JUNAGADH AGRICULTURAL UNIVERSITY

RESEARCH RECOMMENDATIONS FOR FARMERS COMMUNITY

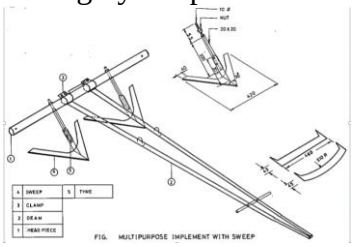
V. AGRICULTURAL ENGINEERING

Total 90 farmers recommendations were developed by Agricultural Engineering disciplines are described herein.

Year: 2004-05

1. Sweep blade for inter-culturing

The farmers of South Saurashtra Agro-climatic Zone growing row crops are advised to use sweep blade (angle 70^0 and working length 42 cm) for inter-culturing to reduce number of clogging and to improve weeding and field efficiency as compared to straight and curved blades. Use of sweep blade for inter-culturing also reduces drudgery to operator.



(*Research, Testing & Training Center, JAU, Junagadh*)

Year: 2005-06

2. Mango positioner

Mango growers are advised to use tractor drawn positioner developed by Junagadh Agricultural University for mango harvesting with uniform stalk length (1-2 cm), for maintaining white layer on fruit and with choice of matured fruit as the harvesting is done at a close distance. Using this machine, one can get economical advantage over local picker.

(*Research, Testing & Training Center, JAU, Junagadh*)

3. Post-hole digger

The engine operated portable post-hole digger developed by Junagadh Agricultural University is useful for making the pits for erecting fencing poles, plantation of fruits and forest saplings etc. This machine makes about 25 to 35 pits of 15 cm (6 inch) diameter and 45 cm (18 inch) depth in one hour. By this machine, the cost of making one pit (Rs. 2.16) is low as compared to manual digging (Rs. 5.60) and tractor operated digger (Rs. 4.10). Looking to the performance and application, this machine is recommended for farmers, manufacturer and other users.

(*Department of Farm Machinery & Power Engineering, CAET, JAU, Junagadh*)

Year: 2006-07

4. Peanut butter

The entrepreneurs/farmers interested in value addition in peanut are recommended to select the GG 20 cultivar (in comparison to GG 2, GG 7, GG 11, GG 13) of peanut for the production of good quality peanut butter.

5. Cleaner-cum-grader for cumin

The cumin cleaner-cum-grader machine developed by Junagadh Agricultural University has cleaning efficiency of 75 per cent at the capacity of 50 kg/h and a low cost of cleaning (Rs. 0.31 per kg). It is recommended for the use of farmers, processors and other users.

(*Department of Processing & Food Engineering, CAET, JAU, Junagadh*)

6. Residue shredder

Agricultural residue shredder developed by Junagadh Agricultural University is recommended for the use of farmers and industries for shredding the plant stalks of castor, cotton and pigeon pea. The machine is operated with 6 hp diesel engine and having capacity of about 170 to 190 kg/h, producing pieces of stalks in size 10 to 75 mm length. The volume of plant stalks reduces to about 80 per cent due to shredding with the value addition of about 170 to 230 per cent.

(*Department of Farm Machinery & Power Engineering, CAET, JAU, Junagadh*)

7. Rainfall -runoff relationships for Mahi basin

The mathematical model and nomograph of rainfall intensity-duration-frequency relationships for Mahi basin developed by Junagadh Agricultural University are recommended to the designers, planners, NGOs and Govt. agencies involved in watershed development projects for the design of structures.

Mathematical Model: I = 113.3211(T) 0.2156(t+1.4275)1.0132.

Where, I = rainfall intensity (mm/h); T = return period (years); t = duration (hours).

8. Rainfall intensity-duration-frequency relationships

The mathematical model and nomograph of rainfall intensity-duration-frequency relationship for Junagadh region developed by Junagadh Agricultural University are recommended to the designers, planners, NGOs and Govt. agencies involved in watershed development projects for the structures.

Mathematical Model: $I = 68.86\ T^{0.265}/(t+0.86)^{1.022}$

Where, I = rainfall intensity (mm/h); T = return period (years); t = duration (hours).

(*Department of Soil & Water Conservation Engineering, CAET, JAU, Junagadh*)

Year: 2007-08

9. Grader for sapota

Hand-operated grader developed by Junagadh Agricultural University for grading sapota on the basis of size is recommended for the use of farmers, manufacturers and processors. The same machine can also be used for grading of similar types of fruits and vegetables.

(*Department of Processing & Food Engineering, CAET, JAU, Junagadh*)

10. Hay rake-cum-loader

Tractor operated hay rake cum loader, developed by Junagadh Agricultural University is recommended for the use of farmers and manufacturers. The machine is easy to operate and reduces time & cost of collecting hay.

(*Department of Farm Machinery & Power Engineering, CAET, JAU, Junagadh*)

11. Time table for green house cooling

The farmers of the Saurashtra region growing flower crops in medium cost green houses are advised to adopt the following time table for operating different cooling systems by using 50 per cent shade net along with natural ventilation (20 to 30 % of the ground floor area) during summer months (March-June) for maintaining productive temperature (20-30 ^{0}C) inside the greenhouse and for saving energy.

Month	Treatment	Time of operation
March	Natural Ventilation	8.00-10.00 /19.00-21.00
	Fogging & Natural Ventilation	10.00-11.00/17.00-19.00
	Fogging & Fan Ventilation/Fan & Pad Ventilation	11.00-17.00
	Without ventilation	21.00-8.00
	Shading	Required
April	Natural Ventilation	7.00-8.00 /22.00-23.00
	Fogging & Fan Ventilation	8.00-10.00/19.00-22.00
	Fan & Pad Ventilation	10.00-19.00
	Without ventilation	23.00-7.00
	Shading	Required
May	Natural Ventilation	22.00-24.00
	Fogging & Fan Ventilation	8.00-11.00/19.00-22.00
	Fan & Pad Ventilation	11.00-19.00
	Without ventilation	0.00-8.00
	Shading	Required
June	Natural Ventilation	22.00-24.00
	Fogging & Fan Ventilation/Fan & Pad Ventilation	8.00-22.00
	Without ventilation	0.00-8.00
	Shading	Required

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

12. Least-cost design for drip irrigation system

The farmers, entrepreneurs and design engineers are advised to install the drip irrigation system as per layout given below for different crops grown in Saurashtra region to minimize installation cost (Table 1 and 2).

Table 1:Drip irrigation in horticultural crops**

Sr. No	Name of Crop	Spacing (m x m)	Expenditure (Rs/ha)	Size of Different components				
				Screen Filter	Main Line	Sub main line	Lateral	Dripper Discharge
				m^3/h	mm	mm	mm	lph
1	Mango	10 x 10	25,376	10	-	50	16	8
2	Sapota	10 x 10	25,493	10	-	50	16	8
3	Coconut	6 x 6	33,855	10	-	50	16	8
4	Custard apple	6 x 6	34,123	10	-	50	16	4
5	Guava	6 x 6	33,372	10	50	40	12	8
6	Lemon	6 x 6	33,855	10	-	50	16	8
7	Pomegranate	6 x 6	35,131	10	-	50	16	4
8	Date palm	8 x 8	30,255	10	-	50	16	8
9	Ber	6 x 6	32,209	10	50	40	12	8
10	Amla	8 x 8	29,476	10	40	32	12	8
11	Papaya	2 x 2	58,789	10	-	75	16	4
12	Cashew nut	5.4 x 5.4	36,124	10	-	50	16	8
13	Banana	1.5 x 1.5	62,290	10	63	50	12	4
14	Banana	3.2 x 1.2	45,101	10	-	50	16	2

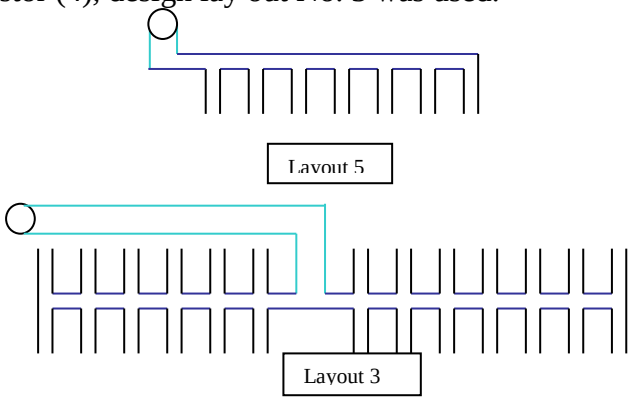
***As per the GGRC rates of 2007.**

**** For all crops, design lay out No. 5 was used, except, Amla (4) and Banana (3).**

Table 2: Drip irrigation in field crops*

Name of Crop	Crop geometry (m x m) (R x P)	Lateral x Dripper Spacing (m x m)	Expen-diture (Rs/ha)	Size of Different Components				
				Screen Filter	Main Line	Sub main line	Late-ral	Dripper Discharge
				m^3/h	mm	mm	mm	lph
Groundnut	0.45 x 0.1	0.9 x 0.6	1,23,986	20	90	75	12	2
Groundnut	0.9 x 0.1	0.9 x 0.6	1,19,971	20	75	63	12	2
Groundnut	0.6 x 0.1	1.2 x 0.6	94,586	20	75	63	12	2
Groundnut	0.75 x 0.1	0.75x 0.6	1,42,174	25	90	75	12	2
Cotton	1.5 x 0.6	1.5 x 1.2	86,723	25	90	75	16	8
Cotton	1.2 x 0.6	1.2 x 1.2	78,612	20	75	63	12	4
Cotton	0.9 x 0.6	0.9 x 1.2	98,673	20	75	63	12	4
Castor	0.6 x 0.6 x 1.2	1.8 x 0.6	68,619	10	63	50	12	2
Castor	0.9 x 0.6	0.9 x 1.2	98,673	20	75	63	12	4
Castor	0.9 x 0.6	0.9 x 0.6	1,48,711	40	75	63	16	4
Tomato/ Brinjal	0.6 x 0.6 x 0.9	1.5 x 1.2	68,301	20	75	63	12	4
Tomato/ Brinjal	0.75 x 0.6	0.75x 1.2	1,16,618	25	90	75	12	4
Chilles	0.6 x 0.6	1.2 x 1.2	78,612	20	75	63	12	4
Lady's finger	0.6 x 0.3	1.2 x 0.6	94,586	20	75	63	12	2
Lady's finger	0.3 x 0.3 x 0.9	1.2 x 0.6	94,586	20	75	63	12	2
Cabbage/ Cauliflower	0.45 x 0.45	0.9 x 0.9	1,02,902	20	75	63	12	2
Cabbage/ Cauliflower	0.3 x 0.3 x 0.9	1.2 x 0.6	94,586	20	75	63	12	2
Bittergourd	1 x 1	1 x 1	99,647	20	90	75	12	4
Sugarcane	0.1 x 0.6 x 1.2	1.8 x 0.6	68,619	10	63	50	12	2

* For all crops, except castor (4), design lay out No. 3 was used.



(*Research, Testing & Training Center, JAU, Junagadh*)

Year: 2008-09

13. Tractor Drawn JAU Groundnut Digger cum Shaker

The farmers and manufacturers are recommended to use tractor drawn "JAU" groundnut digger cum shaker for groundnut harvesting, as it saves 30 per cent of operational cost and 15 per cent time as compared to traditional blade harrow.

14. Tractor drawn JAU groundnut pod exposer

The farmers and manufacturers are recommended to use tractor drawn "JAU" Groundnut pod exposer for exposing left out groundnut pods after harvesting, as it exposes about 93 per cent pods on surface in one pass and saves 12 per cent time as compared to 2 to 3 harrowing with traditional equipment.

15. JAU Vertical Conveyor Harvesting unit

The farmers and manufacturers are recommended to use mini tractor front mounted "JAU" Vertical Conveyor Harvesting Unit for harvesting of cereals as well as fodder crops as it saves about 30 per cent cost of harvesting, compared to manual harvesting.

(*Department of Farm Engineering, College of Agriculture, JAU, Junagadh*)

16. Drying and storage study on seed quality of groundnut

The farmers of South Saurashtra Agro-climatic Zone are advised that after shade drying of summer groundnut having about 8.00 to 8.50 per cent moisture content (wb), considering the minimum weight loss in pods (4.86 %) and kernels (4.92 %), higher germination (81.04 %), minimum pod damage (10.66 %) and higher vigour index. The groundnut variety GG-7 followed by GG-2 was found better for four months storage period.

Also, in *kharif* groundnut having about 8.00 to 8.50 per cent moisture content (wb), considering the minimum weight loss in pods (2.06 %) and kernels (4.28 %), higher germination (81.66 %), minimum pod damage (9.22 %) and higher vigour index, the groundnut variety GG-7 followed by GG-2 were found better for six months storage period.

(*Department of Processing & Food Engineering, CAET, JAU, Junagadh*)

17. Rainfall analysis for planning soil and water conservation structures and for draught occurrence in Rajkot district

In the North Saurashtra Agro-climatic Zone minimum drought observed in 26th to 31st (June 25 to August 5), 34th (August 20-26) and 39th (September 24-30) meteorological standard week. Hence, these meteorological standard weeks are better for storing the excess runoff water during monsoon period, which can be used as supplementary irrigation to save the crops during moisture deficit period.

18. Impact analysis of a watershed management project

The farmers of the watershed area (North Saurashtra Agro-climatic Zone) shifted the cropping pattern in favor of high yielding varieties and cash crops due to implementation of Watershed Development Program, which has increased annual income from agriculture and livestock. Also the Gini concentration ratio, coefficient of variation and standard deviation of agricultural income were reduced. This implies that the Watershed Development Program played a major role in increasing income, irrigation facilities and income disparity among farmers.

(*Main Dry Farming Research Station, JAU, Targhadia*)

19. Ground water recharge estimation in and around Junagadh and Ghed area

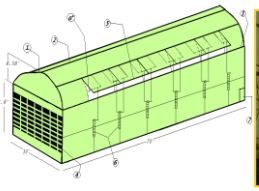
It is recommended to Govt. agencies, NGOs & planners that in Junagadh and Ghed area, the empirical methods are giving annual groundwater recharge in the range of 15 to 18 per cent of the annual rainfall. In these areas by measuring rainfall, pre-monsoon water table and using artificial neural network (architecture 2-5-1), the post groundwater table could be predicted well.

(*Department of Soil & Water Conservation Engineering, CAET, JAU, Junagadh*)

Year: 2009-10

20. Design and development of SPV operated greenhouse ventilation system

The farmers/greenhouse growers and greenhouse manufacturers are recommended to use JAU SPV operated Greenhouse Ventilation System for natural ventilation of greenhouses built in farms, where frequent power cut may cause greenhouse environment unfavorable for crop cultivation.


21. Performance of bio-degradable plastic mulch on onion production in comparison of normal plastic mulch

The farmers of Saurashtra region are advised to use bio-degradable plastic mulch (20 µ, black colour) for the cultivation of onion for the higher yield of the crop (15 %) and to reduce weed growth (50-62 %) as compared to no mulch. After harvesting of the crop, the field should be ploughed for mixing mulch in to the soil.

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

22. Storage study of wheat obtained by combine harvester and thresher

The farmers growing wheat for seed purpose are advised to use thresher for better germination and vigour as compared with self-propelled combine harvester.

23. Studies on drying characteristics of vegetables using crop residue dryer

The agro processor interested in using the crop residue based dryer developed by Junagadh Agricultural University for drying serrated carrot, carrot slices, cabbage leaves, cauliflower pieces, tomato slices and whole green chilies are recommended to use following operating parameters :

1. Air temperature : 51 to 55 ^{0}C
2. Air velocity : 1.5 m/s
3 Bed thickness : 8.0 cm
4. Average fuel required : 5.5 kg/h

(*Department of Processing & Food Engineering, CAET, JAU, Junagadh*)

24. Evaluation of the size of the bed at a given grade for effective soil and water management

The farmers of North Saurashtra Agro-climatic Zone growing bunch groundnut (GG-5) are advised to sow groundnut at 30 cm distance between rows having three rows on broad bed of 90 cm and furrow of 45 cm for getting higher yield and net return per hectare as well as to check runoff and soil loss under dry farming condition.

(*Main Dry Farming Research Station, JAU, Targhadia*)

Year: 2010-11

25. Modified atmosphere packaging technique for sapota

The farmers, processors and exporters are recommended to adopt modified atmosphere packaging technique developed by JAU for increasing the shelf life of *sapota* fruit by packing in 25 µ LDPE bag with a combination of 5 % O_2 +10 % CO_2 gas concentration and stored at 6 ^{0}C temperature. The shelf life of sapota fruits can be increased up to 49 days by using this technique.

26. Modified atmosphere packaging technique for mango

The farmers, processors and exporters are recommended to adopt modified atmosphere packaging technique developed by JAU for increasing the shelf life of mango fruit by packing in 25 µ LDPE bag with a combination of 6 % O_2 + 5 % CO_2 gas concentration and stored at 10 ^{0}C temperature. The shelf life of mango fruits can be increased up to 35 days by using this technique.

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

27. Lime harvester

The farmers having *Kagzi* lime orchards are advised to use the JAU-Lime harvester to reduce losses like impact damage and immature lemon fall-up.

(*Research, Testing & Training Center, JAU, Junagadh*)

28. Application of murrum in groundnut

The farmers of North Saurashtra Agro-climatic Zone growing bunch groundnut (GG-5) are advised to apply murrum @ 40 t/ha or FYM @ 10 t/ha along with recommended dose of fertilizer for obtaining higher yield of groundnut and net return under dry farming condition.

(*Main Dry Farming Research Station, JAU, Targhadia*)

29. Mulching on dripped guava orchard

The farmers of North Saurashtra Agro-climatic Zone growing guava under drip irrigation system are advised to apply black plastic (50 micron) or groundnut shell or wheat straw mulch @ 7.5 kg/plant (0.5 m around the plant) for obtaining maximum plant growth, fruit yield and net return.

(*Main Dry Farming Research Station, JAU, Targhadia*)

Year: 2011-12

30. Modified atmosphere packaging of spine gourd cv. local

The farmers, processors and exporters are recommended to adopt modified atmosphere packaging technique developed by JAU for increasing the shelf life of spine gourd by packing in 50 µ LDPE bag with a combination of 2 % O_2 + 4 % CO_2 gas concentration and stored at 8 ºC temperature. The spine gourd can be stored up to 20 days by using this technique.

31. Transportation losses for sapota

The farmers, processors and exporters are recommended to adopt foldable plastic box with cells developed by JAU for local transportation of sapota fruit. This box was found cheaper compared to other containers considering cost of container, transportation, returning empty container/bag and total losses after transportation including decay after storage and also quality of the fruits retained during transportation**.**

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

32. Dehydration and storage of vegetables

The processors, exporters are advised to store dehydrated onion, garlic and unripe mango powder in polyethylene (HDPE) bags of 50 micron in vacuum packaging (740 mm Hg) to retain the quality up to 120 days of storage period.

33. Storage of onion

The farmers and traders who are interested to store the onion for more than four months are recommended to use forced air ventilated storage structure to get 36 per cent of more marketable red onion.

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

34. Method of sowing of groundnut under poor drainage condition

The farmers of South Saurashtra Agro-climatic Zone growing bunch type groundnut under poor drainage field condition are advised to sow by broad bed furrow method (55 cm width and 15 cm depth of furrow and 100 cm bed width between two furrows) for getting higher yield and net return.

(*Research, Testing & Training Center, JAU, Junagadh*)

35. New horticultural crops in coastal belt area of Saurashtra region using saline water with drip and mulching technology

The farmers of South Saurashtra Agro-climatic Zone having saline ground water (EC-3.15 ds/m) and medium black calcareous soil (EC-0.88 ds/m) conditions are advised to introduce trees like; simaruba, tamarind, aonla, pomegranate, sapota, date palm, ber, carambola and guava with drip irrigation.

Simaruba Date palm

(*Research Testing & Training Centre, JAU, Junagadh and Cotton Research Station, JAU, Khapat*)

Year: 2012-13

36. Determination of groundwater potential of the South West Saurashtra region

Groundwater utilization and management policy guidelines are recommended for the South West Saurashtra region to farmers as well as concerned planners, NGOs and line departments.

- In normal years, the groundwater potential of South West Saurashtra region is estimated at 4060.66 MCM which is just sufficient to meet requirement of existing cropping pattern. The water table in the North East area (Talukas: Bhesan, Dhari, Part of Visavadar, part of Junagadh) usually goes down up to 20 m during pre-monsoon. Therefore, water harvesting activities and low water requirements, crops should be encouraged to improve the groundwater conditions.
- Around Veraval and Talala, the transmissibility of aquifer is observed around 32 sq.m /hr. Veraval is near sea cost having low altitude, whereas Talala having higher altitude. Talala, Mendarada and Visavadar and Malia talukas should be encouraged for surface water harvesting and well recharging (aquifer recharging) as this part has higher transmissibility and upland which creates groundwater flow seaward after recharge which helps to improve ground water quality at coastal belt as well enhance groundwater potential.
- Conjunctive use planning is recommended in good quality groundwater area also to reduce groundwater draft and save power costs.
- Around 2130 sq.km (23%) area of region is under degraded groundwater class during pre-monsoon mostly found along coastal line. The area must be improved by bandharas construction along coastal areas, water harvesting structures and conjunctive water use planning. Also salt tolerance and low water requirement crops should be introduced.
- The absolute head continuously falling from North-East upland to sea cost. Just near coastal line 20 m of head remains in pre monsoon. Under such head condition, water harvesting and conjunctive water use planning should be encouraged. The streams must be checked before 2 km from sea coast by Bandhara system which will reduce sea water intrusion as well as not affects the river livelihood up to the end of river.

In the area of good class of groundwater, high value crops which can grow under local climatic conditions may be encouraged beside existing cropping pattern as good groundwater quality supply is possible to meet.

37. Conjunctive use of surface water with groundwater for irrigating wheat crop

It is recommended to farmers, Planners and NGOs that conjunctive use of surface water from nearby water harvesting structures with groundwater for irrigating wheat crop in Junagadh region is benefited. Further it is recommended to Irrigation Department of Government of Gujarat to allow to use check dam water to nearby farmers freely instead of keeping it for recharge only after monsoon. As under conjunctive use 533.94 cum (7.72 %) of groundwater draft per ha. can be reduced and 123.8 units power per ha. (4.9 %) can be saved per irrigation given from check dam. It is economical when at least two irrigations given from surface sources and from second irrigation B/C can rise by 0.038 per irrigation given from check dam as compare to without Conjunctive water use. The conjunctive use can control up to 101 mm of evaporation loss from surface water sources. Good scopes are lying to avoid deep pumping, reduce groundwater draft and achieve higher economy by utilizing spill over water before it escapes from water harvesting structures.

38. Summer sesame response to irrigation under drip and mulching technology

The farmers of the South Saurashtra region sowing summer sesame (Guj. Til - 3) crop are advised to adopt any one of the following two irrigation scheduling options through high discharge drip irrigation system (20 lph drippers 1 m dripper spacing and 2m lateral spacing) with mulch application (5 tone/ha wheat straw) for getting the maximum return.

Option - I: When water availability is not limiting factor

The irrigation should be scheduled at IW/ET_c of 1.0. For that, the above said high discharge drip system should be run for 4 hr & 25 min (40 mm irrigation) immediately after sowing and 3 hr & 15 min (29.5 mm irrigation) at 8, 18, 28, 36, 43, 49, 54, 59, 64, 69 and 74 days after sowing.

Option - II: When Water availability is limiting factor

The deficit irrigation should be scheduled at IW/ET_c of 0.6. The saved water should be used to bring additional area under sesame crop cultivation at same deficit irrigation scheduling level. For that the above said high discharge drip system should be run for 4 hr & 25 min (40 mm irrigation) immediately after sowing, 3 hr & 15 min (29.5 mm irrigation) at 10 days after sowing and 3 hr & 40 min (33.3 mm irrigation) at 23, 36, 47, 58 and 70 days after sowing.

(*Department of Soil & Water Conservation Engineering, CAET, JAU, Junagadh*)

39. Drought investigation using Standardized Precipitation Index (SPI) for Junagadh

The farmers of South Saurashtra Agro-climatic zone are advised to use the excess rainfall prevailing during 27th to 32nd standard weeks (July 02 to August 12) judiciously and frugally towards supplemental irrigation to sustain crop productivity under rainfed agriculture.

40. Effect of land configuration on groundnut yield

Farmers of South Saurashtra Agro-Climatic Zone growing bunch type groundnut are advised to prefer broad bed furrow (55 cm width and 15 cm depth of furrow and 100 cm bed width between two furrows) land configuration for getting more moisture retention and higher return under rainfed agriculture.

(*Research, Testing & Training Center, JAU, Junagadh*)

41. Performance of screen house for cultivation of capsicum

The farmers of South Saurashtra Agro-climatic Zone who are interested to cultivate the capsicum in protected structures are advised to use JAU developed screen house (poly-cum-shade net house) covered with 50 % green shade net on periphery for natural ventilation and roof covered with 200 UVS PE sheet to get sufficient light. Under such type of structure, drip irrigation system with IW: CPE=0.8 should be used.

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

Year: 2013-14

42. Standardization of packaging technology of fresh guava fruits

The farmers, processors and exporters are recommended to adopt packaging technique developed by Junagadh Agricultural University for increasing the shelf life of guava fruit up to 18 days at room temperature by packing in 50 µ polyethylene bag at a vacuum level of 700 mm Hg.

43. Standardization of packaging technology of processed guava fruits

The farmers, processors and exporters are recommended to adopt hot air drying technique developed by Junagadh Agricultural University for preparing of guava powder by drying of fresh guava slices (3 mm thick) pretreated with 1 % $CaCl_2$ + 2 % Potassium Meta bi Sulphate (KMS) solution for 10 minutes at 60 ^{0}C drying air temperature and 1.25 m/s air velocity in drying period of 17 hours. The powder prepared by this method can be stored up to 80 days at room temperature by packing in 50µ polyethylene bag at a vacuum level of 700 mm Hg.

44. Preparation of custard apple powder by freeze drying methods

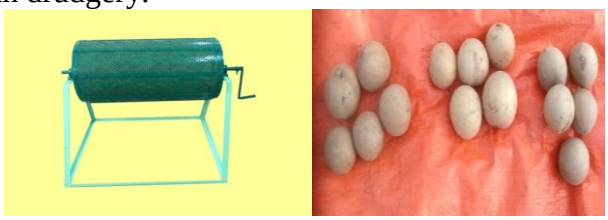
The processors and exporters are recommended to adopt freeze drying technique developed by Junagadh Agricultural University for preparing custard apple powder by freeze drying of fresh custard apple pulp (1.5 kg) pretreated with 5 % maltodextrine at -40 ^{0}C temperature with a drying period of 41 hours. The custard apple powder obtained by this method has better product quality and could be stored up to 90 days at room temperature when packed in 50 µ polyethylene bag at a vacuum level of 700 mm Hg.

45. Extraction of enzymes from potato peels substrate using *bacillus* group of bacteria

Potato processors and entrepreneurs are recommended to adopt a process technology developed by Junagadh agricultural university for the production of Alpha-amylase and protease enzymes through microbial and biochemical methods from bio waste (potato peel) using *Bacillus subtilis* bacteria. This process is beneficial (BCR 7.54:1) as compared to readymade available enzymes in market.

46. Manually operated sapota cleaner

The farmers growing sapota are recommended to use hand operated sapota cleaner developed by Junagadh Agricultural University (capacity: 120 kg/h) having perforated metal sheet drum (45 cm diameter and 90.5 cm length) lined with jute cloth on inner surface and be operated at 65 rpm for 90 seconds with 66 % free space (in batch) for cleaning and shining the sapota surface after harvesting to reduce human drudgery.



(*Department of Processing & Food Engineering, CAET, JAU, Junagadh*)

47. Tractor drawn plant thinning device for row crops

The farmers and manufacturers are recommended to use mini tractor drawn JAU developed two row plant thinning device for maintaining plant spacing of 10 to 12 cm for small seed crops like pearl millet and sesamum. High thinning efficiency can be achieved using this device. As compared to manual thinning, approximately 70 % man-hours/ha can be saved.


(*Department of Farm Machinery & Power Engineering, CAET, JAU, Junagadh*)

48. Watershed development activities conducted in dark zone area of Junagadh district

The Planners, Designers, NGOs, Field Officers, and Government Departments of Junagadh district are recommended to use below given daily rainfall-runoff prediction equations for estimating daily runoff which are derived by JAU Junagadh using practically derived SCS Curve number (73.03) and adopting Remote Sensing approach. The groundwater contribution for the district can be taken as 12.67 % of the above estimated runoff for efficient watershed planning. Additionally the updated Land Capability Classification for Ozat catchment in Junagadh can be taken as provided in the below table.

A) Rainfall – Runoff Relationships for Ozat Catchments (Daily basis)

SN	Catchment Name	Rainfall (x) – Runoff (y) Equation*	R^2
1	Ambajal Catchment	y = 0.6403x - 11.459	0.9237
2	Motagujariya Catchment	y = 0.4599x - 5.9043	0.8317
3	Zanjeshri Catchment	y = 0.5525x - 7.7979	0.8971
4	Dhrafad Catchment	y = 0.5748x - 8.2758	0.8706
5	Ozat Weir-2 Catchment	y = 0.366x - 3.4271	0.7299
6	Ozat Weir-Shapur Catchment	y = 0.4994x - 5.9403	0.8571
7	Ozat Weir-Vanthli Catchment	y = 0.459x - 5.1273	0.8493
8	Ozat River Catchment	y = 0.5366x - 7.3009	0.8591

* Rainfall and Runoff are in mm

B) Updated Land Capability Classification for Ozat Catchment

Sr. No	Particular	Area, km²	Percent (%)	Remark
1	CLASS - I	975.34	69.22	Cultivable land
2	CLASS - Il	7.67	0.54	
3	CLASS - IV	131.16	9.31	
4	CLASS - V	14.42	1.02	Uncultivable land
5	CLASS - VI	233.12	16.54	
6	Village	20.52	1.46	
7	River, Reservoir	26.93	1.91	
	Total	1409.16	100.00	

(*Department of Soil & Water Conservation Engineering, CAET, JAU, Junagadh*)

49. Geometry of wetting pattern under trickle irrigation

The following three models developed by JAU can be used to decide the lateral and emitter spacing in drip irrigation design for a particular emitter discharge in loamy soil.

Case: a) If moisture data before irrigation is not monitored

Planners Designers, NGO's, Field officers and Govt. Departments are recommended to use the following expression for determining the wetting dimensions if moisture information is not available

$$W = 0.516\ V^{0.393}\,(K_s / q)^{0.062} \qquad (R^2 = 0.983)$$

$$Z = 0.069\ V^{0.303}\,(K_s / q)^{-0.060} \qquad (R^2 = 0.965)$$

Where W = Diameter of wetted spread on the ground surface, *m*; q= emitter discharge in lph; V = volume of water application, *l*, and K_s = saturated hydraulic conductivity, *m/sec*; and Z= depth of wetting front below the emitter, *m*.

Case: b) If moisture data before irrigation is monitored then

The Planners Designers, NGO's, Field officers and Govt. Departments are recommended to use the following expression for determining the wetting dimensions if moisture information is available

$$R = \Delta\theta^{-452.978}\ v^{0.393}\ q^{-0.062}\ K_s^{-17352.497} \qquad (R^2 = 0.983)$$

$$Z = \Delta\theta^{-439.643}\ v^{0.303}\ q^{0.060}\ K_s^{-16840.965} \qquad (R^2 = 0.965)$$

Where R = Radius of wetted spread on the ground surface, *cm*; q= emitter discharge in *ml/h*; V = volume of water application *ml*; and K_s = saturated hydraulic conductivity, *cm/h*; and Z= depth of wetting front below the emitter, *cm*.

Case: c) If time of application is mentioned

The Planners Designers, NGO's, Field officers and Govt. Departments are recommended to use revised Debral (2012) model for greater accuracy for determining the wetting dimensions if time of irrigation is known:

$$W = 15.081\ t^{0.418}\ q^{0.448}\ K_s^{0.091} \qquad (R^2 = 0.960)$$

$$Z = 27.185\ t^{0.303}\ q^{0.363}\ K_s^{0.174} \qquad (R^2 = 0.965)$$

Where W= Diameter (*m*); q = emitter discharge cumec; t = time of application sec; Ks = saturated hydraulic conductivity, *m/sec*; Z = depth of wetting front below the emitter (*m*).

(*Research, Testing & Training Center, JAU, Junagadh*)

Year: 2014-15

50. Impact of irrigation regimes and mulching on the economic productivity of drip irrigated cotton

Farmers of South Saurashtra Agro-climatic Zone growing Bt. Cotton are advised to adopt drip irrigation (with 1.2 m lateral spacing, 40 cm dripper spacing and emitter discharge of 2 lph) in raised bed covered with silver black plastic mulch of 20 micron and irrigate every alternate day at 0.8 ET_c level (or to operate system for 2 to 3.5 hrs, 2.25 to 3.25 hrs and 1.25 to 3 hrs during September-October, November-December and January, respectively) for acquiring higher yield (33 %), water use efficiency (79 %), higher water productivity (91 %) and higher net return over no mulch.

(*Research, Testing & Training Center, JAU, Junagadh*)

51. Extraction of pectin from kesar mango peel by resins

Mango processors are recommended to adopt a process technology developed by Junagadh Agricultural University for the production/extraction of pectin from mango peel using cation exchange resin as an extracting medium with peel to extracting medium ratio of 1:4, extraction pH of 2.56, extraction temperature of 80 °C, extraction time of 60 min and two extractions. This method can give better yield and quality of pectin with benefit cost ratio (BCR) of 1.17.

(*Department of Processing and Food Engg., CAET, JAU, Junagadh*)

52. Low cost greenhouse fertigation system

The greenhouse / net house growers are advised to use low cost greenhouse fertigation system developed by Junagadh Agricultural University to apply fertilizer through drip irrigation as well as interested manufacturers are recommended for manufacturing this system.

53. Microclimate and plant growth of capsicum under different type of shade net

The farmers of South Saurashtra Agro-climatic Zone are recommended to adopt white coloured 50 per cent shade net house for cultivation of capsicum. This type of net house results in early production approximately 10-12 days, protection from insects/pests, diseases and higher yield of capsicum as compared to use of green, black and blue coloured shade net house.

54. Effect of mulch and irrigation level by drip on water use efficiency and yield of water melon

The farmers of South Saurashtra Agro-climatic Zone are advised to use silver black plastic mulch (20 µm) with drip irrigation at 0.6 ETc level to achieve higher crop production of water melon in summer season.

Details of mulching technology :		**Details of irrigation system :**	
1	Mulch film: 20 µm silver black plastic	1	Lateral spacing : 180 cm
2	Bed size: (a) Top width : 40 cm (b) Bottom width : 70 cm (c) Height : 30 cm	2 3 4	Dripper spacing : 40 cm Dripper discharge : 2 lph Irrigation scheduling :
3	No. of row per bed : 2		Feb. : 20 to 45 min/day
4	Spacing : (a) Bed spacing : 180 cm (b) Row spacing : 20 cm (c) Plant spacing : 40 cm		March: 30 to 95 min/day April : 70 to 105 min/day May : 70 to 90 min/day

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

Year: 2015-16

55. Evaluation of different mulches for sapota crop under drip irrigation

Farmers of South Saurashtra Agro-climatic Zone growing sapota (Kalippati) are advised to adopt drip irrigation (2 drippers per plant up to 2 years and after that 4 dripper per plant, dripper discharge of 4 lph) covered with black plastic mulch of 100 micron and irrigate every alternate day at 0.6 IW/ET_c (or apply water 14, 34, 48, 34, 8, 11 and 9 liters per day per plant during January-February, March-April, May, June, July-August, September-October and November-December, respectively) for acquiring higher yield and net return of sapota over no mulch.

(Research, Testing & Training Centre (RTTC), JAU, Junagadh)

56. Preparation of extruded products from flour of amaranth grain, sago and defatted groundnut

Food processors are advised to prepare quality cold extruded pasta by blending defatted groundnut flour, amaranth flour and sago flour (as a binder) in the ratio of 20, 70 and 10 % respectively followed by sun drying for 14 hours in summer months or in solar cabinet dryer for 1 hour at 55 ^{0}C. The product can be stored in transparent polyethylene (LDPE) bags of 75 micron to retain the good quality at least up to two months of storage period.

57. Power operated sapota cleaner

The farmers are recommended to use power operated sapota cleaner developed by Junagadh Agricultural University for cleaning and shining sapota surface after harvesting. This machines saves 90 per cent cost of cleaning as compared to manual cleaning. Machine capacity is 575 kg/hr.


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

58. Effect of different structures on protection of cumin crop against adverse climate

The farmers of South Saurashtra Agro-climatic Zone are recommended to adopt plastic (LDPE-50 micron) low tunnel (sing tunel size: 4 x 2 x 1 m) covered with 30 % shade net at both the ends for cultivation of cumin. This type of structure protects the crop from adverse climate, insects/pests, diseases and results in better quality and higher yield of cumin. It can be used for seed production also.

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

Year: 2016-17

59. Tractor mounted rural transporter

Farmers are recommended to use tractor mounted "JAU Rural Transporter" for carrying up to 500 kg live/dead load for better safety and fatigue reduction as compared to carrying on tractor mudguard or trailer. Rural transporter is also released for commercial exploitation.


(*Department of Farm Machinery & Power Engineering, CAET, JAU, Junagadh*)

60. Protected environment for off-season seedling raising of Papaya

The farmers of South Saurashtra Agro-climatic Zone interested to raise papaya seedling in protected structure are advised to use poly-cum-shade net house covered with 50 % white shade net on periphery and roof covered with 200 micron UVS polyethylene sheet.

61. Evolvement of mulching technology for bunch type groundnut crop

The farmers of South Saurashtra Agro-climatic Zone are advised to use silver black plastic mulch (20 µm) with drip irrigation and raised bed for water saving and to achieve higher yield of bunch type groundnut in summer season.

	Details of mulching technology
1	Mulch film: 20 µm silver black plastic
2	Bed size: (a) Top width: 75 cm (b) Bottom width: 90 cm (c) Height: 20 cm
3	No. of rows per bed : 3
4	Spacing: (a) Bed spacing :120 cm (b) Row spacing: 20 cm (c) Plant spacing: 20 cm

	Details of drip system
1	No. of laterals / bed : 2
2	Lateral spacing: 20 cm
3	Dripper spacing: 40 cm
4	Dripper discharge: 2 lph
5	Irrigation scheduling : a. Feb.: 10 to 15 min/day b. March: 30 to 35 min/day c. April: 40 to 45 min/day d. May: 55 to 60 min/day

(*Department of Renewable Energy Engineering, CAET, JAU, Junagadh*)

62. Aquifer mapping of Uben river basin

The farmers, NGOs and line department's people are advised to construct ground water recharge structures and shaft recharging technique for augmenting ground water resources around the area starting from Sakkarbaugh, Vadal, Choki, Makhiyala up to Fareni keeping in view the higher horizontal, vertical hydraulic conductivity and transmissibility of unconfined/ confined aquifer. The surface water harvesting structures should be encouraged for augmenting the surface water resources in rest parts of the Uben basin.

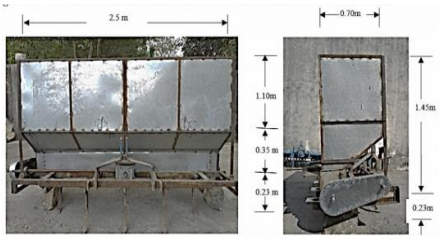
(*Department of Soil & Water Conservation Engineering, CAET, JAU, Junagadh*)

63. Conjunctive effect of emitter configuration and irrigation regimes on productivity of cumin

Farmers of South Saurashtra Agro-climatic Zone growing cumin are advised to adopt drip irrigation with triangular geometry having 0.6 m lateral spacing and 2 lph emitter discharge and to irrigate at 4 days interval with 0.8 IW/ETc (2 hours) for acquiring higher yield (38 %), water use efficiency (60.95 %), water productivity (61 %) and net return (38.87 %) as compared to farmers' practices.

64. Tractor operated FYM applicator

Tractor operated Farm Yard Manure applicator developed by Junagadh Agricultural University is recommended for farmers' use and for commercial exploitation to apply FYM at desired row spacing within furrow as per requirement. It saves time and economical as compared to manual FYM application.



(Research, Testing & Training Center, JAU, Junagadh)

65. Rain water management for sustaining cotton productivity in medium black soils under dry farming conditions

The farmers of North Saurashtra Agro-climatic Zone growing Bt. cotton are advised to apply FYM @ 10 t/ha and kaolin @ 4 % spray (400 g/10 liter water) at dry spell for obtaining higher productivity and maximum net returns as well as for getting maximum rain and crop water use efficiency under dry farming conditions.

66. Rainwater management for sustaining groundnut productivity in medium black soils under dry farming conditions

The farmers of North Saurashtra Agro-climatic Zone growing groundnut (GG 20) are advised to apply FYM @ 10 t/ha and kaolin @ 4 % spray (400 g/10 liter water) at dry spell for obtaining higher productivity and net returns as well as maximum rain and crop water use efficiency under dry farming conditions.

(Main Dry Farming Research Station, JAU, Targhadia)

Year: 2017-18

67. Enzymatic pre-treatment in the processing of pigeon pea

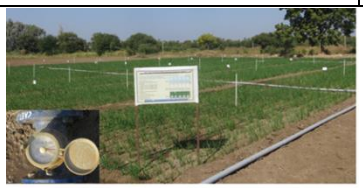
The pulse processing entrepreneurs are recommended to give enzymatic pre-treatment at specific concentration, time and temperature to get higher recovery and to reduce the dhal making time.


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

68. Irrigation scheduling of wheat under high discharge drip irrigation

Farmers of South Saurashtra Agro-climatic Zone growing wheat in medium black soil are recommended to adopt the drip irrigation system having spacings of 1.8m lateral to lateral and 1m emmiter to emmiter of 14 liters per hour to irrigate at 150 cbar soil moisture tension to get higher net return with 21.04 % water saving and 4 % energy saving. For this, farmers are advised to irrigate the crop with following schedule.

Month	Number of Irrigation	Time of operation	Irrigation Interval
November	1	Flood irrigation	Post sowing
December	3	4 hours and 45 minute	10 Days
January	5	3 hours and 40 minute	6 Days
February	3	5 hours and 40 minute	9 Days

69. Evaluation of on stream check dam groundwater recharge technique for Junagadh region

It is recommended to farmers, NGOs and line departments of Government on-stream check dam groundwater recharge technique is a cost effective groundwater recharge technique. In Junagadh region, it results 0.15 cum groundwater recharge per square meter of catchment area at the cost of ₹ 1.02 per cum as per prevailing cost.

70. Evaluation of groundwater recharge basin technique for Junagadh region

It is recommended to farmers, NGOs and line departments of Government that recharge basin is a cost effective recharge technique. In Junagadh region, it results in recharge about 0.13 cum. groundwater per square meter of catchment area at the cost of ₹ 0.27 per cum.

71. Evaluation of roof water harvesting recharge technique for Junagadh region

It is recommended to citizens, farmers, NGOs and line departments of Government that roof water harvesting is an effective groundwater recharge technique. In Junagadh region, it results in groundwater recharge of 0.22 cum out of potential runoff of 0.73 cum per sq. m of roof area, which may be done through tube well recharge and remaining 0.51 cum may be stored in a sump with a cost of ₹ 34 per cum at prevailing cost. The annual runoff coefficient of 0.71 for roof top is recommended for designing the roof water harvesting system.

72. Estimation of irrigation demand for different crops of ozat river basin using remote sensing and GIS

The irrigation department and planners of Ozat river basin are recommended that based on remote sensing technology, 9 irrigations should be applied for wheat crop in basin apart from pre sowing irrigation at 16, 31, 40, 50, 62, 72, 80, 89 and 96 days after sowing with irrigation depths of 33, 38, 32, 37, 45, 43, 37, 44 and 35 mm, respectively.

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

73. *In-situ* moisture conservation in rainfed stressed regions for increasing productivity of cotton crop

The farmers of North Saurashtra Agro-climatic Zone growing Bt. cotton G. Cot Hy-8 (BG-II) at the distance of 120 x 45 cm are advised to prepare ridge and furrow OR broad bed with 2 rows(180 cm width) and furrow (60 cm) at 20 days after sowing and apply plastic mulch (25 micron) OR straw mulch @ 5 t/ha at withdrawal of monsoon in the month of September (38 to 39 Std. week) for obtaining higher productivity and maximum net returns as well as maximum *in-situ* moisture conservation and rain water use efficiency under dry farming conditions.

(Main Dry Farming Research Station, JAU, Targhadia)

74. Development and performance evaluation of tractor drawn cultivator cum spiked roller

The farmers of South Saurashtra Agro-climatic Zone and manufacturers are recommended to use Junagadh Agricultural University developed tractor drawn cultivator cum spiked roller for seed bed preparation. It saves 68.31 per cent cost of operation as compared to traditional method.

(Department of Farm Engineering, CoA, JAU, Junagadh)

75. Effect of coloured plastic mulches on cultivation of tomato crop

Farmers of South Saurashtra Agro-climatic Zone are recommended to adopt silver/black or red/black plastic mulch (20 µm) with drip irrigation and raised bed for cultivation of tomato during *rabi* season. This plastic mulch diminishes the infestation of insects/pests and diseases in the crop, controls weeds and results higher crop yield and income.

(Department of Renewable Energy Engg., CAET, JAU, Junagadh)

76. Development and performance evaluation of low cost plastic mulch cum drip lateral laying machine

Tractor mounted plastic mulch cum drip lateral laying low cost machine (₹ 60,000) developed by Junagadh Agricultural University is recommended for farmers' use and for farm machinery manufacturers. It can be used for laying plastic film with width ranging from 900 to 1500 mm (3 to 5 ft.) along with two lines of drip lateral at a time. It saves about 97.23 % time and 46.03 % cost of laying plastic mulch and drip lateral as compared to conventional manual laying method.

(*Department of Farm Machinery & Power Engineering, CAET, JAU, Junagadh*)

Year: 2018-19

77. 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 µm 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****)***

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

The farmers of South Saurastra 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)

79. 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)

80. 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.

81. Enzymatic Pre-treatment in the Processing of Pigeon pea

The pulse processing entrepreneurs are recommended to give enzymatic pretreatment 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 (^{o}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)

82. 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)

Year: 2019-20

83. Design and development of a manually operated seed drill for small seeds

Farmers and manufacturers are recommended to adopt JAU developed manually operated drum seeder for sowing of small seeds (like sesame, pearl millet *etc*). The drum seeder sows 45 cm spaced two rows at a time with the effective field capacity of 0.18 ha/h. The drum seeder is found useful for precision sowing of small seeds.

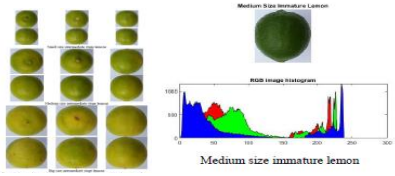
84. Development of device for dung collection from cattle shed

Animal rearer's and Gaushala owners are recommended to use 'Mini Tractor Operated Cattle Dung Collecting Device' developed by Junagadh Agricultural University. It reduces the labour requirement by 87 % with collection efficiency of about 91 % and it is also beneficial from hygiene point of view for labourers and animals.

(Department of Farm Machinery & Power Engg., CAET, JAU, Junagadh)

85. Lemon grading simulation based on image processing technique

Fruit grading machine manufacturers are recommended to adopt the image processing technique-based simulation developed by Junagadh Agricultural University, Junagadh for grading of lime (kagji) based on their size and colour. The limes can be graded in 3 x 3 different categories according to their size (small, medium and big) x maturity (immature, intermediate and mature) by applying the size and colour features of lime obtained through this simulation.



86. Design and development of on farm solar assisted dryer for drying of groundnut pods for longer storage

The farmers growing groundnuts and processors drying groundnut pods are recommended to use the solar assisted dryer developed by Junagadh Agricultural University. Use of solar assisted dryer for drying of threshed groundnut pods to reduce moisture content from 11 to 13.9 % (wb) to safer storage moisture content of 6 to 7 % (wb) using dryer condition of about 50 °C air temperature and about 0.099 m^3/s air flow in 7 to 8 hours (i.e. 1 day). Use of solar assisted dryer can reduce drying

time (7 h) to seven times less than sun drying (50 h) and reduces the post-harvest losses of groundnut pods in drying, handling, storage as compared to sun drying**.**

Details of solar assisted dryer

- Capacity of dryer : 125 kg per batch (Groundnut pods)
- Drying trays : 12 trays arranged in 6 tiers (10±0.50 kg per tray)
- Solar collectors: 8 Nos. (1 m x 2 m)
- Drying air temperature : about 50 °C
- Air flow rate: 1.0 m/s
- Blower capacity: 1.5 hp, 28 m^3/min
- Maximum increment in drying temperature: 26.9 ^{0}C to 39.8 ^{0}C
- Drying time: 7 to 8 hours

87. Forced air curing of onion

The farmers curing traditionally and storing red onion are recommended to use forced air curing at about 40 ^{0}C temperature with air flow rate about 0.24 m^3/s and without foliage onion bulb for obtaining higher quantity of marketable onion after six months of storage.

88. Development of high protein extruded product using defatted peanut flour

Snack manufacturing units are recommended to adopt a process technology developed by Junagadh Agricultural University for the preparation of extruded product by using a proportion of defatted peanut flour and corn flour as 26:74 (w/w) with the help of twin screw extruder machine to increase the protein content in Ready-to-Eat extruded products. The suggested optimum conditions to prepare extruded product using defatted peanut flour are feed moisture content: 13 % (wb), die head temperature: 135 °C, feed temperature: 60 °C, barrel temperature: 100 °C and screw speed: 250 rpm. This process can prepare the extruded product of increased protein content with desired product characteristics.

89. Preparation and storage studies of Jamun Juice

Farmers/ Food processors are advised to heat the Jamun juice at 67 ^{0}C temperature for 13 minutes and add 0.03 % (w/w) sodium benzoate at little warm state to preserve its nutrients. The Jamun juice, thus, prepared packed in 1 litre PET bottle, can safely be stored up to 30 days in the refrigerator (7 $\pm$ 2 ^{0}C).

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

90. Value addition in sesame: Standardization of technology for preparation of Sani - Jaggery based crushed sesame

Sesame producers and processers are recommended to adopt the process technology developed by Junagadh Agricultural University to prepare *sani*. The *Sani* should be prepared from black raw sesame, added with 60 % jaggery as well as 10 % shredded cashew nut and almond (1:1). Sani prepared through this method and packed in PET (Polyethylene Terephthalate) container remains safe up to 25 days of storage. This method can prepare the good quality *sani* with benefit cost ratio (BCR) of 1.51.

(Agricultural Research Station, JAU, Amreli)