

The farmers of Gujarat state growing groundnut during *kharif* season are advised to grow virginia runner groundnut variety Gujarat Groundnut 41 (GG 41). This variety has recorded mean pod yield of 2722 kg/ha, which was 15.74 and 16.10 per cent higher over the check varieties, GG 11 (2352 kg/ha) and GJG 17 (2344 kg/ha), respectively. This variety has also recorded high shelling and oil per cent over the check varieties. GG 41 was found comparable to the check varieties against tikka and rust diseases. The incidence of stem rot and collar rot diseases was very low in GG 41. The damage due to thrips and leaf defoliators was also lower in GG 41 than the check varieties.



[Main Oilseeds Research Station, JAU, Junagadh]

Pearl Millet Hybrid: Gujarat Hybrid Bajara 1129 (GHB 1129)

The pearl millet growing farmers of Gujarat state are recommended to grow the biofortified pearl millet hybrid GHB 1129 during *kharif* season as medium maturing hybrid. This hybrid has given 2957 kg/ha grain and 6210 kg/ha dry fodder yield which is 8.0 and 12.9 per cent, respectively higher over presently recommended medium maturing check hybrid GHB 744 and 6.9 and 11.7 per cent, respectively higher over latest medium maturing check hybrid GHB 905. This biofortified hybrid is also recommended to grow during summer season, in which it has given 5303 kg/ha grain and 9179 kg/ha dry fodder yield which is 15.7 and 7.3 per cent higher over check hybrid GHB 558, respectively and at par yield and 6.2 per

cent higher dry fodder yield than check hybrid GHB 732. The hybrid has also given higher grain and dry fodder yield over private sector check hybrid. Further, this hybrid is tolerant to major pearl millet diseases, pest and lodging. Moreover, this hybrid is having higher micro nutrient minerals Fe (more than 70 ppm) and Zn (more than 40 ppm) in its grain over it's all the yield checks which is additional benefit to the farming and consumer community of pearl millet for their nutritional security.



[Main Pearl Millet Research Station, JAU, Jamnagar]

Pearl Millet Hybrid: Gujarat Hybrid Bajara 1225 (GHB 1225)

The *kharif* pearl millet growing farmers of Gujarat state are recommended to grow the GHB 1225 as late group dual purpose biofortified hybrid. It has given 3023 kg/ha grain and 7306 kg/ha dry fodder yield which is 22.98 and 10.74 per cent higher grain and 21.1 and 17.4 per cent higher dry fodder yield over presently recommended medium late group hybrids GHB 558 and GHB 732, respectively. The hybrid has also given higher grain and dry fodder yield over private sector check hybrid. Further, the hybrid is resistant to major pearl millet diseases and pest and this hybrid is having higher micronutrients minerals Fe (more than 70 ppm) and Zn (more than 40 ppm) content in its grain which is additional benefit to the farming and consumer community of pearl millet for their nutritional security.



[Main Pearl Millet Research Station, JAU, Jamnagar]

Cotton: Gujarat Cotton 38 (G. Cot 38)

The farmers of Gujarat state growing Non Bt cotton (*Gossypium hirsutum* L.) under irrigated conditions are advised to grow variety Gujarat Cotton-38 (G.Cot-38). This variety has recorded a seed cotton yield of 2315 kg/ha, which is 28.1, 19.7, 9.0 and 18.9 per cent higher than the check varieties, G.Cot-18, G.Cot-20, GN.Cot-22 and CNHO-12 as a zonal check, respectively. The lint yield in G.Cot-38 was 767 kg/ha, which is 27.5, 18.1, 6.0 and 11.4 per cent higher than check varieties G.Cot-18, G.Cot-20, GN.Cot-22 and CNHO-12, respectively. It has 33.1 per cent ginning outturn and 19.2 per cent oil. This variety is medium late in maturity.



[Cotton Research Station, JAU, Junagadh]

Urdbean: Gujarat Urd 2 (GU 2)

Farmers of Gujarat growing urd in *kharif* season are advised to cultivate Gujarat Urd-2 (GU 2) variety. This variety has produced (1079 kg/ha) 14.9 per cent higher seed yield over both the check varieties T-9 (939 kg/ha) and Gujarat Urd-1 (939 kg/ha). Seeds of this variety are of large size and greenish brown in colour. This variety is resistant to MYMV, leaf curl and powdery mildew diseases.



[Pulses Research Station, JAU, Junagadh]

Ridge Gourd:Gujarat Ridge Gourd 2 (GRG 2)

The farmers of Saurashtra and Middle Gujarat regions, growing ridge gourd during *kharif* season are advised to grow Gujarat Ridge Gourd-2 (GRG-2). This variety has recorded average fruit yield of 105.70 q/ha, which was 22.06 and 29.76 per cent higher over check varieties; Gujarat Anand Ridge Gourd-1 (86.60 q/ha) and Pusa Nasdar (81.46 q/ha), respectively. The fruits of this variety are long in size, green in colour with better in quality characters *viz.*, protein, sugars, TSS and chlorophyll-B contents as compared to check varieties.



[Vegetable Research Station, JAU, Junagadh]

RECOMMENDATION FOR FARMERS

Effect of pre-treatment on seed emergence and seedling vigour of coriander

The farmers of South Saurashtra region growing coriander are advised that the bitted seeds of coriander with pre-treatment of GA₃@ 50 mg/ litre for 12 hrs or NaCl 2 g/ litre for 12 hrs or the bitted seeds tied in wet coarse cloth (*Pacchedi*) for 12 hrs gives early emergence with good germination percentage and seedling vigour.

[Dept. of Genetics & Plant Breeding, JAU, Junagadh]

II CROP PRODUCTION

(A) Nutrient Management

Herbicidal control of purple nutsedge

The farmers of South Saurashtra Agro-climatic Zone are recommended to spray either tank-mix glyphosate 1230 g/ha (41 % SL 60 ml/10 L water) + halosulfuron-methyl 33.75 g/ha (75 % WG 0.9 g/10 L water) or halosulfuron-methyl 67.5 g/ha (75 % WG 1.8 g/10 L water) at 30 days after emergence for effective control of purple nutsedge under non-cropped condition during summer season. These herbicides have no residual effect on the succeeding *kharif* crops (groundnut, pearl millet, cotton and sesame) grown 90 days after spray.



(Department of Agronomy, JAU, Junagadh)

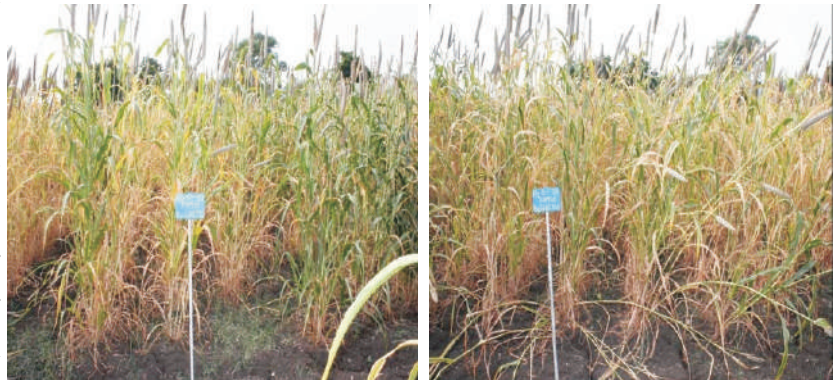
Fertilizer management in groundnut + castor (3:1) intercropping system under rainfed condition

The farmers of North Saurashtra Agro-climatic Zone growing groundnut + castor (3:1) intercropping system are recommended to apply 75 % of recommended fertilizer dose to groundnut and 100 % recommended fertilizer dose to castor on area basis of both the crops for obtaining higher yield and net return.

(Main Dry Farming Research Station, JAU, Targhadia)

Performance of pearl millet hybrid and popular cultivars under organic condition

The farmers of North Saurashtra Agro-climatic Zone adopting organic farming of pearl millet are recommended to apply FYM 10 t/ha and sow pearl millet hybrid GHB 732 or GHB 744 or GHB 538 for achieving higher yield and net realization, maintaining soil fertility and improving quality of produce.



(Main Pearl millet Research Station, JAU, Jamnagar)

Effect of N, P and K fertilizers on growth, yield and nutrients uptake by brinjal

The farmers of South Saurashtra Agro-climatic Zone growing brinjal under medium black calcareous soil in late *kharif* season are recommended to apply nitrogen @ 125



kg/ha in four equal splits (Basal, 25, 50 and 75 days after transplanting), P_2O_5 @ 50 kg/ha and K_2O @ 50 kg/ha as basal for achieving higher yield and net return.

(Dept. of Agril. Chem. & Soil Sci. and Vegetable Research Station, JAU, Junagadh)

(B) Cultural Practices

Evaluation of groundnut + sweet corn mix/inter cropping systems

The farmers of South Saurashtra Agro-climatic Zone growing *kharif* groundnut are recommended to adopt paired row (45-75-45 cm) groundnut + sweet corn (2:1) or groundnut + sweet corn (3:1) additive intercropping system for achieving higher net returns as compared to sole groundnut.



(Department of Agronomy, CoA, JAU, Junagadh)

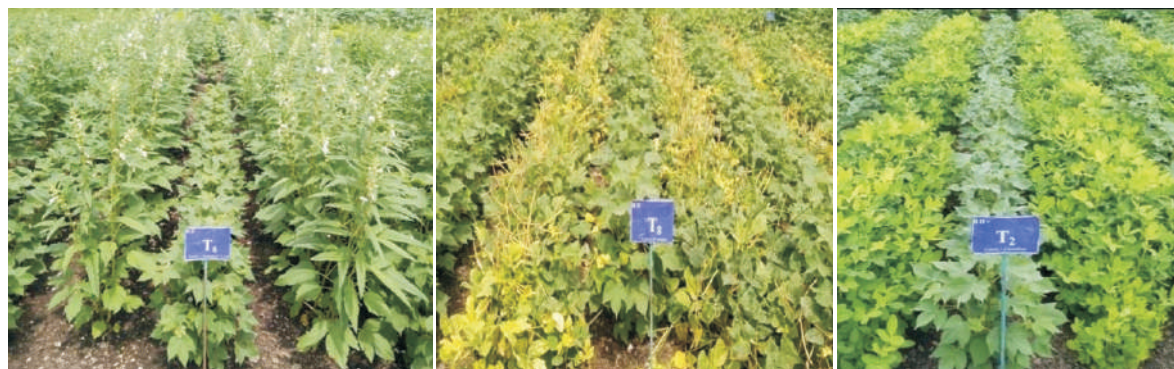
Optimization of seed rate and spacing in semi-spreading groundnut cultivars having differential seed sizes

The farmers of South Saurashtra Agro-climatic Zone growing *kharif* semi-spreading groundnut varieties having seed index of 42-45 and 50-52 g/100-seed are recommended to sow at spacing of 45 cm x 10 cm with seed rate of 110 and 125 kg/ha, respectively for obtaining higher yield and net returns.



(Main Oilseeds Research Station, JAU, Junagadh)

Production potential and economics of Bt cotton based intercropping system under rainfed condition



The farmers of North Saurashtra Agro-climatic Zone adopting Bt cotton-based intercropping system under rainfed condition are recommended to intercrop one row of cowpea or sesame or groundnut or green gram in between two rows of cotton (Spacing: 120 cm x 30 cm) for obtaining higher yield and net return.

(Main Dry Farming Research Station, JAU, Targhadia)

Effect of spacing on castor under conserved moisture condition at Ratia

The farmers of North Saurashtra Agro-climatic Zone growing castor in Ghed area under conserved soil moisture are recommended to sow the castor at 120 cm x 60 cm for obtaining higher yield and net return.

(Dry Farming Res. Station, JAU, Ratia & Main Dry Farming Res. Station, JAU, Targhadia)

(C) Irrigation Management

Response of Bt cotton to high density planting and nitrogen levels through fertigation

The farmers of South Saurashtra Agro-climatic Zone growing Bt cotton (Cv. G.Cot.Hy.-8 BG-II) under high density planting are recommended to sow the crop at 30-60-30 cm x 30 cm or 30-90-30 cm x 30 cm in paired row and fertilized with 125 % RDN (300 kg N/ha) in eight equal splits at 15 days interval through drip fertigation along with 50 kg P₂O₅ and 150 kg K₂O/ha for obtaining higher yield and net return.

Details of drip system

Details of drip system particular	Detail	Duration of irrigation
Lateral spacing	90 cm	Oct.: 1 hour 30 minutes
Dripper distance	40 cm	Nov.: 1 hour 20 minutes
Dripper discharge rate	4 lph	Dec.: 1 hour 15 minutes
Operation pressure	1.2 kg/cm ²	
Irrigation interval	Alternate day	



(Department of Agronomy, JAU, Junagadh)

(D) Weed Management

Integrated weed management in Indian bean

The farmers of South Saurashtra Agro-climatic Zone growing Indian bean in *rabi* season are recommended to carry out hand weeding at 15, 30 and 45 DAS for effective weed management and achieving higher seed yield and net realization.



(Department of Agronomy, JAU, Junagadh)

Post-emergence weed management in wheat

The farmers of South Saurashtra Agro-climatic Zone growing wheat are recommended to carry out hand weeding at 15 DAS *fb* either ready-mix sulfosulfuron + metsulfuron 32 g/ha (75 + 5 % WDG 0.8 g/10 L water) or ready-mix clodinafop + metsulfuron 64 g/ha (15 + 1 % WP 8 g/10 L water) at 30 DAS or hand weeding at 15 and 30 DAS as per availability of labourers for effective weed management along with higher yield and net returns.



(Department of Agronomy, JAU, Junagadh)

Weed control in kharif groundnut

The farmers of North Saurashtra Agro-climatic Zone growing groundnut during *kharif* season are recommended to keep their crop weed free through hand weeding and interculturing at 15, 30, 45 and 60 DAS or apply Quizalofop-ethyl 40 g/ha at 20 DAS *fb* IC & HW at 40 DAS for effective weed management as well as to obtain higher yield and net return.



(Main Dry Farming Res. Station, JAU, Targhadia)

Weed management in autumn planted sugarcane-chickpea intercropping system

The farmers of South Saurashtra Agro-climatic Zone growing autumn-planted sugarcane are recommended to grow one row of chickpea as an intercrop in sugarcane planted at 90 cm row spacing for securing higher yield and net return. Weed control should be done

with two hand weeding at 30 and 60 days after sowing of the intercrop.

(Main Sugarcane Research Station, JAU, Kodinar)

III. PLANT PROTECTION

(A) Entomology

Effectiveness of *Beauveria bassiana* in combination with different insecticides against onion thrips

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply three sprays of dimethoate 30 EC 0.03 % (10 ml/10 l of water) OR *Beauveria bassiana* 1.15 WP 0.0035 % (Min. 2 x 10⁶ cfu/g) + dimethoate 30 EC 0.015 % (30 g + 5.0 ml/10 l of water) OR *Beauveria bassiana* 1.15 WP 0.007 % (60 g/10 l of water) first at initiation of pest infestation and subsequent two sprays at 10 days interval for effective and economical management of thrips, *Thrips tabaci* in onion.

Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)		
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)	
2018-19	Onion	Thrips	Dimethoate 30 EC	150	0.500 l	0.03	10 ml	500 l	First spray at pest initiation and subsequent two sprays at ten days interval after first spray	-	
			<i>Beauveria bassiana</i> 1.15 WP + dimethoate 30 EC	17 + 75	1.5 kg + 0.250 l	0.0035 (Min 2 x 10 ⁶ cfu/g) + 0.015	30 g + 5 ml			500 l	-
			<i>Beauveria bassiana</i> 1.15 WP	35	3.0 kg	0.007 (Min 2 x 10 ⁶ cfu/g)	60 g			500 l	-



(Department of Entomology, JAU, Junagadh)

Effect of different schedule base insecticidal spray against garlic thrips

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply schedule spraying of *Beauveria bassiana* 1.15 WP (Min. 2x10⁶ cfu/g), first spray at initiation



of pest infestation 0.0035 % (30 g/10 l of water). Subsequent second 0.007 % (60 g/10 l of water) and third 0.009 % (80 g/10 l of water) spray at 10 days interval for effective and economical management of thrips, *Thrips tabaci* in garlic.

Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2018-19	Garlic	Thrips	<i>Beauveria bassiana</i> 1.15 WP	17	1.50 kg	0.0035% (Min. 2x10 ⁶ cfu/g)	30 g	500 l	First spray at initiation of pest infestation and subsequent two sprays at ten days interval after first spray	-
			<i>Beauveria bassiana</i> 1.15 WP	35	3.00 kg	0.007% (Min. 2x10 ⁶ cfu/g)	60 g			-
			<i>Beauveri bassiana</i> 1.15 WP	46	4.00 kg	0.009% (Min. 2x10 ⁶ cfu/g)	80 g			-

(Department of Entomology, JAU, Junagadh)

Management of sucking pests in cumin

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply two sprays of *Beauveria bassiana* 1.15 WP (Min. 2x10⁶ cfu/g) 0.007 % (60 g/10 l of water), first at initiation of pest infestation and second at 10 days interval for effective, economical and eco-friendly management of thrips, *Thrips tabaci* in cumin.



Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendmen ts required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulation in 10 l of water (g or ml)
2018-19	Cumin	Thrips	<i>Beauveria bassiana</i> 1.15 WP	35	3.0 kg	0.007 (Min. 2x10 ⁶ cfu/g)	60 g	500 l	First spray at initiation of pest infestation and second spray at 10 days interval after first spray	-

(Department of Entomology, JAU, Junagadh)

Evaluation of new pheromone based mating disruption technology for fruit fly in mango

The farmers of South Saurashtra Agro-climatic Zone (VII) growing mango are advised to give Sawaj MDP technology 400 g paste/ha uniformly distributed in 1000 dots on main and subsidiary branches of each tree against fruit fly, first application in the month of March, when fruit fly catches in the trap and successive two applications at 30 days interval for effective, economical and eco-friendly management.



Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendmen ts required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)			
2018-19	Mango	Fruit fly	Sawaj MDP technology	-	400 g Paste per application per ha	-	-	-	First application in the month of march, while second and third at 30 days interval after first application.	-

(Department of Entomology, JAU, Junagadh)

Effectiveness of different bio-pesticides against mealybug in custard apple

The farmers of South Saurashtra Agro-climatic Zone (VII) are advised to apply two sprays of *Lecanicillium lecanii* 1.15 WP (Min. 2×10^6 cfu/g) 0.007 % (60 g/10 l of water) OR *Beauveria bassiana* 1.15 WP (Min. 2×10^6 cfu/g) 0.007 % (60 g/10 l of water) along with sticker (3 ml/10 l of water), first at initiation of pest infestation and second at 20 days interval for effective, economical and eco-friendly management of mealybug



in custard apple.

Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendmen ts required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)
				a.i. (g/ ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)			
2018-19	Custard apple	Mealy bug	<i>Lecanicillium lecanii</i> 1.15 WP	83	7.2 kg	0.007 (Min. 2x10 ⁶ cfu/g)	60 g	1200 l	First spray at initiation of pest infestation and second spray at 20 days interval after first spray	-
			<i>Beauveria bassiana</i> 1.15 WP	83	7.2 kg	0.007 (Min. 2x10 ⁶ cfu/g)	60 g			-

(Department of Entomology, JAU, Junagadh)

Testing the bio-efficacy of newer insecticides against castor defoliators

The farmers of South Saurashtra Agro-climatic Zone (VII) growing castor are advised to apply two sprays of chlorantraniliprole 18.5 SC 0.006 % (3.0 ml/10 l of water) OR indoxacarb 14.5 SC 0.0073 % (5.0 ml/10 l of water) OR spinosad 45 SC 0.009 % (2.0 ml/10 l of water) OR emamectin benzoate 5 % WG 0.002 % (4.0 g/10 l of water) at 15 days interval starting from pest infestation for effective and economical management of defoliators (*Spodoptera* and *Semilooper*).



Year	Crop	Pest	Pesticides/ Biopesticidesform ulation	Dosage				Qty. of water/ soil amendmen ts required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remarks
				a.i. (g/ ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2018	Castor	Defoliators	Chlorantraniliprole 18.5 SC	27.8	0.150 l	0.006	03 ml	500 l	First spray at initiation of defoliators and second at 15 days after first spray	112	Result of residual analysis was found below detection limit.
			Indoxacarb 14.5 SC	36.3	0.250 l	0.0073	05 ml	500 l			
			Spinosad 45 SC	45	0.100 l	0.009	02 ml	500 l			
			Emamectin benzoate 5 WG	10	0.200 l	0.002	04 g	500 l			

Note: Castor being a non-edible crop CIB recommendation for insecticides are not considered.

(Main Oilseeds Research Station, JAU, Junagadh)

Management of lepidopteron pests using botanicals in groundnut

The farmers of South Saurashtra Agro-climatic Zone (VII) growing groundnut in *kharif* season are advised to apply two sprays of pongamia oil (30 ml/10 l of water) OR ponneem (30 ml/10 l of water) at 15 days interval starting from pest infestation for effective and economical management of defoliators (*Helicoverpa* and *Spodoptera*). To prepare ponneem, mix 450 ml of neem oil + 450 ml of pongamia oil (karanj oil) + 100 ml of soap solution (wetting agent).



(Main Oilseeds Research Station, JAU, Junagadh)

Evaluation of egg parasitoid *Trichogramma bactrae* through inundative release for the management of cotton pink bollworm

The farmer of the South Saurashtra Agro-climatic Zone (VII) growing cotton are advised to apply *Trichogramma bactrae* 1.5 lakh parasitoid eggs per hectare, two release at flowering stage (40-50 days) at weekly interval and three release at boll formation stage (60-75 days) at weekly interval for biological management of pink bollworm.



(Cotton Research Station, JAU, Junagadh)

Evaluation of pheromone traps and lures against cotton pink bollworm through mass trapping

The farmers of the South Saurashtra Agro-climatic Zone (VII) growing cotton are advised to install the phero-sensor TM-BP-sleeve trap OR phero-sensor TM-SP-sleeve trap, 20 traps/ha after 30 days of germination.



Change the sex pheromone trap lure thrice in a season at 45 days interval for effective management of pink bollworm.

Year	Crop	Pest	Pesticides/ Biopesticidesfor mulation	Dosage			Qty. of water/ soil amendment s required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)			
2018	Cotton	Pink bollworm	Phero-sensor TM-BP-sleeve trap	-	20 traps/ha	-	-	Installation of traps at 30-35 days after germination and each trap lure changed after 45 days interval.	-
			Phero-sensor TM-SP-sleeve trap	-	20 traps/ha	-	-		-

(Cotton Research Station, JAU, Junagadh)

Bio-efficacy of insecticides against major sucking pests in Bt cotton

The farmers of South Saurashtra Agro-climatic Zone (VII) growing Btcotton are advised to apply three sprays of flonicamid 50 WG 0.02 % (4.0 g/10 l of water) OR diafenthiuron 50 WP 0.06 % (12.0 g/10 l of water) OR dinotefuran 20 SG 0.008 % (4.0 g/10 l of water), first at pest initiation and subsequent two sprays at 15 days interval for effective and economical management of aphid, jassid, whitefly and thrips.

Year	Crop	Pest	Pesticides/ Biopesticidesf ormulation	Dosage			Qty. of water/ soil amendments required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)				Qty. of formulati on in 10 l of water (g or ml)
2017-18	Cotton	Aphid, Jassid, Thrips and Whitefly	Flonicamid 50 WG	100	0.200 kg	0.02	4 g	500 l	First spray at pest appearance and subsequent two sprays at 15 days interval after first spray	25
			Diafenthiuron 50 WP	300	0.600 kg	0.06	12 g			21
			Dinotefuran 20 SG	40	0.200 kg	0.008	4 g		15	

(Cotton Research Station, JAU, Junagadh)

Management of major insect pests infesting pearl millet under organic cultivation

The farmers of North Saurashtra Agro-climatic Zone (VI) growing organic pearl millet are advised to apply two sprays of *Beauveria bassiana* 1.15 WP (2×10^6 cfu/g) 50 g/10 l

of water at 30 and 60 days after sowing for the effective and economical management of shoot fly and stem borer, whereas for ear head worm, *Helicoverpa armigera* one spray of *HaNPV* 250 LE/ha at anthesis stage to be carried out.

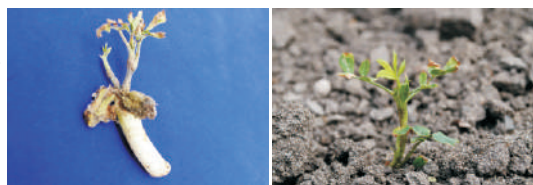
Year	Crop	Pest	Pesticides/ Biopesticides formulation	Dosage			Qty. of water/ soil amendment s required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remark s	
				a.i. (g/ ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)					Qty. of formulation in 10 l of water (g or ml)
2019	Pearl millet (bajra)	Shoot fly and stem borer	<i>Beauveria bassiana</i> 1.15 WP (2 x 10 ⁶ cfu/g)	28.7 5	2.500 kg	5g/l	50 g	500 l	Two spray at 30 and 60 DAS	-	-
	Pearl millet	<i>Helicoverpa armigera</i>	<i>HaNPV</i> @ 250 LE/ha	--	0.250 l	250 LE/h a	5 ml	500 l	Single spray at anthesis stage	-	--

(Main Pearl millet Research Station, JAU, Jamnagar)

(B) Plant Pathology

Efficacy of bio-agents against *Aspergillus flavus* and aflatoxin production in groundnut

Farmers of South Saurashtra Agro-climatic Zone (VII) growing groundnut are advised furrow application of *Trichoderma harzianum* 1 % WP (2 x 10⁶ cfu/g) 0.625 kg + *Pseudomonas fluorescens* 1 % WP (1x10⁸ cfu/g) 0.625 kg in 125 kg of castor



cake/ha at the time of sowing and soil application (broadcasting at plant base) of same quantity at one month after sowing found effective for management of aflarot (*Aspergillus flavus*).

Year	Crop	Disease	Pesticides/ Biopesticidesf ormulation	Dosage			Qty. of water/ soil amendment s required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remarks	
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)					Qty. of formulation in 10 l of water (g or ml)
2019	Groundnut	Aflarot disease	<i>Trichoderma harzianum</i>	-	0.625 kg	2 x 10 ⁶ cfu/g	--	125 kg	At sowing and 30 DAS	Nil	These bio pesticides are not registered with CIB & RC for use in groundnut crop for managem ent of this disease.
			<i>Pseudomons fluorescens</i>	-	0.625 kg	1 x 10 ⁸ cfu/g	--	125 kg	At sowing and 30 DAS	Nil	

(Department of Plant Pathology, JAU, Junagadh)

Management of groundnut diseases through organic amendments, bio products and biocontrol agents

Farmers interested in organic cultivation of groundnut are advised to apply *Trichoderma harzianum* 1 % WP (2×10^6 cfu/g) as a seed treatment 10 g/kg seed along with its furrow application 4.0 kg/ha enriched in 300 kg FYM at the time of sowing for management of collar rot and stem rot diseases. Whereas, for leaf spot spray neem seed kernel extract 5 % (500 g/10 l of water) at 30, 45 and 60 DAS OR to spray cow urine 10 % (1000 ml/10 l of water) at 20, 40, 60 and 80 days after sowing.



Year	Crop	Disease	Pesticides/ Biopesticidesf ormulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Applicatio n schedule	Waiting period/ PHI (days)	Remark (s)
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulatio n in 10 l of water (g or ml)				
2019	Groundnut	Collar rot, Stem rot & leaf spot disease	<i>Trichoderma harzianum</i>	--	10 g/ kg seed	2×10^6 cfu/g	--	--	As a seed treatment	Nil	-
			<i>Trichoderma harzianum</i>	--	4.0 kg	2×10^6 cfu/g	--	300 kg FYM	Furrow application at the time of sowing	Nil	
			Neem seed kernel extract	-	25 l	5 %	0.500 l	500 l	Three sprays at 30, 45 and 60 DAS	Nil	
			Cow urine	--	50 l	10 %	1.000 l	500 l	Four sprays at 20, 40, 60 and 80 DAS	Nil	

(Main Oilseeds Research Station, JAU, Junagadh)

Efficacy of *Trichoderma harzianum* on growth and stem rot disease management in groundnut

The farmers of South Saurashtra Agro-climatic Zone (VII) growing *kharif* groundnut are advised to apply *Trichoderma harzianum* 1 % WP (2×10^6 cfu/g) as furrow application 4 kg/ha in 250 kg of castor cake at the time of sowing and soil drenching 4 kg/ha in soil at 30 days

after sowing for effective and economical management of stem rot disease and obtaining higher pod yield. The application of *Trichoderma harzianum* also resulted in growth promoting ability by increasing leaf dry weight, leaf area, plant height, number of branches, pods per plant and root length in groundnut.



Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendments required (kg or l/ha)	Applicati on schedule	Waiting period/ PHI (days)	Remark (s)
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Groundnut	Stem rot & Growth promoting Ability	<i>Trichoderma harzianum</i>	--	4.00 kg	2 x 10 ⁶ cfu/g	--	250 kg castor cake	Furrow applicatio n at the time of sowing	NIL	-
			<i>Trichoderma harzianum</i>	--	4.0 kg	2 x 10 ⁶ cfu/g	--	1000 l	As a soil drenchin g at 30 DAS	NIL	

(Main Oilseeds Research Station, JAU, Junagadh)

Integrated management practices to minimize *Aspergillus flavus* infection and other diseases in groundnut

The farmers of South Saurashtra Agro climatic Zone (VII) growing *kharif* groundnut are advised seed treatment with mancozeb (75 % WP) 3 g/kg of seed + furrow application of *Trichoderma harzianum* 1 % WP (2x10⁶ cfu/g) 2.5 kg in 250 kg of castor cake/ha at the time of sowing for effective and economical management of aflarot and obtaining higher pod yield. It is also effective for management of stem rot and collar rot.

Farmers interested in nonchemical cultivation of groundnut are advised seed treatment with *Trichoderma harzianum* 1 % WP (2x 10⁶ cfu/g) 10 g/kg of seed + furrow application of *Trichoderma harzianum* 2.5 kg enriched before one week in 250 kg of FYM/ha at the time of sowing for effective and economical management of aflarot and



obtaining higher pod yield. It is also effective for management of stem rot and collar rot.

Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendmen ts required (kg or l/ha)	Applicatio n schedule	Waiting period/ PHI (days)	Remark (s)
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Groundnut	Aflarot disease and collar and stem rots	Mancozeb 75 % WP	0.36	3 g/kg seed	0.2 %	---	--	As a seed treatment	---	Registere d product with CIB
			<i>Trichoderma harzianum</i>	---	2.5 kg	2 x 10 ⁶ cfu/g	--	250 kg castor cake	Furrow application at the time of sowing	Nil	-
OR											
2019	Groundnut	Aflarot disease and collar and stem rots	<i>Trichoderma harzianum</i>	---	10 g /kg seed	2 x 10 ⁶ cfu/g	--	--	As a seed treatment	Nil	-
			<i>Trichoderma harzianum</i>	--	2.5 kg	--	250 kg FYM	Furrow application at the time of sowing	Nil	-	

(Main Oilseeds Research Station, JAU, Junagadh)

Biological control of root rot of castor

The farmers of South Saurashtra Agro climatic Zone (VII) growing castor during *kharif* season are advised to apply *Trichoderma harzianum* 1 % WP (2x10⁶cfu/g) as seed treatment 4 g/kg seed along with its soil application 2.5 kg enriched in 100 kg FYM/ha for a week and applied at the time of sowing for effective and economical management of root rot disease.



Year	Crop	Disease	Pesticides/ Biopesticides formulation	Dosage				Qty. of water/ soil amendmen ts required (kg or l/ha)	Application schedule	Waiting period/ PHI (days)	Remark (s)
				a.i. (g/ha)	Qty. of formulation g or ml/kg seed, kg or l/ha	Con. (%)	Qty. of formulation in 10 l of water (g or ml)				
2019	Castor	Root rot of castor	<i>Trichoderma harzianum</i>	---	4 g/kg seed	2 x 10 ⁶ cfu/g	---	--	As a seed treatment	---	--
			<i>Trichoderma harzianum</i>	---	2.5 kg	2 x 10 ⁶ cfu/g	--	100 kg FYM	Furrow application at the time of sowing	---	

(Main Oilseeds Research Station, JAU, Junagadh)

Standardization of numbers of pheromone traps for fall army worm in maize

For effective management of fall army worm in maize, the farmers are advised to install 50 sex pheromone traps per hectare. The lure to be changed after 40 days

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

Evaluation of bio-agents and chemical insecticides against fall army worm in maize

For effective management of fall army worm in maize, the farmers are advised to apply three sprays of *Beauveria bassiana* 1.15 WP (2×10^6 cfu/g) 0.009 % (80 g/10 l of water) OR *Nomuria rileyi* 1.15 WP (2×10^6 cfu/g) 0.007 % (60 g/10 l of water) + *SfNPV* 450 LE (10 ml/10 l of water) OR two sprays of emamectin benzoate 5 SG 0.0025 % (5 g/10 l of water) OR thiodicarb 75 WP 0.075 % (10 g/10 l of water) OR spinetoram 11.7 EC 0.012 % (10 ml/10 l of water), first at initiation of pest infestation and second at 15-day interval.

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

IV. HORTICULTURE AND AGRO FORESTRY

Effects of different doses of N and K with split application through fertigation system on yield and quality of banana (*Musa paradisiaca* L.) cv. Grand Naine

Banana growers of South Saurashtra are cultivating in paired row system (1.2 x 1.2 x 2.4 m) are advised to apply 150 g each at N & K₂O per plant (325 g urea + 250 g muriate of potash) through fertigation with 30 splits at 7 days interval along with 5 kg FYM as a basal and 90 g/plant phosphorus (560 g single super phosphate) in three equal splits at 3rd, 4th and 5th months after planting for getting higher yield and net return.



(Dept. of Horticulture, JAU, Junagadh)

Effect of polyamines on quality and shelf life of mango (*Mangifera indica* L.) cv. Kesar

Kesar mango traders are advised to dip freshly harvested mango fruit in Putrescine Dihydrochloride 175 mg/l for 5 minute for increasing shelf life and quality up to 12 days storage at room temperature.



(Dept. of Horticulture, JAU, Junagadh)

Effect of boron and NAA on flowering, fruit set and yield of coconut cv. D x T

Farmers of South Saurashtra having mature coconut (cv. D x T) plantation are advised to spray on palm inflorescence with sodium borate (20.50 B) 0.4 % (4 g/ litre) at monthly intervals from January to June for getting higher nut yield and net return.



(Dept. of Horticulture, JAU, Junagadh)

Standardization of severity of pruning and crop load on yield and quality in pomegranate (*Punica granatum* L.) var. Bhagwa

Farmers of south Saurashtra preferring hast bahar in pomegranate are advised to prune branches at 30 cm from top after 45 days of resting from withdrawal of monsoon and retain 50 fruits load per plant for getting higher yield and net return.



(Dept. of Horticulture, JAU, Junagadh)

Integrated nutrient management in gaillardia (*Gaillardia pulchella* Var. *Lorengiana*) cv. Yellow Double under saline water

The farmers of south Saurashtra growing gaillardia flower crop under saline irrigation condition up to 14 dSm-1 EC are advised to apply 50 % RDF of N: P₂O₅: K₂O as a 25:25:25 kg/ha + 50 % N from castor cake or neem cake (500 kg/ha) for obtaining higher yield and net realization.



(Fruit Research Station, JAU, Mangrol)

V.AGRICULTURAL ENGINEERING

Optimum water management for off-season okra cultivation under protected environment

The farmers of South Saurashtra Agro climatic Zone are recommended to use net-cum-polyhouse without ridge vent with silver black plastic mulch (20 µm) for cultivation of okra during winter season (off season). This net-cum-polyhouse without ridge vent increase water



productivity and water saving as well as controls weeds.

Details of mulching technology :	
1.	Mulch film: 20 μ m silver black plastic
2.	Bed size: (a) Top width : 60 cm, (b) Bottom width : 75 cm, (c) Height : 20 cm
3.	Spacing: (a) Bed spacing : 100 cm, (b) Plant spacing on bed : 35 cm x 35 cm
4.	No. of row per bed: 2

(Dept. of Renewable Energy Engineering, CAET, JAU, Junagadh)

Coriander crop response to deficit soil moisture in various growth stages under drip irrigation system

The farmers of South Saurashtra Agro-climatic zone growing coriander crop (variety: GC-2) are advised to irrigate the crop using drip irrigation having following system details and time of operation to get maximum net return and water saving upto 17.6 %. They are also advised to consider flowering stage as most sensitive to deficit irrigation followed by vegetative stage and seed development/setting.



Drip system details	Stage (Duration, DAS)	Irrigation time	Irrigation interval
Lateral size: 16 mm Lateral spacing :0.9 m Dripper spacing : 0.5 m Dripper discharge: 4 lph	Vegetative stage (0 to 55)	55 min	Alternate day
	Flowering stage (56 to 80)	63 min	
	Seed development/setting stage (81 to 100)	77 min	

(Dept. of Soil & Water Conservation Engg., CAET, JAU, Junagadh)

Evaluation of well recharge techniques for Junagadh region

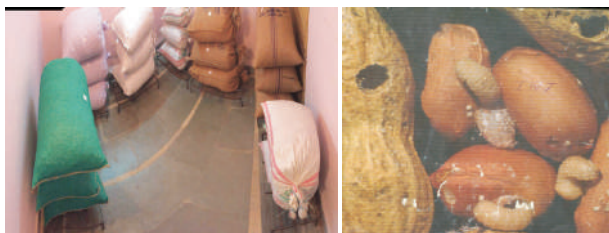
It is recommended to the farmers, Govt. departments and NGOs that the open well technique is effective for recharging shallow aquifer in Junagadh region which may recharge 103 cum groundwater per sq.m of bottom area of open well with recharge cost of Rs 1.94 per cum.

The tube well is effective for deep aquifer recharge, which may recharge 44473 cum groundwater per year with recharge cost of Rs. 0.45 & 0.28 per cum including and excluding tube well cost, respectively.

(Dept. of Soil & Water Conservation Engineering, CAET, JAU, Junagadh)

To study the effect of different packing materials against Groundnut Bruchid (*Caryedon serratus* Olivier.) during storage

Farmers storing groundnut are advised to store the well dried (8.0 % MC) groundnut pods in Purdue Improved Crop Storage (PICS) bag or closely woven net bag for effective and economical management of *bruchid* pest up to six months.



(Dept. of Processing & Food Engg., CAET, JAU, Junagadh)

Enzymatic Pre-treatment in the Processing of Pigeon pea

The pulse processing entrepreneurs are recommended to give enzymatic pre-treatment at specific enzyme concentration, incubation time, incubation temperature and tempering water pH as given below in table 1 for different varieties of pigeon pea to get higher recovery, to reduce the dhal making time and to get more protein content as compared to traditional method as table 2.

Table 1: Optimization of enzymatic pretreatment parameters for seven varieties.

Variety	Optimized value			
	Enzyme concentration (mg/100 g dry matter)	Incubation time (hr)	Incubation temperature(°C)	pH
BDN-2	31.34	8.72	43.47	5.99
GJP1	28.79	7.46	44.97	4.96
Vaishali	27.64	8.05	45.04	5.31
ICP2043	32.36	8.19	40.00	5.50
BSMR736	31.62	7.34	44.70	5.34
ICPL87119	28.64	7.62	43.00	5.50
Pinku	30.86	7.84	43.58	5.62

Table 2: Results of different treatment for seven varieties of pigeon pea.

Variety	Traditional method			Optimized value			Actual value		
	Hulling efficiency (%)	Cooking time (min)	Protein (%)	Hulling efficiency (%)	Cooking time (min)	Protein (%)	Hulling efficiency (%)	Cooking time (min)	Protein (%)
BDN2	78.30	14.50	19.80	84.35	13.06	22.60	80.74	12.80	25.30
GJP1	76.63	16.92	19.80	84.24	15.51	24.64	82.80	15.10	23.43
Vaishali	75.66	13.23	20.89	83.71	13.51	23.16	78.30	13.14	23.28
ICP2043	72.16	14.97	21.81	80.47	13.63	23.26	77.60	13.01	20.70
BSMR736	66.00	18.00	18.74	80.95	14.64	21.42	76.90	13.50	21.53
ICPL87119	69.12	16.24	18.89	84.44	13.59	22.68	82.52	13.12	22.15
Pinku	72.62	13.45	19.63	75.27	12.35	20.96	76.54	12.42	22.16

(Dept. of Processing & Food Engg., CAET, JAU, Junagadh)

Impact of irrigation frequency and regimes on the economic productivity of drip irrigated fennel

Farmers of South Saurashtra Agro-climatic Zone growing fennel are advised to adopt drip irrigation for acquiring higher yield (59 %), water saving (69 %) and higher net return over control.



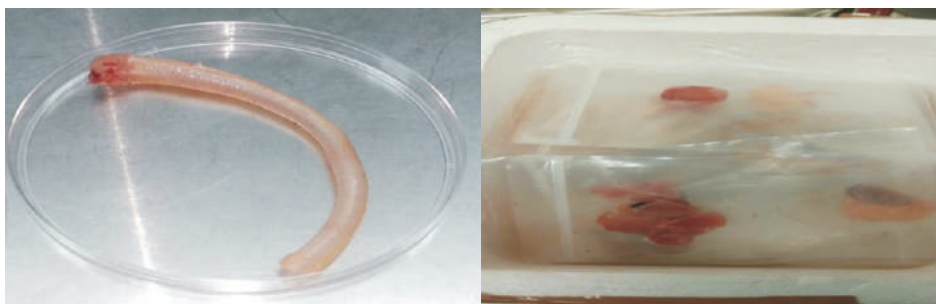
Details of drip system	Irrigation scheduling
Lateral spacing : 75 cm Dripper spacing: 40 cm Dripper discharge: 2 lph	At 3 days interval with 0.8 IW/ETc or a) November-December: 1 h and 15 min to 1 h and 30 min b) January: 2 h and 20 min c) February-March: 3 h to 3 h and 20 min d) April: 2 h and 20 min

(Research Testing & Training Centre, JAU, Junagadh)

VI. ANIMAL HEALTH & ANIMAL PRODUCTION

Ecological studies of *Staphylococcus aureus* isolates from poultry meat and associated environment in and around Junagadh district

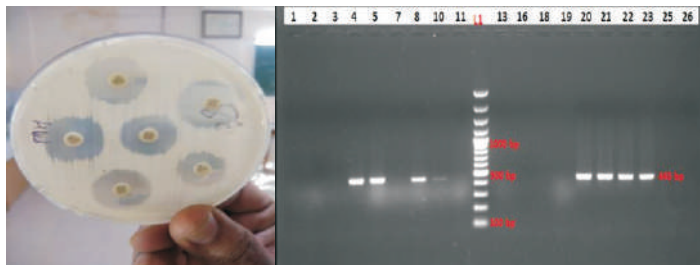
Poultry meat handlers need awareness for hygienic production of poultry meat to reduce possible food infection caused by *Staphylococcus aureus* in Junagadh District.



(Dept. of Vet. Public Health & Epidemiology, College of Vet. Sci. & A.H., JAU, Junagadh)

Phenotypic and Molecular characterization of extended-spectrum β -lactamase (ESBL) producing *Escherichia coli* from poultry in Junagadh, Gujarat

The presence of *E. coli* is confirmed in poultry in and around Junagadh, hence poultry farmers are advised to use antibiotics in the treatment of poultry diseases under the guidance of registered veterinary



practitioners and strictly follow prescribed antibiotic regimens to avoid anti-microbial resistance.

(Dept. of Livestock Product Technology, College of Vet. Sci. & A.H., JAU, Junagadh)

Studies on nutritive value and feeding varying levels of Marvel (*Dicanthium annulatum*) grass on milk production and milk composition in lactating Gir cows

Dairy farmers are recommended to feed 18 kg/day green Marvel/Jinjavo grass equivalent to 50 % crude protein replacement to Gir cows (470 kg body weight and 7.6 litres milk/day) to enhance milk production by 6.81 % and profit (return over feed cost) by 41.08 %. Marvel/Jinjavo grass should be harvested at 40-45 days interval.

(Cattle Breeding Farm, JAU, Junagadh)

VII. FISHERIES SCIENCE

Utilization of duckweed (*Lemna minor*) meal as partial supplementation in the diet of Catla catla fry

Fish Farmers are recommended to incorporate 15 % of duckweed (*Lemna minor*) leaf meal in the feed of Catla catla to obtain better growth rate, survival rate and economic return in freshwater rearing pond.

(College of Fisheries Science, JAU, Veraval)

VIII. BASIC SCIENCE

Influence of weather parameters on cotton (*Gossypium hirsutum* L.) phenology and seed cotton yield

The farmers of South Saurashtra Agro-Climatic Zone sowing early (31st May) and late (10th July) Bt cotton hybrids under irrigated condition are advised to sow cotton crop timely (20th June) for increasing chlorophyll content, leaf area, specific leaf weight, higher heat use efficiency, reduce pink bollworm damage, higher seed cotton yield and net return. Farmers preferring early sowing (31st May) are also advised to sow G.Cot. Hy-8 for higher seed cotton yield and net return.

(Cotton Research Station, JAU, Junagadh)

Manipulation of source-sink relationship in pearl millet through growth retardants

The farmers of North Saurashtra Agro-Climatic Zone growing *kharif* pearl millet are advised to apply foliar spray of CCC (chloromequet chloride, 99 %) @ 250 ppm (2.5 ml/ 10 liter water) attillering and post-anthesis stage to get higher grain yield and net return.

(Main Pearl Millet Research Station, JAU, Jamnagar)

RECOMMENDATION FOR SCIENTIFIC COMMUNITY

I. CROP PRODUCTION

Integrated weed management in castor

Under South Saurashtra Agro-climatic Zone, effective weed management as well as higher seed yield and net returns from irrigated castor during *kharif* season can be achieved by keeping the crop weed free through interculturing and hand weeding at 20, 40, 60, 80, 120 and 150 DAS or pendimethalin as pre-emergence 1 kg/ha *fb* Quizalofop ethyl 0.05 kg/ha as post-emergence at 25 DAS *fb* IC & HW at 60 DAS.

(Main Oilseeds Research Station, JAU, Junagadh)

Weed control in *kharif* groundnut

Under North Saurashtra Agro-climatic Zone, effective weed management as well as higher yield and net returns from *kharif* groundnut can be achieved by application of Oxyfluorfen 0.24 kg/ha as pre-emergence *fb* IC & HW at 40 DAS.

(Main Dry Farming Research Station, JAU, Targhadia)

Integrated weed management in Indian bean

Under South Saurashtra Agro-climatic Zone, effective weed management along with higher yield and net returns from *rabi* Indian bean can be achieved by pre-emergence application of either pendimethalin 30 % EC 900 g a.i./ha as pre-emergence or pendimethalin 37.8 % CS 900 g a.i./ha as pre-plant incorporation followed by interculturing and hand weeding at 45 DAS.



(Department of Agronomy, JAU, Junagadh)

Weed management in autumn planted sugarcane + chickpea intercropping system

The scientific community is informed that application of pendimethalin 1.0 kg/ha as pre-emergence followed by hand weeding at 45 days after sowing of chickpea as intercrop in sugarcane planted at 90 cm row spacing gave higher yield and net return as well as effective weed management.



(Main Sugarcane Research Station, JAU, Kodinar)

Performance of sesame genotypes differing in maturity and plant types and their response to spacing in *kharif* season

In North Saurashtra Agro-climatic Zone, sesame varieties/genotypes differing in

maturity and plant type gave higher seed yield with different spacing in *kharif* season as below.

- * Variety with profuse branches and late maturity (G.Til 10) at 45 cm x 10 cm or 60 cm x 10 cm spacing.
- * Variety with few branches and mid late (G.Til 3 and GJT 5) as well as late maturity (AT 308) at 45 cm x 10 cm or 30 cm x 10 cm spacing.
- * Variety with few branches and early maturity (AT 375 and AT 377) at 30 cm x 10 cm spacing.
- * Uniculm variety with late maturity (AT 363 and AT 374) at 30 cm x 10 cm spacing.



(Agricultural Research Station, JAU, Amreli)

Establishment of critical limit of sulphur for green gram crop in medium black calcareous soils

For recommending sulphur application to green gram crop grown in calcareous soils of Saurashtra, STLs of Gujarat should consider the critical limit of 13.8 ppm in soil and 0.395 per cent in green gram plant at 45 DAS.



(Dept. of Agril. Chem. & Soil Sci., JAU, Junagadh)

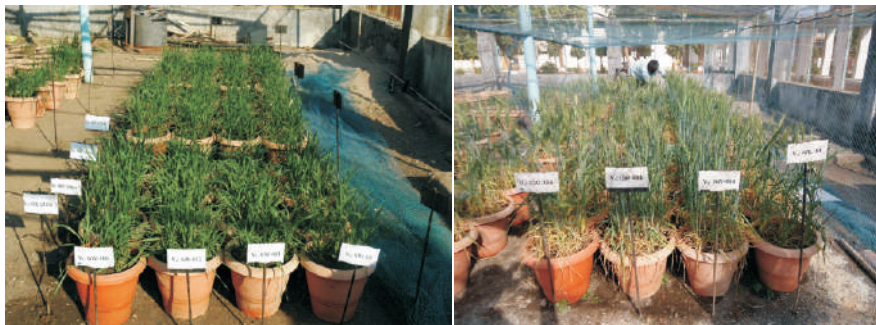
Soil test based fertilizers application for targeted yield of soybean in Saurashtra region of Gujarat

The soil testing laboratories are informed that the nutrients requirement for production of one quintal soybean seed was assessed as 5.65, 0.91 and 2.53 kg; N, P₂O₅ and K₂O, respectively. The fertilizer prescription equations are: for N: [FN = (7.87 x T) - (0.50 x SN) - (0.39 x FYM)], P: [FP₂O₅ = (3.10 x T) - (1.87 x SP) - (0.17 x FYM)] and K: [FK₂O = (4.70 x T) - (0.20 x SK) - (0.19 x FYM)] with FYM. Targeted yield concept could effectively be adopted up to 20 q/ha for site specific fertilizer recommendation to achieve high yields of soybean in the medium black calcareous soils of Saurashtra region of Gujarat.



(Dept. of Agril. Chem. & Soil Sci. & Main Oilseed Research Station, JAU, Junagadh)

Effect of saline irrigation water on wheat crop



It is information for scientific community especially plant breeders that wheat varieties GW 366 and KRL 19 recorded higher mean salinity index (86.7 and 79.8 %), comparable mean seed yield (18.4 and 14.4 g/pot), minimum yield decline (29.38 and 34.89 %) at EC 8.0 dS/m and for 50 % yield reduction at EC 12.24 and 10.54 dS/m, respectively as well as lower Na/K ratio in grain (GW 366) and straw (KRL19), hence found more tolerant as compared to GW 451 and GW 463.

(Dept. of Agril. Chem. & Soil Sci., JAU, Junagadh)

Effect of saline irrigation water on tomato crop

It is information for scientific community especially plant breeders that tomato varieties Anand Tomato 3 and Gujarat Tomato 1 recorded higher mean fruit yield (219.3 and 213.1 g/pot), higher mean salinity index (80.8 and 76.9 %), minimum yield decline (29.84 and 37.84 %) at 8.0 dS/m and for 50 % yield reduction at EC 11.92 and 10.21 dS/m, respectively, hence found more salt tolerant compared to Gujarat Tomato 2 and Junagadh Tomato-3.

(Dept. of Agril. Chem. & Soil Sci., JAU, Junagadh)

Effect of saline irrigation water on brinjal crop

It is information for scientific community especially plant breeders that brinjal variety GJB 2 recorded higher mean fruit yield (1490.2 g/plot) with mean salinity index (78.7%), yield decline (31.16 %) at 8.0 dS/m and for 50 % yield reduction at EC 11.28 dS/m, as well as lower Na/K ratio in fruit (0.124) and stalk (0.10) comparable with other varieties.



(Dept. of Agril. Chem. & Soil Sci., JAU, Junagadh)

II. PLANT PROTECTION

Entomology

Effectiveness of *Beauveria bassiana* in combination of different insecticides against onion thrips

For effective and economical management of thrips, *Thrips tabaci* in onion, three sprays of spinosad 45 SC 0.0135 % (3 ml/10 l of water) OR *Beauveria bassiana* 1.15 WP 0.0035 % (Min. 2×10^6 cfu/g) + spinosad 45 SC 0.0068 % (30 g + 1.5 ml/10 l of water), first at initiation of pest infestation and subsequent two sprays at ten days interval found effective in onion.

(Department of Entomology, JAU, Junagadh)

Effect of different schedule base insecticidal spray against garlic thrips

For effective and economical management of thrips, *Thrips tabaci* in garlic, schedule spraying of dimethoate 30 EC 0.003 % (10 ml/10 l of water), fipronil 5 SC 0.01 % (5 ml/10 l of water) and acetamiprid 20 SP 0.006 % (4 g/10 l of water) OR profenophos 50 EC 0.075 % (20 ml/10 l of water), spiromesifen 240 SC 0.011 % (10 ml/10 l of water) and thiamethoxam 25 WG 0.01 % (4 g/10 l of water), first at initiation of pest infestation and subsequent two sprays at 10 days interval after first spray.

(Department of Entomology, JAU, Junagadh)

Management of sucking pests in cumin

For effective and economical management of thrips, *Thrips tabaci* in cumin, two sprays of *Beauveria bassiana* 1.15 % WP + dinotefuran 20 % SG 0.005% (60 g + 2.5 g/10 l of water) OR *B. bassiana* + flonicamide 50 % SG 0.0125 % (60 g + 2.5 g/10 l of water), first at pest infestation and second at ten days interval.

(Department of Entomology, JAU, Junagadh)

Screening of sesame genotypes against insect pests and diseases under unprotected as well as protected condition

Sesame genotype AT 382 and variety G.Til 10 found resistant to mite pest whereas G.Til 10 also found resistant to powdery mildew and phytophthora diseases. These cultures can be utilized as multiple resistant source for further breeding programme.



(Agricultural Research Station, JAU, Amreli)

Plant Pathology

Management of leaf spot of custard apple

For the effective and economical management of leaf spot of custard apple, apply three spray of tebuconazole 50 % + trifloxystrobin 25 % WG 0.045 % (6 g/10 l of water) OR carbendazim 12 % + mancozeb 63 % WP, 0.15 % (20 g/10 l of water) OR azoxystrobin 23 % SC, 0.023 % (10 ml /10 l of water) OR mancozeb 75 % WP 0.2 % (27 g/10 l of water), first at initiation of disease and subsequent sprays at 20 days interval.



(Department of Plant Pathology, JAU, Junagadh)

III. AGRICULTURAL ENGINEERING

Assessment of potential water resources of Aji river basin using SWAT Model

The scientific Community/ Policy makers working for Aji River Basin are informed as below.

1. Warming trend

- The day maximum temperature may increase by 3.31°C, 1.46°C and 2.52°C up to end of 2070 over the present 34.51°C, 38.65°C, 36.01°C and minimum temperature by 3.35°C, 5.80°C and 3.07°C up to end of 2070 over the present 14.83°C, 26.38°C and 22.37°C in winter, summer and monsoon season respectively.
- The adoptions of heat resistant crop varieties with frequent irrigations of smaller depth through MIS particularly during summer season should be promoted to lessen the adverse effects of higher temperature.
- The following mathematical models may be used to predict the day maximum and day minimum temperature for the period up to 2070.

Period/ Season	Day maximum temperature (°C)		Day minimum temperature (°C)	
	Model	R ²	Model	R ²
Annual	$T_{\max} = 0.0462 \times \text{Year} - 56.927$	0.90	$T_{\min} = 0.081 \times \text{Year} - 141.62$	0.98
Winter	$T_{\max} = 0.0625 \times \text{Year} - 91.552$	0.86	$T_{\min} = 0.0632 \times \text{Year} - 112.64$	0.98
Summer	$T_{\max} = 0.0276 \times \text{Year} - 17.023$	0.90	$T_{\min} = 0.1094 \times \text{Year} - 194.28$	0.98
Monsoon	$T_{\max} = 0.0476 \times \text{Year} - 59.997$	0.87	$T_{\min} = 0.0579 \times \text{Year} - 94.417$	0.88

2. Surface water

- The crop water requirements during winter, summer and monsoon season may change by the tune of 6.4 %, - 0.3 % and 1.5 % respectively in future up to 2070 as compared to the past, due to global warming. On an average, the water balance components like rainfall and runoff may be decreased by 26 %, and 29 % in future up to 2070 as compared to past. The monsoon seasonal rainfall and runoff will be decreased up to 2070 but the extreme event (100 years return period) will be increased by tune of 39 % and 87.5 % respectively due to climate change impacts. Therefore, the following empirical probability distributions should be used for the rainwater management planning.

Hydrological Parameter	Probability distribution	Empirical cumulative probability function
Monsoon Rainfall(mm)	Frechet type (Fisher-Tippett 2)	$P(x \geq X) = 1 - e^{-\left \frac{(x-(-58))}{-10.5627} \right ^{-1.88227}}$
Monsoon runoff(mm)	Log-logistic	$P(x \geq X) = 1 - \frac{1}{1 + e^{(-1.20156 \ln(x) + 5.00776)}}$

3. Ground water

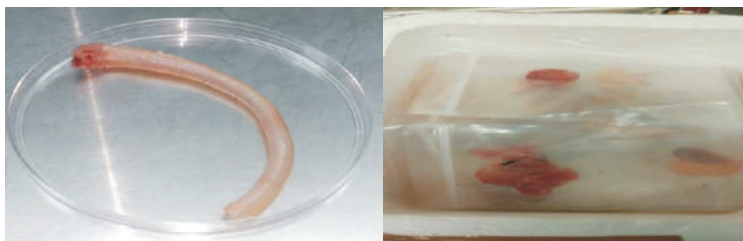
- The groundwater recharge may be decreased by 51 % up to 2070 as compared to past due to the climate change impacts. Therefore, the water harvesting-cum-groundwater recharge structures as well as artificial groundwater recharge through open/tube well should be planned for the groundwater sustainability.

(Dept. of Soil & Water Conservation Engineering, CAET, JAU, Junagadh)

IV. ANIMAL HEALTH & ANIMAL PRODUCTION

Ecological studies of *Staphylococcus aureus* isolates from poultry meat and associated environment in and around Junagadh district

A total of 27 (13.5 %) isolates of *Staphylococcus aureus* were recovered from samples collected from poultry raw meat, knife and hands of poultry meat handlers in and around Junagadh district. Among isolates, 19 (70.37 %) and 17 (62.96 %) were resistant to tetracycline and ampicillin, respectively.



(Dept. of Vet. Public Health and Epidemiology, College of Vet. Sci. & A.H., JAU, Junagadh)

Etiological and Therapeutic studies on Canine Dermatoses in and around Junagadh

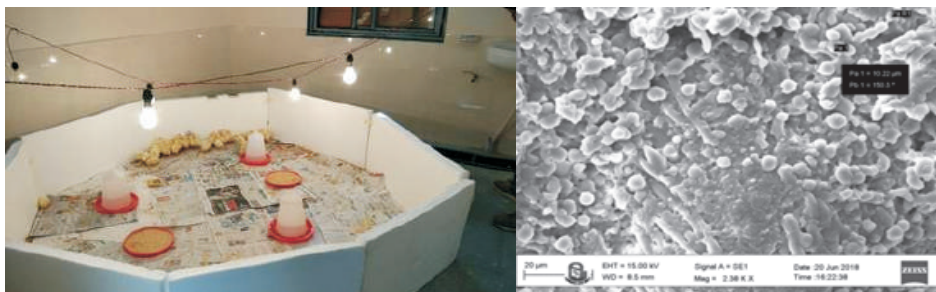
Higher prevalence of dermatoses are seen in Pug, Labrador and Doberman in the age group of 4 -5 years during summer and monsoon seasons with higher Staphylococcal infection (80.33 %) followed by *Streptococcus* Spp. (11.48 %) and *Micrococcus* Spp. (8.2 %) which favourably responded to Amoxicillin - Sulbactam or Cefaperazone - Sulbactam antibiotics.



(Dept. of Teaching Vet. Clinical Complex, College of Vet. Sci. & A.H., JAU, Junagadh)

Evaluation of an antioxidant effect of poly-herbal mixture against cadmium induced oxidative stress in chickens

Addition of poly-herbal mixture (2 %) comprising of powders of fruits of *Opuntia elatior* Mill. (*Hathlo thor*) and *Sphaeranthus indicus* (L.) (*Gorakh Mundi*); leaves of *Peltophorum pterocarpum* (DC) Baker ex DC, (*Pilo Gulmohar*), *Syzygium cuminii* (L.) Skeels (*Kala Jambu*) and *Cressa cretica* (L.) (*Rudravanti*); aerial part of *Withania somnifera* (L.) Dunal (*Ashwagandha*) and *Solanum xanthocarpum* Schrad. & Wendl (*Bhoi ringani*) at equal proportions in feed ameliorates the cadmium chloride induced oxidative damage in chickens.



(Dept. of Vet. Pharmacology & Toxicology, College of Vet. Sci. & A.H., JAU, Junagadh)

Principal component analysis to predict the herd life using first lactation traits in Gir cattle

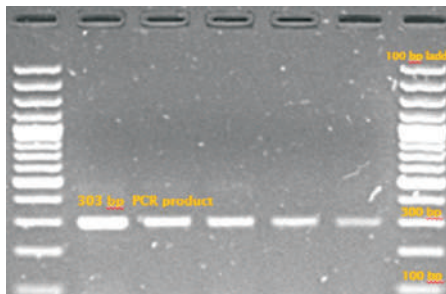
The first lactation records viz., AFC, FLL and DP can be used to predict herd life up to

five lactations using MLR equation $HLFL = 608.64 + (1.18 \times AFC) + (2.08 \times LL) + (1.33 \times DP)$ explaining 70 % of underlying variance (Adjusted $R^2 = 0.694$). The explained variance ($R^2 = 0.687$) for estimating herd life up to five lactations using PCA can be invariably be used using regression equation $HLFL = 3422.69 + (468.15 \times FAC1) + (127.63 \times FAC2)$ with added advantage of nullifying collinearity among independent variables.

(Dept. of Animal Genetics and Breeding, College of Vet. Sci. & A.H., JAU, Junagadh)

Molecular characterization of BoLA-DRB3 gene in Gir cattle

Partial exon II of DRB 3 gene amplified with reported HL 030 (5' - ATCTCTCTCTGCAGCACATTTC-3') and HL 031 (5' - TTTAATTGCGCTCACCTCGCCGCT-3') primers showed high variation (~22%) and polymorphism in sampled Gir cattle population. Pst I, EcoR V and Sal I restriction enzymes showed their restriction sites in analyzed sequences which can be further used for genotyping and association studies.



(Dept. of Animal Genetics and Breeding, College of Vet. Sci. & A.H., JAU, Junagadh)

Studies on nutritive value and feeding varying levels of Marvel (*Dicanthium annulatum*) grass on milk production and milk composition in lactating Gir cows

Marvel/Jinjavo (*Dicanthium annulatum*) grass has 8.65 % Digestible Crude Protein (DCP) and 61.83 % Total Digestible Nutrients (TDN). Chemical composition of Marvel/Jinjavo grass: Crude protein-13.4 %, Crude fibre-32.8 %, Crude fat-2.1 %, DCP-8.65 % and TDN-61.83 %.

(Cattle Breeding Farm, JAU, Junagadh)

V. FISHERIES SCIENCE

Study of copepod diversity in coastal region of Okha-mandal and its culture potential as live feed



Nineteen copepod species were recorded from coastal areas of Okhamandal, i.e. eight species of calanoid copepods mainly *Eucalanus elongatus*, *Calanus minor* and *Paracalanus parvus*; five species of harpacticoid copepods mainly *Longipedia weberi*, *Microsetella norvegica* and six species of cyclopoid copepods mainly *Oncea venusta* and *Oithona similis* were recorded. Higher copepod diversity was found in Okha area followed by Mithapur and Dwarka, higher diversity during monsoon season followed by winter and least in summer. *Macrosetella gracilis* and *Oithana brevicornis* have culture potential.

(Fisheries Research Station, JAU, Okha)

Estimation of agar and alginic acid from the seaweeds available at coast of Okha

The highest % agar yield 17.98 ± 1.87 was observed in *Gracilaria corticata* among the Rhodophyceae species available at Okha coast. The highest gel strength (63.46 ± 2.66 g/cm²) of agar was observed in *Gracilaria corticata* among Rhodophyceae species available at Okha coast. At Okha coast, higher % of agar yield 17.98 ± 1.87 was observed in *Gracilaria corticata* among the Rhodophyceae species. The higher gel strength (63.46 ± 2.66 g/cm²) of agar was observed in *Gracilaria verucosa* among Rhodophyceae species. Among the phaeophycean species available, higher percent (40.21 ± 1.95) alginic acid content was observed in *Sargassum wightii*.

(Fisheries Research Station, JAU, Okha)

Estimation of in vitro antioxidant potential of the seaweeds available at coast of Okha

Amongst the seaweeds available at Okha coast, the highest *in vitro* antioxidant potential was observed in *Sargassum johnstonii* with the value of 1.72 ± 0.22 DPPH (2, 2, Diphenyl-1-Picrylhydrazyl) activity Eq. mM Ascorbic acid/g FW.

(Fisheries Research Station, JAU, Okha)

VI. BASIC SCIENCE

Draft genome sequencing and analysis of fungal phytopathogen *Sclerotium rolfsii* to reveal insight into its genetic structure

It is recommended to the scientific community involved in Groundnut improvement that the sequencing of plant pathogenic fungi *Sclerotium (Athelia) rolfsii* showed the size of genome is 73 Mb. The draft genome having 8919 contigs, 16830 genes and 11171 SSR present in the genome. In genome 3507 and 261 genes involve in transporter and catalytic function respectively, 1531 genes involve in cellular component and 709 of genes involve in biological process. Pathogenicity related genes identified in this study have high relevance in future fungicide designing and following primers can be used for the specific identification of

pathogenic fungi *Sclerotium (Athelia) rolfsii*.

Name	Primer 3'-5'	Product length	GC %	Tm
JAUSRF1	GAAGAGTTTGCCTCGAGTCC	250	55	59.85
JAUSRR1	GCTGTCAGAGAAACCGAAGA		50	59.84
JAUSRF2	ACGAACTCGATCCCAGCATC	170	50	60.47
JAUSRR2	TCGATTATGAGGGTTTCCTC		50	60.05
JAUSRF3	CGGACTAATAATCGACCCTA	230	50	60.07
JAUSRR3	ATAAAGGTGCGTTGACGTTT		45	60.17

(Department of Biochemistry and Biotechnology, JAU, Junagadh)

VII.SOCIAL SCIENCE

Performance and price discovery of cotton in spot and futures markets in India

The efficiency of futures markets of cotton and cotton oilseed cake can be improved by increasing the participation of various stakeholders including farmers. This can be tackled with the help of a three pronged strategy: (i) Creating large scale awareness among various stakeholders, including farmers by focusing on market oriented extension services. (ii) Mobilizing farmers under groups to pool their resources. (iii) Decreasing the current lot size of cotton based future contract which is a prime reason behind nonparticipation of farmers.

(Dept. of Agril. Economics, Junagadh)

Comparison of various methods of stability analysis to identify stable genotypes in sesame

The Desirability Index (Di) of parametric method and Mean of absolute Rank Difference of genotype over environments ($S_i^{(3)}$), Variance among the ranks over environments ($S_i^{(6)}$) of non-parametric methods found useful for stability analysis of genotypes in sesame. These non-parametric methods need not require to fulfill strong assumptions as in case of Eberhurt & Russel.

(Dept. of Agril. Statistics, JAU, Junagadh)

Scope and opportunities of Agro-tourism in Saurashtra region

There is an ample potential for development of agro-tourism in four identified routes; route-I (Junagadh-Amreli-Sasan Gir-Junagadh), II (Junagadh-Jamnagar–Porbandar–Junagadh), III (Junagadh–Rajkot-Surendranagar-Junagadh) and route-IV (Junagadh- Veravel –Junagadh) of Saurashtra region.

(PG Institute of Agri. Business Management, JAU, Junagadh)

Table: Production of breeder/ truthful seeds, planting materials, bio-agent and bio-fertilizers (2018-19)

Sr. No.	Particular	Production
1	Nucleus and Breeder Seeds (q)	3709.52
2	Truthful, foundation and certified seeds (q)	5351.27
3	Fruit crop graft (Nos.)	28678
4	Fruit crops saplings (Nos.)	74556
5	Seedlings (Nos.)	45788
6	Ornamentals & Medicinal plants (Nos.)	53086
7	<i>Trichoderma</i> (tonne)	186.981
8	<i>Rhizobium</i> (litre)	2067
9	<i>Azotobacter</i> (litre)	1556
10	PSB (litre)	3050
11	<i>Beauveria</i> (tonne)	115
12	<i>Metarhizium</i> (tonne)	52.41
13	HNPV (liter)	253.5
14	SNPV (liter)	161.75
15	Fruit fly traps (Nos.)	4864
16	Fruit fly lure for fruit crops (Nos.)	5212
17	Fruit fly lure for vegetable crops (Nos.)	607
18	Pheromone Trap (Nos.)	46,365
19	Pheromone Lure (Pink bollworm) (Nos.)	1,03,998
20	Pheromone Lure (<i>Heliothis</i>) (Nos.)	4378
21	Pheromone Lure (<i>Prodenia</i>) (Nos.)	816
22	Pheromone Lure (Brinjal shoot and fruit borer) (Nos.)	1322
23	MDP Technology for Pink bollworm (100 gm Tube)	1528
24	Honey (litre)	170.25