



Optimum Surface Irrigation Scheduling in Crops for Increased Water Use Efficiency

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AICRP on Irrigation Water Management
ICAR-Indian Institute of Water Management
Bhubaneswar - 751023, Odisha
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PREFACE

Surface irrigation through flood irrigation is one of the common methods of irrigation largely practiced by Indian farmers. Flood irrigation causes huge water loss through evaporation and deep percolation. This indiscriminate use of water also leads to increased cost of production along with lowered crop and water productivity. Scheduling of irrigation has a substantial influence on the agronomic and economic viability of farms. Irrigation scheduling can be effectively done using improved surface irrigation methods like check basin, border strip, furrow irrigation, etc. The methods are employed according to the crop geometry and land configuration. These methods have been instrumental in the judicious application of water in the field based on crop needs. Improved yield, water use efficiency, and net profit have been associated with surface irrigation scheduling among the scientific community.

Adoption of surface irrigation scheduling by small and marginal farmers will also fulfill some of the objectives of PMKSY through enhancement of access to water on the farms, expansion of area under cultivation, distribution, and efficient use of irrigation water to make the best use through appropriate technologies and practices, and improvement of on-farm water use efficiency by reducing wastage as well as increasing water availability both in duration and extent. This would also improve the scope of irrigation in rainfed agriculture.

ICAR-Indian Institute of Water Management through AICRP on Irrigation Water Management has standardized/developed surface irrigation technologies for 53 crops in various soil types and seasons for different agro-ecological regions. Many of the irrigation schedules developed on-station have been demonstrated on farmers' fields, recommendations included as package of practices of the respective states and extended to various state government agencies as well as farmers. There is substantial improvement in crop yield, water-saving, and income enhancement with the irrigation scheduling technologies.

The authors are hopeful that this document would be a reference for state and central agricultural departments, KVKs, researchers, and farmers. Owing to the wide range of crops covered in the document, farmers may adopt the irrigation schedules for a particular crop according to their suitability.

Authors



ABBREVIATIONS

AAU	Assam Agricultural University
AER	Agro-ecological region
AGRESO	Agricultural Research Council
AICRP	All India Coordinated Research Project
ATMA	Agricultural Technology Management Agency
CPE	Cumulative pan evaporation
CS	Continuous submergence
DADPW	Days after disappearance of ponded water
DAS	Days after sowing
FIRBS	Furrow Irrigated Raised Bed System
FP	Farmers' practice
IW	Irrigation water
KAU	Kerala Agricultural University
KVK	Krishi Vigyan Kendra
ORP	Operation Research Project
PE	Pan evaporation
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
POP	Package of Practice
PVC	Polyvinyl chloride
RRA	Rapid Rural Appraisal
SAU	State Agricultural University
SCSP	Schedule Caste Sub Plan
SLREC	State Level Research and Extension Council
SRI	System of Rice Intensification
WUE	Water use efficiency
ZAREC	Zonal Agricultural Research and Extension Council

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INTRODUCTION

Agriculture sector is the major water user in India and it accounts for more than 80% of country's freshwater resources. Surface irrigation system is one of the common methods of irrigation employed by the farmers. Flood irrigation largely practiced by the farmers cause huge water loss through evaporation and deep percolation (Jain et al., 2019). Recent studies show that deforestation, increased population, urbanization, over-exploitation of surface and groundwater resources are causing depletion of freshwater resources in the country. According to the report of Dynamic Groundwater Resources of India- 2017 (CGWB, 2019), a total 1499 out of 6881 assessed units (blocks/ mandals/ taluks) in 2017 came under 'over-exploited' and 'critical' categories. In this context, irrigation scheduling is important for efficient and judicious use of freshwater resources.

Irrigation scheduling is a decision making process that relates to the timing and amount of irrigation water to be applied to a crop in the growing season. Irrigation scheduling requires knowledge on crop water requirements, constraints of irrigation method, limitations of the water supply system and economic viability of the irrigation method (Heermann, 1996). The purpose of irrigation scheduling is to maximize irrigation efficiency by applying the amount of water needed to replenish soil moisture to the desired level in plant root zone. Research has recognized that adoption of appropriate irrigation scheduling practices can lead to increased yields, significant water savings, improved sustainability of irrigated agriculture, and greater profit for farmers (Pereira, 1999). Appropriate irrigation scheduling practices are inter-relationships among method of irrigation, timing and amount of water applied (Pereira, 1996).

This bulletin contains the compiled research results of the irrigation scheduling trials carried out for different crops in different agro-ecological regions of the country. IW/CPE is one of the common methodologies adopted for scheduling of surface irrigation system. The cumulative pan evaporation (CPE) value is fixed based on the irrigation water depth (IW) and pre-determined IW/CPE ratio. Once the CPE value is reached, surface irrigation of fixed IW depth is applied to the crop. The suitable irrigation schedules can contribute towards achievement of higher irrigation performance that involves improved potential of crop in terms of productivity, water use efficiency and profit generation. Thus the combined effect of irrigation method and irrigation scheduling can be a major factor for influencing agronomic and economic viability of farms. This mainly aims at optimizing water saving while maintaining potential growth and yield of crops.

Since the inception of All India Coordinated Research Project (AICRP) on Irrigation Water Management (earlier known as AICRP on Water Management) in 1967, the scheme has been pioneer in conducting irrigation scheduling trials in different crops across the country. Fourteen agro-ecological regions covering 17 states have been covered under the scheme in the last 50 years. The scheme aimed to i) optimize irrigation schedules of popular crops grown in different states as a part of water management technology, ii) maximize water use efficiency while maintaining yield of crops particularly under limited water supply conditions. It was noticed that farmers at the tail reach of canal command systems received delayed and deficient water supplies, while those in upper reach used water wastefully. AICRP on Irrigation Water Management made interventions to see that freshwater resources are used efficiently with appropriate choice of crops, timely sowing and optimized irrigation schedules so that farmers in the middle and tail reaches of canal commands can make higher profits from their produce. Several irrigation scheduling treatments were put under trial using improved surface irrigation methods based on cumulative pan evaporation, soil moisture depletion and crop growth stage. Crop performance was compared with farmers' practice of using flood irrigation. The irrigation schedule that resulted in higher yield, water saving and higher income was put under trial in farmer's field, recommended to farmers, extended to the line departments and included in package of practices. Trainings and workshops were conducted to educate farmers about the benefits of cultivating crops with improved surface irrigation methods. Apart from this, several high value crops with optimized irrigation schedules were introduced in different agro-ecological regions of the country.

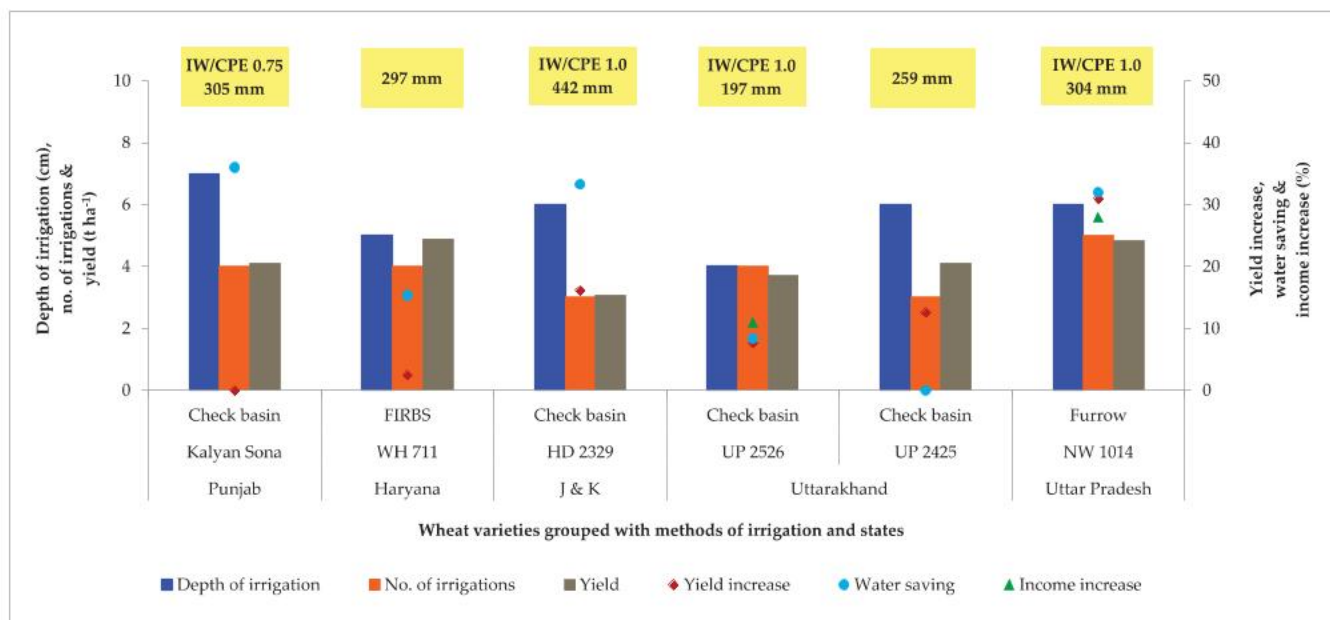
In this bulletin, effort has been made to summarize location-specific and crop-specific irrigation schedules developed at different centers of AICRP on Irrigation Water Management by employing improved surface irrigation methods. Irrigation scheduling was mostly done based on the ratio of irrigation water and cumulative pan evaporation (IW/CPE), critical crop growth stage, soil moisture depletion, alternate wetting and drying, days after disappearance of ponded water, etc. The results have been presented with respect to agro-ecological regions (AERs) of the country in tabular form. A summary paragraph has been given at the end of every table. The goal is to prepare an extensive document of the recommended surface irrigation schedules of crops that may be used as a reference by the state government's officials, extension workers and farmers for adoption and introduction of profitable crop cultivation with economic use of water.

Irrigation Scheduling in Wheat

Northern Zone

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	Kalyan Sona	Check basin	At IW/CPE 0.75. Irrigation depth: 7 cm, Irrigation interval: 1 st irrigation 3 weeks after sowing, 2 nd and 3 rd irrigations 5-6 weeks after previous irrigation, 4 th irrigation 4 weeks after previous irrigation for timely sown wheat, No. of irrigations: 4, I: 225, R: 80, T: 305.	13.44	Widely adopted throughout Punjab
Haryana	WH 711	Furrow Irrigated Ridge-till Bed-planting System (FIRBS)	Irrigation depth: 5 cm, Irrigation interval: At sowing, CRI (30 DAS), booting (70 DAS) & milking (100 DAS), No. of irrigations: 4, I: 216, R: 81, T: 297.	16.46	-
Jammu & Kashmir	HD 2329	Check basin	At IW/CPE 1.0 (after common irrigation at CRI stage) Irrigation depth: 6 cm, Irrigation interval: 12 days, No. of irrigations: 3, I: 180, R: 262, T: 442.	6.95	Technology was passed on through university ZREAC meeting. On farm trial was conducted and result was passed on to extension department of SKUAST, Jammu
Uttarakhand	UP 2526	Check basin	At IW/CPE 1.0. Irrigation depth: 4 cm, Irrigation interval: Initially at 25-30 days interval thereafter at 15-20 days interval in March-April, No. of irrigations: 3-4, I: 136, R: 61, T: 197.	18.78	Information has been extended to the state line department
	UP 2425	Check basin	Irrigation depth: 6 cm, Irrigation interval: 30-40 days (at CRI (30 DAS), booting (70 DAS), milking (100 DAS) under shallow water table condition. No. of irrigations: 3, I: 180, R: 79, T: 259.	15.83	Farmers are following this under limited water availability condition
Uttar Pradesh	NW 1014	Furrow	At IW/CPE 1.0. Irrigation depth: 6 cm, Irrigation interval: 20-25 days (at CRI, tillering, late jointing, flowering and milking stages), No. of irrigations: 5, I: 300, R: 4, T: 304.	15.89	Adopted by farmers of tubewell and canal commands

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in wheat was optimized in four agro-ecological regions of the country viz., 2, 4, 9 and 14 involving five states viz., Punjab, Haryana, J&K, Uttarakhand and Uttar Pradesh. Irrigation scheduling was done for six wheat varieties using surface irrigation methods like check basin and furrow irrigation. There was improvement in yield upto 31%, water saving upto 36% and enhancement in net return through the irrigation scheduling technologies. The technologies have been extended to state line department, and widely adopted by farmers of canal and tubewell commands of the states.

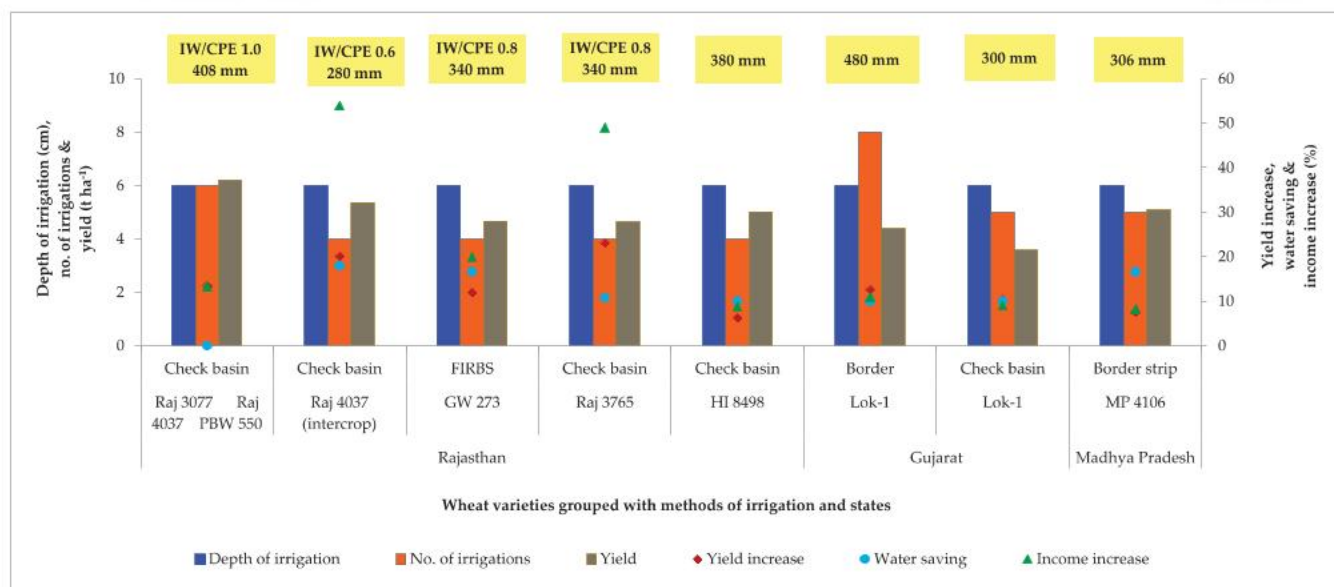


Wheat under check basin irrigation in Uttarakhand

Western Zone

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	Raj 3077 Raj 4037 PBW 550	Check basin	At IW/CPE 1.0. Irrigation depth: 6 cm, Irrigation interval: 15-30 days, No. of irrigations: 5-6, I: 370, R: 38, T: 408.	15.22	Included in POP and adopted by farmers of Rajasthan
	Wheat (Raj. 4037) intercropping with chickpea, mustard, pea, fenugreek	Check basin	At IW/CPE 0.6. Irrigation depth: 6 cm, Irrigation interval: 15-30 days, No. of irrigations: 4, T: 280.	19.18	
	GW 273	FIRBS	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 24-32 days, No. of irrigations: 4, I: 340 (including 100 mm pre-sowing irrigation), R: 0, T: 340.	13.74	Included in POP for Agroclimatic Zone-V for rabi crops
	Raj 3765	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 25-30 days, No. of irrigations: 4, I: 340 (including 100 mm pre-sowing irrigation), R: 0, T: 340.	13.65	
	HI 8498	Check basin	At 40% depletion of available soil moisture. Irrigation depth: 6 cm, Irrigation interval: 15-35 days (1st at 25-30, 2 nd at 30-35, 3 rd at 20-30, 4 th at 15-20 days interval), No. of irrigations: 4, I: 340 (including 100 mm pre-sowing irrigation), R: 40, T: 380.	13.21	
Gujarat	Lok-1	Border	Irrigation depth: 6 cm, Irrigation interval: At sowing, thereafter three irrigations at 15 days interval, and remaining at 10-12 days interval, Total no. of irrigations: 8, I: 480, R: 0, T: 480.	9.17	Demonstrated at 25 to 40 farmers' fields in coastal areas of south Gujarat
	Lok-1	Check basin	Irrigation depth: 6 cm, Irrigation interval: At sowing, thereafter three irrigations at 21 days interval, fifth at 17 days after fourth irrigation, No. of irrigations: 5, I: 300, R: 0, T: 300.	11.93	
Madhya Pradesh	MP 4106	Border strip (irrigation with 90% cut-off length)	Irrigation depth: 6 cm, Irrigation interval: 20 days (pre-sowing irrigation, thereafter at CRI, tillering, jointing, flowering and milking stages), No. of irrigations: 5, I: 300, R: 6, T: 306.	16.63	As per Rapid Rural Appraisal (RRA) data, technology adopted in over 4.6 lakh hectare in Gird, MP.

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in wheat was optimized in five agro-ecological regions of the country viz., 2, 4, 5, 10 and 19 involving three states viz., Rajasthan, Gujarat and Madhya Pradesh (MP). Irrigation scheduling was done for eight wheat varieties using surface irrigation methods like check basin, border and furrow irrigation. There was 6 to 23% improvement in yield, water saving upto 18% and 8 to 54% more income generation through the irrigation scheduling technologies. The technologies have been included in package of practices, demonstrated in farmers' fields, and adopted by farmers in the states.

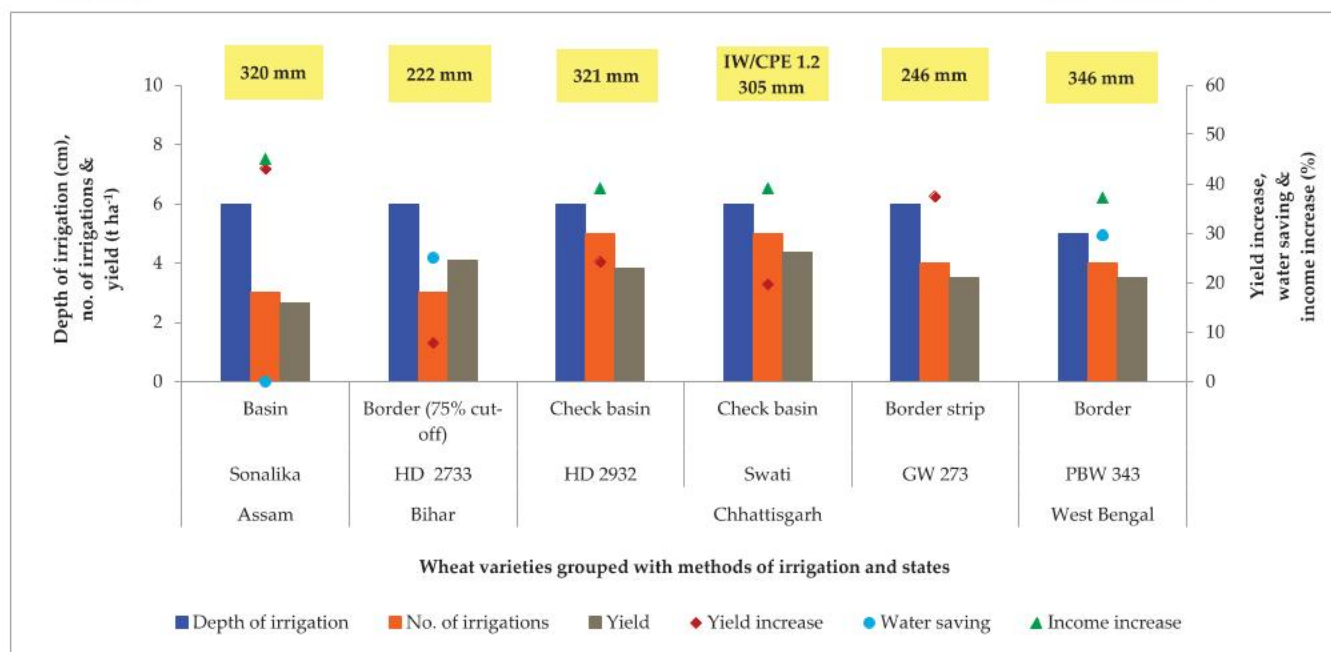


Wheat under check basin irrigation in Rajasthan

Eastern Zone

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Assam	Sonalika	Basin	Irrigation depth: 6 cm, Irrigation interval: 50 days (at 3-4 days before sowing, CRI (20-25 DAS) and heading (70-75 DAS) under upland and rainfed condition), No. of irrigations: 3, I: 180, R: 140, T: 320.	8.28	Technology approved for recommendation through POP. "POP for rabi crops of Assam 2019" published by AAU, Jorhat (Page 19-23)
Bihar	HD 2733	Border (with 75% cutoff)	Irrigation depth: 6 cm in check basin of size 40 m ² , Irrigation interval: At 25, 65 & 95 DAS, No. of irrigations: 3, I: 180, R: 42, T: 222.	18.47	-
Chhattisgarh	HD 2932	Check basin	Irrigation depth: 6 cm, Irrigation interval: 18 days (at CRI, tillering, late jointing, flowering & milking), No. of irrigations: 5, I: 300, R: 21, T: 321.	11.84	-
	Swati	Check basin	At IW/CPE 1.2. Irrigation depth: 6 cm, Irrigation interval: 18 days, No. of irrigations: 5, I: 300, R: 5, T: 305.	14.33	
	GW 273	Border strip	Irrigation depth: 6 cm, Irrigation interval: 36 days (at CRI, tillering, flowering & milking stages), No. of irrigations: 4, I: 240, R: 6, T: 246.	14.19	
West Bengal	PBW 343	Border	At 45% depletion of available soil moisture Irrigation depth: 5 cm, Irrigation interval: 12-36 days, No. of irrigations: 4, I: 193, R: 153, T: 346.	10.20	Recommended to New Alluvial Zone (NAZ) for adoption in West Bengal

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in wheat was optimized in three agro-ecological regions of the country viz., 11, 13 and 15 involving four states viz., Assam, Bihar, Chhattisgarh and West Bengal. Irrigation scheduling was done for six wheat varieties using surface irrigation methods like check basin, border strip and

furrow irrigation. There was 7 to 43% higher yield, water saving upto 29% and 37 to 45% higher income through the irrigation scheduling technologies. The technologies generated by Assam and West Bengal have been included in package of practices and recommended for Gangetic Alluvial Zone of West Bengal, respectively.

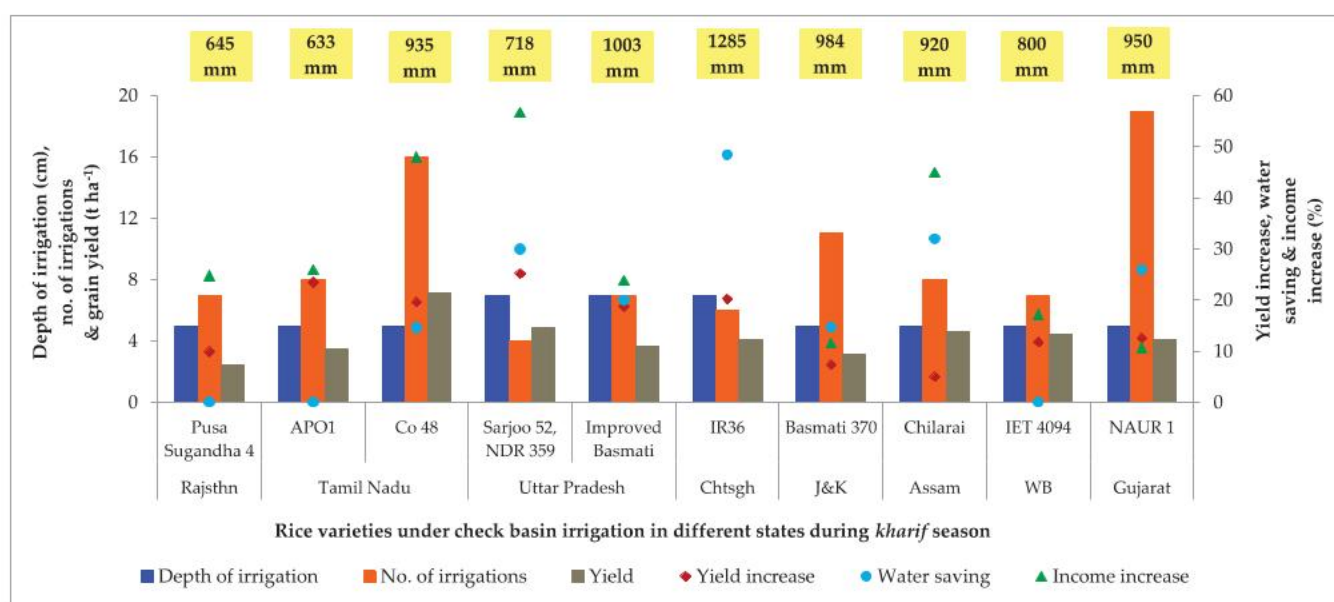
Irrigation Scheduling in Rice

Kharif Season

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha ⁻¹ mm ⁻¹)	Extension
Rajasthan	Pusa Sugandha 4	Check basin	At 100% CPE. Irrigation depth: 5 cm, Irrigation interval: 11-17 days, No. of irrigations: 7, I: 350, R: 295, T: 645	3.78	Included in the POP for kharif crops in Agro-climatic Zone V
Tamil Nadu	APO 1	Check basin	Irrigation depth: 5 cm, Irrigation interval: 4 days, No. of irrigations: 8, I: 383, R: 250, T: 633.	5.53	Demonstrated at farmers' field in Tamil Nadu
	Co 48	Check basin	Water level 15 cm below ground level up to panicle initiation stage using water tube device. Irrigation depth: 5 cm, Irrigation interval: Depending upon depletion upto 15 cm below ground level, No. of irrigations: 16, I: 819, R: 116, T: 935.	7.59	Training conducted on installing PVC water tubes in rice fields of Tamil Nadu under SCSP programme
Uttar Pradesh	Sarjoo 52 & NDR 359	Check basin	At 3 DADPW. Irrigation depth: 7 cm, Irrigation interval: As per requirement, No. of irrigations: 4, I: 280, R: 438, T: 718.	6.70	Technology being adopted by the farmers of tubewell command and Sharda Sahayak canal command in UP
	Improved Basmati	Check basin	At 3 DADPW before panicle initiation (PI) & 1 DADPW from PI to milking stage. Irrigation depth: 7 cm, Irrigation interval: As per requirement, No. of irrigations: 7, I: 490, R: 513, T: 1003.	3.60	
Chhattisgarh	IR36	Check basin	At 3 DADPW. Irrigation depth: 7 cm, Irrigation interval: As per requirement, No. of irrigations: 6, I: 420, R: 865, T: 1285.	3.20	Technology being adopted in 70% of Hirakud command area covering 1,20,000 hectares

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Jammu & Kashmir	Basmati 370	Check basin	At 1 DADPW Irrigation depth: 5 cm, Irrigation interval: As per requirement, No. of irrigations: 11, I: 434, R: 550, T: 984.	3.17	Technology passed on to state line department through ZREAC meeting of SKAUST, Jammu
Assam	Chilarai & Lachit	Check basin	At 3 DADPW. Irrigation depth: 5 cm, Irrigation interval: 6-7 days, No. of irrigations: 8, I: 400, R: 520, T: 920.	5.00	Approved for recommendation through "POP for <i>kharif</i> crops of Assam 2019" published by AAU, Jorhat
West Bengal	IET 4094	Check basin	Farmers' practice of continuous submergence. Irrigation depth: 5 cm, Irrigation interval: 2-5 days, No. of irrigations: 7, I: 350, R: 450, T: 800.	5.53	Recommended for adoption in New Alluvial Zone of West Bengal (WB-4)
Gujarat	NAUR 1	Check basin	Irrigation depth: 5 cm, Irrigation interval: 6 days, No. of irrigations: 3, I: 150, R: 800, T: 950.	4.29	Recommended to farmers of south Gujarat

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R), Irrigation interval in *kharif* is maintained when there is no intermittent rainfall



Note: Total water applied given in yellow boxes in the chart

Irrigation scheduling was done with check basin irrigation for 12 rice varieties grown during *kharif* season in six agro-ecological regions of the country viz., 5, 8, 9, 14, 15 and 19. It was found that grain yield increased from 5 to 25%, with water saving upto 48%

and 10 to 57% higher income through the irrigation scheduling technologies. Most of the technologies have been successfully extended to state line departments, included in POP, widely adopted by farmers in some of the states.



(a)



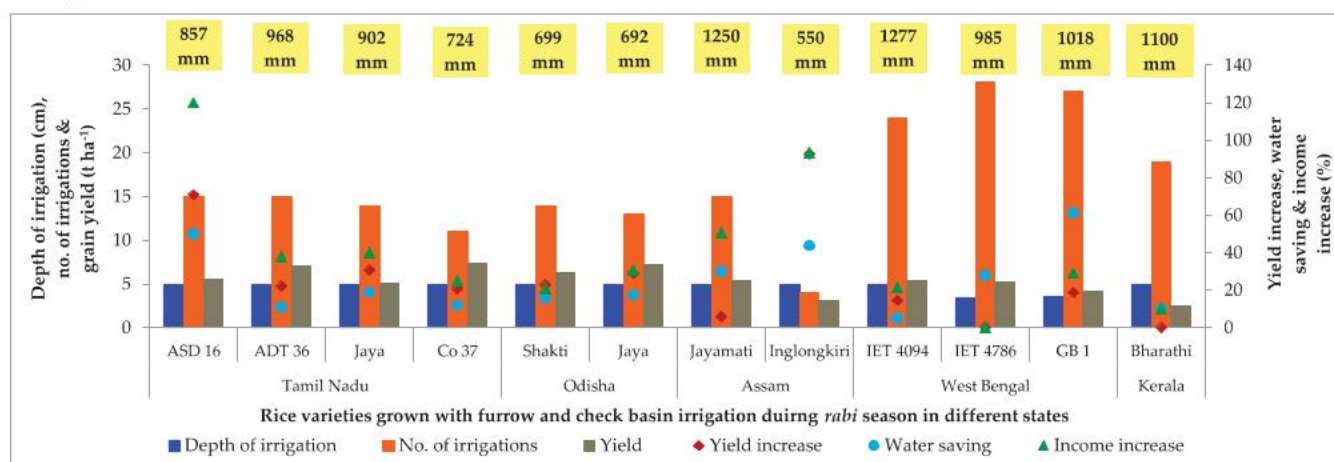
(b)

Rice under check basin irrigation in (a) Rajasthan and (b) Gujarat during *kharif* season

Rabi Season

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Tamil Nadu	ASD 16	FIRB	At 150% PE. Irrigation depth: 5 cm, Irrigation interval: 7 days, No. of irrigations: 15, I: 749, R: 108, T: 857.	6.53	Demonstrated at farmers' field in Tamil Nadu
	ADT 36	Check basin	At 1 days after disappearance of ponded water (DADPW) Irrigation depth: 5 cm, Irrigation interval: As per requirement, No. of irrigations: 15, I: 723, R: 245, T: 968.	7.33	
	Jaya	Check basin	At 1 DADPW. Irrigation depth: 5 cm, Irrigation interval: As per requirement, No. of irrigations: 14, I: 676, R: 226, T: 902.	5.65	
	Co 37	Check basin	At 1 DADPW. Irrigation depth: 5 cm, Irrigation interval: As per requirement, No. of irrigations: 11, I: 550, R: 174, T: 724.	10.22	
Odisha	Shakti	Check basin	Irrigation depth: 5 cm, Irrigation interval: 9 days, No. of irrigations: 12-13, I: 650, R: 49, T: 699.	8.87	70% of Hirakud command area having 1,20,000 ha is adopting the technologies
	Jaya	Check basin	Irrigation depth: 5 cm, Irrigation interval: 9 days, No. of irrigations: 12-13, I: 650, R: 42, T: 692.	10.40	
Assam	Jayamati	Check basin	At 3 DADPW. Irrigation depth: 5 cm, Irrigation interval: 6-7 days, No. of irrigations: 15, I: 750, R: 500, T: 1250.	4.29	Technology approved for recommendation through state POP i.e. "Package of practices for rabi crops of Assam, 2019" and "Package of practices of field and horticultural crops, 2019" published by AAU, Jorhat
	Inglongkiri	Check basin	At 20-25% depletion of available soil moisture. Irrigation depth: 5 cm, Irrigation interval: 12-13 days, No. of irrigations: 4, I: 200, R: 350, T: 550.	5.73	
West Bengal	IET 4094	Check basin	Irrigation depth: 5 cm, Irrigation interval: 3 days, No. of irrigations: 24, I: 1200, R: 77, T: 1277.	4.24	Recommended to New Alluvial Zone (WB-4) for adoption
	IET 4786	Check basin	Alternate wetting and drying. Irrigation depth: 3.0-3.3 cm, Irrigation interval: 3 days, No. of irrigations: 27-30, I: 900, R: 85, T: 985.	5.32	
	Gontra Bidhan 1	Check basin	Arsenic laden groundwater irrigation with alternate wetting and drying. Irrigation depth: 3.2-3.5 cm, Irrigation interval: 3 days, No. of irrigations: 25-28, I: 885, R: 133, T: 1018.	4.05	
Kerala	Bharathi	Check basin	Irrigation depth: 5 cm, Irrigation interval: 6 days, No. of irrigations: 19, I: 950, R: 150, T: 1100.	2.30	Adopted by Department of Agriculture, Kerala; also included in "POP recommendation of KAU 2016"

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R); FIRB, Furrow Irrigated Raised Bed



Note: Total water applied given in yellow boxes in the chart

Irrigation scheduling was done with improved surface irrigation methods like check basin and furrow irrigation for 12 rice varieties grown during *rabi* season in four agro-ecological regions of the country viz., 8, 12, 15 and 19. It was found that grain yield increased upto 93%, with 5 to 61% water saving and upto 120% higher income through the irrigation scheduling technologies. Most of the technologies have been successfully extended to line departments, included in POP, with farmers' adoption in some of the states.

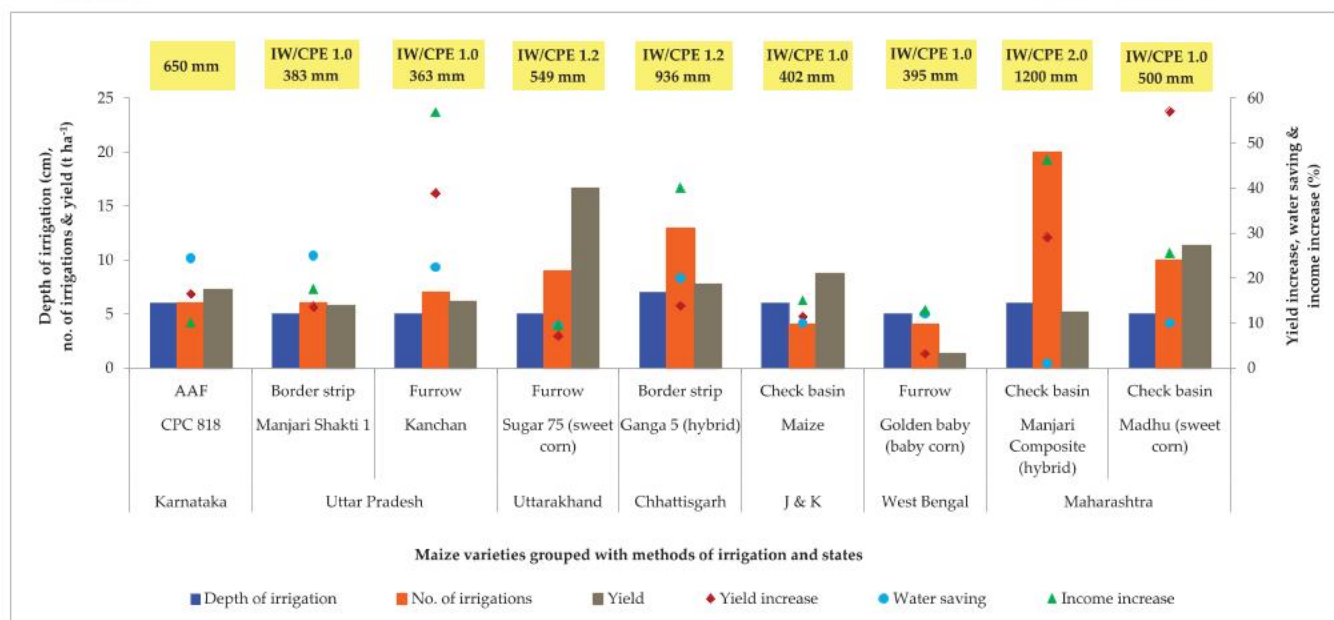


Rice under check basin irrigation in
Tamil Nadu during *rabi* season

Irrigation Scheduling in Maize

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Karnataka	CPC 818	Alternately alternate furrow (AAF)	At IW/CPE 1.0. Irrigation depth: 6 cm, Irrigation interval: 12-15 days, No. of irrigations: 5-6, T: 650 mm.	11.11	Demonstrated in farmers' fields of north Karnataka
Uttar Pradesh	Manjari Shakti 1	Border strip	At IW/CPE 1.0. Irrigation depth: 5 cm, Irrigation interval: 20 days, No. of irrigations: 6, I: 300, R: 83, T: 383.	15.01	Adopted by farmers of tubewell command of Uttar Pradesh
	Kanchan	Furrow	At IW/CPE 1.0, with rice straw mulch. Irrigation depth: 5 cm, Irrigation interval: 10 days, No. of irrigations: 7, I: 350, R: 13, T: 363.	16.78	
Uttarakhand	Sugar 75 (sweet corn)	Furrow	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 15 to 20 days in February-March, 10 days in April, 7 to 8 days in May, No. of irrigations: 8-10, I: 508, R: 41, T: 549.	30.24	Recommended to state extension and line department
Chhattisgarh	Ganga 5 (hybrid maize)	Border strip	At IW/CPE 1.2. Irrigation depth: 7 cm, Irrigation interval: 9 days, No. of irrigations: 13, I: 910, R: 26, T: 936.	8.24	-
Jammu & Kashmir	Maize	Check basin	At IW/CPE 1.0 (after one pre- & one post-sowing irrigation). Irrigation depth: 6 cm, Irrigation interval: 8 days, No. of irrigations: 4, I: 360, R: 42, T: 402.	21.64	Technology passed on through ZREAC meeting of SKAUST, Jammu
West Bengal	Golden baby (baby corn)	Furrow	At IW/CPE 1.0. Irrigation depth: 5 cm, Irrigation interval: 15-17 days, No. of irrigations: 4, I: 200, R: 195, T: 395.	3.39	Recommended for adoption in New Alluvial Zone (WB-4) of West Bengal
Maharashtra	Manjari Composite (hybrid maize)	Check basin	At IW/CPE 2.0. Irrigation depth: 6 cm, Irrigation interval: 4-6 days, No. of irrigations: 20, I: 1200, R: 0, T: 1200.	4.33	Recommendation provided through state agriculture department of Maharashtra
	Madhu (sweet corn)	Check basin	At IW/CPE 1.0. Irrigation depth: 5 cm, Irrigation interval: 10 days, No. of irrigations: 10, I: 500, R: 0, T: 500.	22.80	

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Surface irrigation scheduling was optimized for maize crop in four agro-ecological regions of the country viz., 9, 11, 14 and 15 involving six states. Optimized irrigation scheduling for seven maize varieties including hybrid maize, fodder maize, sweet

corn, baby corn using surface irrigation methods was developed. There was 3.2 to 57.0% increase in yield, 25% water saving, and 12 to 56% higher income as compared to farmers' practice. Most of the technologies have been successfully extended to line departments and farmers with wide adoption.



(a)



(b)



(c)



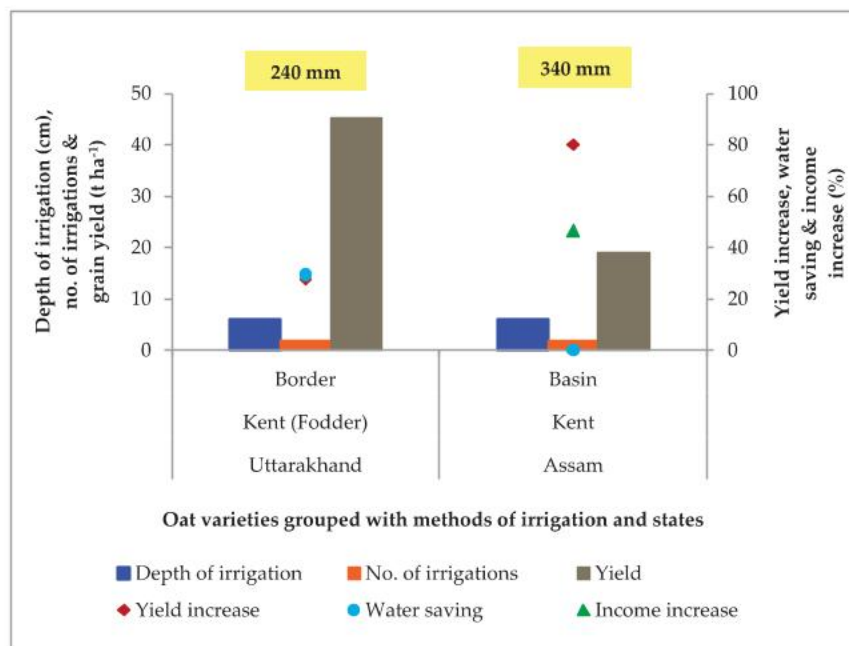
(d)

a) Sweet corn under check basin irrigation in Maharashtra, (b) sweet corn under alternate furrow irrigation in Karnataka, (c) baby corn under furrow irrigation in West Bengal, and (d) sweet corn under furrow irrigation in Uttarakhand

Irrigation Scheduling in Oat

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Uttarakhand	Kent	Border	At 25 & 60 days after planting. Irrigation depth: 6 cm, Irrigation interval: 35 days, No. of irrigations: 2, I: 120, R: 120, T: 240.	188.30	Information has been passed to line department and extension department
Assam	Kent	Basin	At 45 & 65 days after sowing in rainfed condition. Irrigation depth: 6 cm, Irrigation interval: 20 days, No. of irrigations: 2, I: 120, R: 220, T: 340.	56.00 (for green fodder)	Technology approved for recommendation through state POP. 'Package of practices for <i>rabi</i> crops of Assam, 2019" published by AAU, Jorhat in page no. 32-33.

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow boxes in the chart

Irrigation scheduling in oat crop was optimized in two agro-ecological regions *viz.*, 9 in Uttarakhand and 15 in Assam. Irrigation scheduling for one oat variety using border and basin irrigation methods resulted in yield improvement in the range of 27 to 80%, with about 30% water saving and 46.5% higher income compared to the conventional practice. The technologies have been successfully extended to line departments and farmers.

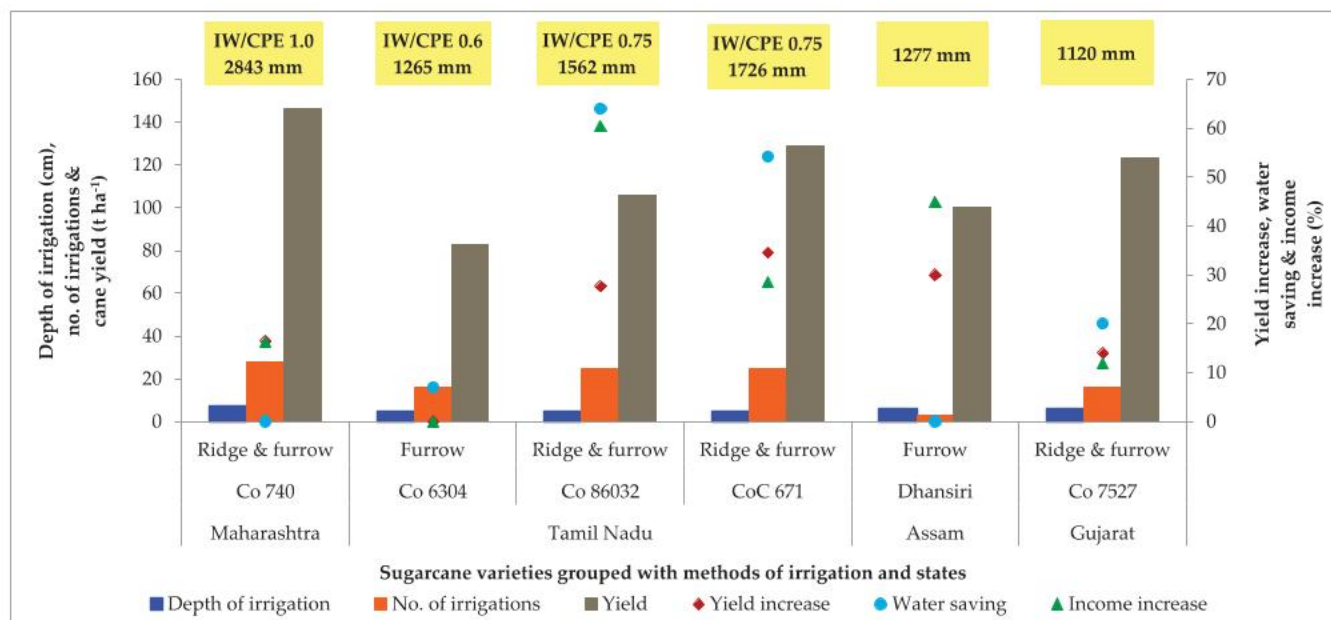


Oat under basin irrigation in Assam

Irrigation Scheduling in Sugarcane

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha ⁻¹ mm ⁻¹)	Extension
Maharashtra	Co 740	Ridge & Furrow	At IW/CPE 1.0. Irrigation depth: 7.5 cm, Irrigation interval: 10-12 days, No. of irrigations: 28 (7, 9, 10 & 2 irrigations during sprouting, tillering, grand growth & maturity stages, respectively), I: 2100, R: 743, T: 2843.	51.39	Technology was disseminated by line department and adopted by farmers of Marathwada region
Tamil Nadu	Co 6304 (Ratoon)	Furrow (Alternate furrow irrigation upto 90 days & thereafter all furrows)	At IW/CPE 0.6. Irrigation depth: 5 cm, Irrigation interval: 15 days (depending on rainfall), No. of irrigations: 16, I: 780, R: 485, T: 1265.	65.61	Cane industry has benefitted
	Co 86032	Ridge & furrow	At IW/CPE 0.75. Irrigation depth: 5.5 cm, Irrigation interval: 12-14 days, No. of irrigations: 23-25, I: 1350, R: 212, T: 1562.	67.86	Demonstrated at farmers' field. Adopted in 54 hectares in Tamil Nadu
	CoC 671	Ridge & furrow	At IW/CPE 0.75. Irrigation depth: 6 cm, Irrigation interval: 14 days, No. of irrigations: 25, I: 1500, R: 226, T: 1726.	74.56	
Assam	Dhansiri	Furrow	One irrigation each in April, October & November in alternate furrow. Irrigation depth: 6 cm, Irrigation interval: 5 months interval between first two irrigations and one month interval between 2 nd & 3 rd irrigations, No. of irrigations: 3, I: 180, R: 1097, T: 1277.	78.50	Technology approved for recommendation through state Package of Practice (POP)
Gujarat	Co 7527	Ridge & furrow	Irrigation depth: 6 cm, Irrigation interval: 20-22 days interval (DI) from December to February, 11-13 DI in March, 8-10 DI from April onwards, No. of irrigations: 16, I: 960, R: 160, T: 1120.	109.82	Over 80% farmers have adopted the recommendation

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigations schedule and total water applied given in yellow boxes in the chart

Surface irrigation scheduling of sugarcane crop was standardized in agro-ecological region no. 6, 8, 15 and 19 involving the states of Maharashtra, Tamil Nadu, Assam and Gujarat. Irrigation scheduling with improved irrigation methods like furrow and alternate furrow irrigation resulted

in higher cane yield upto 34.5%, 54.2% water saving and 60% income increase compared to farmers' practice of flood irrigation. Most of the technologies have been successfully extended to line departments, cane industry and farmers with wide adoption in the local areas.



(a)



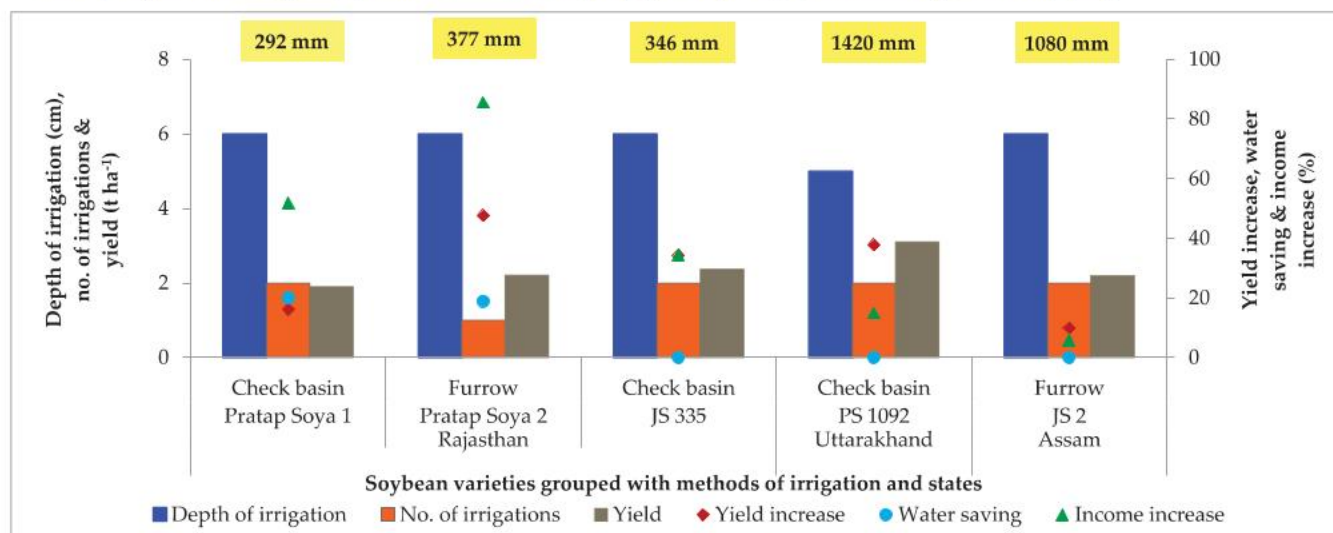
(b)

Sugarcane under ridge and furrow irrigation in (a) Gujarat and (b) Maharashtra

Irrigation Scheduling in Soybean

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	Pratap Soya 1	Check basin	At 40% depletion of available soil moisture. Irrigation depth: 6 cm, Irrigation interval: 31-38 days, No. of irrigations: 2, I: 120, R: 172, T: 292.	6.51	Included in package of practices for kharif crops in Agro-climatic Zone V
	Pratap Soya 2	Furrow	Irrigation depth: 6 cm, Irrigation interval: 15-20 days, No. of irrigations: 1 (at flowering or pod development stage), I: 60, R: 317, T: 377.	5.86	
	JS 335	Check basin	Irrigation depth: 6 cm, Irrigation interval: 30 days (at 30 & 60 DAS), No. of irrigations: 2, I: 120, R: 226, T: 346.	6.85	
Uttarakhand	PS 1092	Check basin	Irrigation depth: 5 cm, Irrigation interval: 20 days, No. of irrigations: 2 (at pre-flowering & pod development stages), I: 100, R: 1320, T: 1420.	2.18	Information has been passed on to line and extension department & farmers are following this practice
Assam	JS 2	Furrow	Irrigation depth: 6 cm, Irrigation interval: 20 days, No. of irrigations: 2 (at flowering & pod formation stages), I: 120, R: 960, T: 1080.	2.04	Technology approved for recommendation through state POP. Technology being given to state Agriculture and Horticultural Department, Govt of Assam

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow boxes

Irrigation scheduling in soybean crop was standardized in agro-ecological regions 5, 9, 14 and 15. Irrigation scheduling of five soybean varieties was optimized using check basin and furrow irrigation. Irrigation scheduling with the improved surface irrigation methods like check basin and furrow irrigation, resulted in 10 to 48% higher yield and 5.9 to 85.5% income increase compared to the farmers' practice of flood irrigation. There was water saving up to 20% for two soybean varieties grown in Rajasthan. There was no water saving for soybean crops in Uttarakhand and Assam because the crops were grown in rainfed condition during *kharif* season. Most of the technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



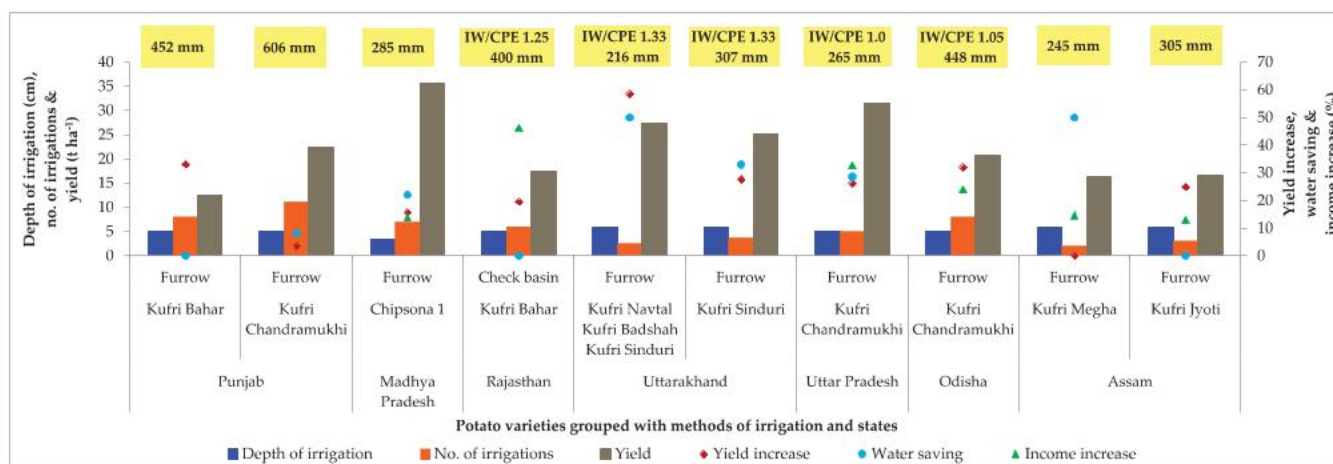
Soybean grown in broad bed furrow under furrow irrigation in Rajasthan

Irrigation Scheduling in Potato

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	Kufri Bahar	Furrow	Alternate irrigation with canal water & poor quality tubewell water (CW-TW) with plastic mulch. Irrigation depth: 5 cm, Irrigation interval: 10-14 days, No. of irrigations: 7-8, I: 400, R: 52, T: 452.	27.88	Adopted in some pockets of Punjab where groundwater is of poor quality.
	Kufri Chandramukhi	Furrow	Irrigation depth: 5 cm, Irrigation interval: 7-10 days, No. of irrigations: 11, I: 560, R: 46, T: 606.	36.96	Light irrigations are being practiced by potato growers in Punjab
Madhya Pradesh	Kufri Chipsona 1	Furrow	Irrigation depth: 3.5 cm, Irrigation interval: 10 days, No. of irrigations: 7, I: 245, R: 40, T: 285.	124.74	As per RRA data, the technology has been adopted in >4000 ha in Gird, MP
Rajasthan	Kufri Bahar	Check basin	At IW/CPE 1.25. Irrigation depth: 5 cm, Irrigation interval: 15-20 days (1 st irrigation 5-8 days interval; 2 nd irrigation 9-11 days; 3 rd irrigation 10-12 days; 4 th irrigation 12-15 days; 5 th irrigation 15-17 days & 6 th irrigation 17-20 days), No. of irrigations: 6, I: 400 (including pre-sowing irrigation 100 mm), R: 0, T: 400.	44.00	Included in package of practices of <i>rabi</i> crops for Agro-climatic Zone V of Rajasthan
Uttarakhand	Kufri Navtal, Kufri Badshah, Kufri Sinduri	Furrow	First irrigation at 25 DAS and thereafter at IW/CPE 1.33. Irrigation depth: 6 cm, Irrigation interval: 20-25 days, No. of irrigations: 4, I: 150, R: 66, T: 216.	127.31	Information has been passed to line department and extension department
	Kufri Sinduri	Furrow	At IW/CPE 1.33. Irrigation depth: 6 cm, Irrigation interval: 1st irrigation at 25 DAS, 2 nd irrigation at 45 DAS, thereafter at 20-25 days interval. No. of irrigations: 4, I: 225, R: 82, T: 307.	82.08	
Uttar Pradesh	Kufri Chandramukhi	Furrow	At IW/CPE 1.0 with 75% N. Irrigation depth: 5 cm, Irrigation interval: 15 days No. of irrigations: 5, I: 250, R: 15, T: 265.	119.06	Technology is being adopted by the farmers of tubewell command in UP
Odisha	Kufri Chandramukhi	Furrow	At IW/CPE 1.05. Irrigation depth: 5 cm, Irrigation interval: 13 days, No. of irrigations: 6-8, I: 400, R: 48, T: 448.	46.65	30% potato farmers in Odisha have adopted this technology

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Assam	Kufri Megha	Furrow	Partial root drying (PRD). Irrigation depth: 6 cm, Irrigation interval: 20 days, No. of irrigations: 2 (partial root drying at stolon, tuber formation & tuber development stages), I: 120, R: 125, T: 245.	67.14	Not brought under POP. The technology can be used under water deficit condition. It was used under world bank assisted APART project
	Kufri Jyoti	Furrow	Irrigation depth: 6 cm, Irrigation interval: 20 days, No. of irrigations: 3 (at stolon, tuber formation & tuber development stages), I: 180, R: 125, T: 305.	54.10	Technology approved for recommendation for state "Package of practices for <i>rabi</i> crops of Assam, 2019" published by AAU, Jorhat (Pg no. 71-74)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in potato crop was done for seven agro-ecological region *viz.*, 2, 4, 5, 9, 12, 14 and 15 involving seven states. Improved surface irrigation methods like furrow irrigation and check basin were employed. Irrigation scheduling with improved methods led to increased potato

yield by 60.4%, water saving by 50.0% and income increment in the range of 13.0 to 46.4% compared to farmers' practice. Most of the technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



(b)



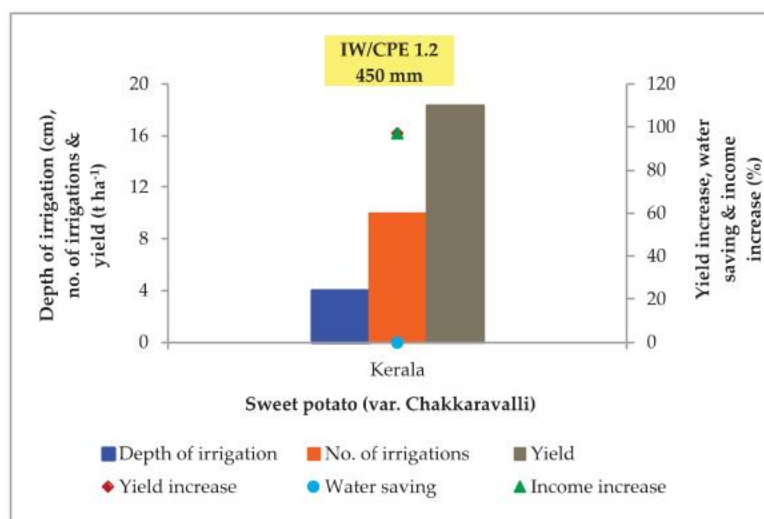
(c)

Potato under (a) check basin irrigation in Rajasthan, and furrow irrigation in (b) Uttar Pradesh and (c) Punjab

Irrigation Scheduling in Sweet Potato

State	Variety (Season)	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Kerala	Chakkaravalli (Local cultivar)	Furrow	At IW/CPE 1.2. Irrigation depth: 4 cm, Irrigation interval: 11 days, No. of irrigations: 10, I: 375, R: 75, T: 450.	40.89	Adopted by Department of Agriculture and recommended to farmers (POP recommendation of KAU)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling of sweet potato crop was standardized for agro-ecological region 19 at Chalakudy centre (Kerala) of AICRP on Irrigation Water Management. Irrigation scheduling with furrow irrigation method to sweet potato crop led to 97% higher yield and 97% higher income compared to farmers' practice.

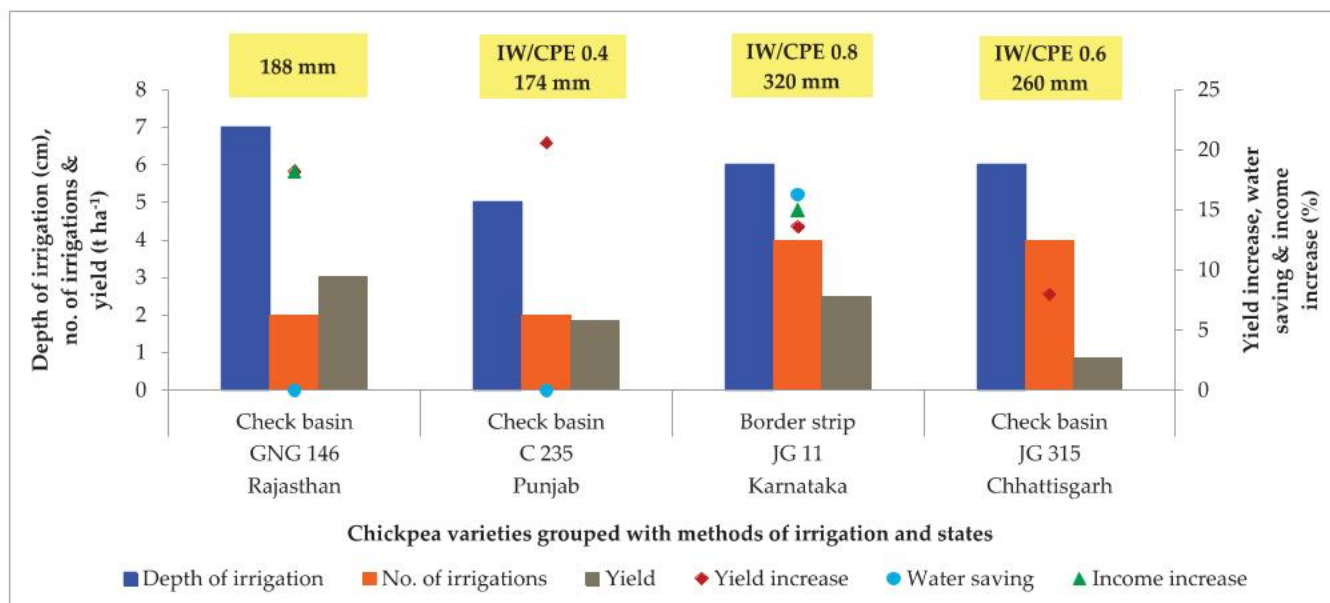


Sweet potato under furrow irrigation in Kerala

Irrigation Scheduling in Chickpea

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Adoption
Rajasthan	GNG 146	Check basin	At vegetative (50 DAS) & pod formation (130 DAS) stages. Irrigation depth: 7 cm, Irrigation interval: 50-80 days, No. of irrigations: 2, I: 140, R: 48, T: 188.	16.01	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
Punjab	C 235	Check basin	At IW/CPE 0.4. Irrigation depth: 5 cm, Irrigation interval: 8 weeks, No. of irrigations: 2, I: 100, R: 74, T: 174.	10.75	Adopted in 1700 hectares in Punjab
Karnataka	JG 11	Border strip	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 20 days, No. of irrigations: 3-4, I: 240, R: 80, T: 320	7.81	Demonstration conducted on 25 acres in farmers' field in Karnataka
Chhattisgarh	JG 315	Check basin	At IW/CPE 0.6. Irrigation depth: 6 cm, Irrigation interval: 30 days, No. of irrigations: 4, I: 240, R: 20, T: 260.	3.31	-

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for chickpea crop in agro-ecological regions 2, 4, 6 and 11 involving four states. Irrigation scheduling for four chickpea varieties was optimized using surface irrigation methods like check basin and border strip irrigation. This resulted in 8 to 20.6% increased yield, upto

16.3% water saving and upto 18.2% higher income compared to conventional practice. The technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



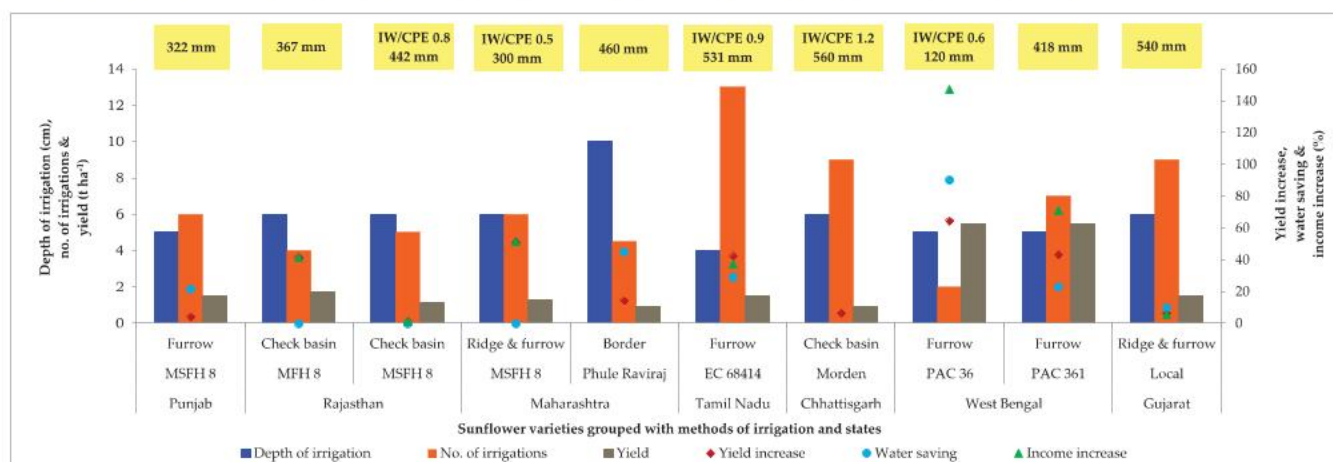
(b)

(a) Chickpea under check basin irrigation in Rajasthan and (b) border strip irrigation in Karnataka

Irrigation Scheduling in Sunflower

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	MSFH 8	Furrow	Irrigation depth: 5 cm, Irrigation interval: 10-14 days depending upon soil type and rainfall, No. of irrigations: 5-7. I: 282, R: 50, T: 332.	4.46	Adopted in Doaba belt of Punjab
Rajasthan	MSFH 8	Check basin	At 25 DAS, flowering initiation (85 DAS), complete flowering (100 DAS) & seed setting (105 DAS). Irrigation depth: 6 cm, Irrigation interval: 25, 85, 100 & 105 days after sowing (DAS), No. of irrigations: 4, I: 240, R: 127, T: 367.	4.67	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
	MSFH 8	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 20-23 days (15, 25, 45, 68 & 88 DAS), No. of irrigations: 5. I: 300, R: 142, T: 442.	2.53	
Maharashtra	MSFH 8	Ridge & Furrow	At IW/CPE 0.5. Irrigation depth: 6 cm, Irrigation interval: 7-8 days, No. of irrigations: 5, I: 300, R: 0, T: 300.	4.33	Technology was disseminated by line department and adopted by farmers of Marathwada region
	Phule Raviraj	Border	At critical growth stages i.e. seedling (15-20 DAS), bud initiation (30-35 DAS), flowering (45-50 DAS) & grain filling (60-65 DAS). Irrigation depth: 10 cm, Irrigation interval: 15-20 days, No. of irrigations: 4, I: 450, R: 10, T: 460.	2.04	Approved in the joint meeting of 4 agril. universities of Maharashtra. Technologies are passed on to line departments for dissemination to farmers
Tamil Nadu	EC-68414	Furrow	At IW/CPE 0.9 with N @ 40 kg ha ⁻¹ . Irrigation depth: 4 cm, Irrigation interval: 7 days, No. of irrigations: 13, I: 520, R: 11, T: 531.	2.84	Demonstrated at farmers' field in Tamil Nadu
Chhattisgarh	Morden	Check basin	At IW/CPE 1.2. Irrigation depth: 6 cm, Irrigation interval: 17 days, No. of irrigations: 9, I: 540, R: 20, T: 560.	1.67	-
West Bengal	PAC 36	Furrow	At IW/CPE 0.6. Irrigation depth: 5 cm. Irrigation interval: 30 days, No. of irrigations: 2, I: 100, R: 20, T: 120.	45.83	Recommended to New Alluvial Zone (WB-4) for adoption
	PAC 361 or Advanta	Furrow	At 50% available soil moisture depletion. Irrigation depth: 5 cm, Irrigation interval: 15-16 days, No. of irrigations: 7, I: 350, R: 68, T: 418.	13.11	
Gujarat	Local	Ridge & furrow	Irrigation depth: 6 cm, Irrigation interval: 1 st after sowing, 2 nd at 11 DAS, and remaining at 8 days interval, No. of irrigations: 9, I: 540, R: 0, T: 540.	2.85	Demonstrated at farmers' field in Navsari, Gujarat

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for sunflower crop in agro-ecological regions 2, 6, 8, 11, 15 and 19 involving seven states. Irrigation scheduling was done for seven sunflower varieties using surface irrigation methods like furrow, ridge and furrow, check basin and border irrigation. There was 1.34

to 51.2% increase in yield, upto 45% water saving and upto 147% increase in net return compared to the conventional practice. The technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



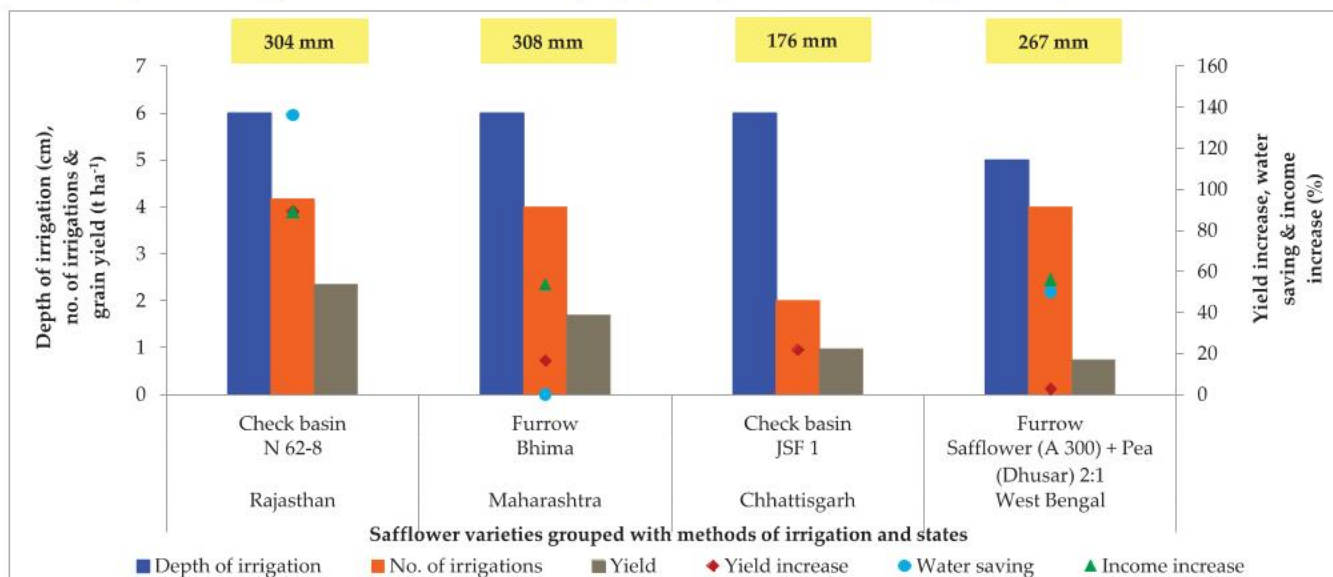
(b)

Sunflower crop under (a) furrow irrigation in West Bengal, and (b) border irrigation in Maharashtra

Irrigation Scheduling in Safflower

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	N 62-8	Check basin	Irrigation depth: 6 cm, Irrigation interval: At 35 days after sowing (DAS), 70 DAS (rosette), 100 DAS (flowering) & 165 DAS (seeding), No. of irrigations: 4, I: 250, R: 54, T: 304.	7.73	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
Maharashtra	S 4 or Bhima	Furrow	Irrigation depth: 6 cm, Irrigation interval: 15-20 days, No. of irrigations: 4, I: 240, R: 68, T: 308.	5.49	Technology was disseminated by line department and adopted by farmers of Marathwada region
Chhattisgarh	JSF-1 or Shweta	Check basin	Irrigation depth: 6 cm, Irrigation interval: 25 days, No. of irrigations: 2, I: 120, R: 56, T: 176.	5.51	-
West Bengal	Safflower (A 300) + Pea (Dhusar) intercrop with planting row ratio 2:1	Furrow	At CPE 45 mm. Irrigation depth: 5 cm, Irrigation interval: 20-30 days, No. of irrigations: 4, I: 200, R: 67, T: 267.	2.77	-

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Irrigation scheduling was optimized for safflower crop for four agro-ecological regions viz., 2, 6, 11 and 15 involving four states. Three safflower varieties were grown using surface irrigation methods like check basin and furrow irrigation. There was upto



89.2% higher yield, upto 136% water saving and 53.6 to 89.2% higher income compared to the conventional practice. The technologies have been successfully extended to line departments and farmers with wide adoption in local areas.

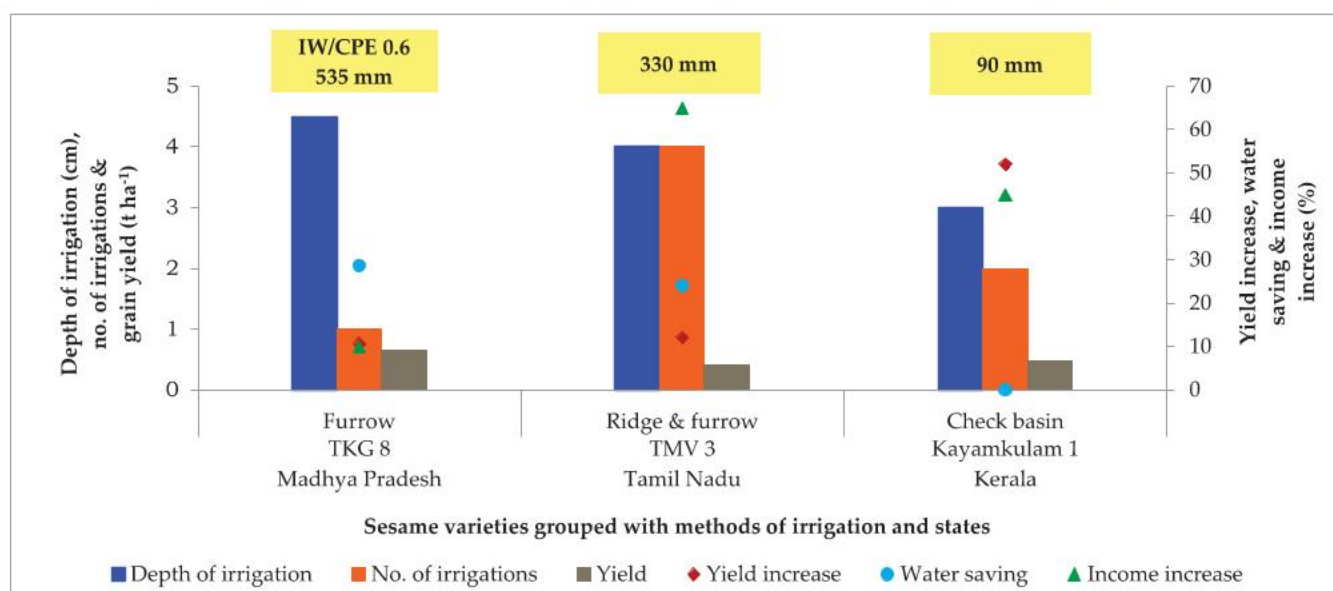


Intercrop of safflower and pea under check basin irrigation in West Bengal

Irrigation Scheduling in Sesame

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Madhya Pradesh	TKG 8	Furrow (Seeding in ridge & furrow method)	At IW/CPE 0.6. Irrigation depth: 4.5 cm, Irrigation interval: After withdrawal of monsoons, No. of irrigations: 1, I: 45, R: 490, T: 535.	1.22	As per RRA data this technology adopted in more than 6000 hectares in Gird region of Madhya Pradesh
Tamil Nadu	TMV 3	Ridge & furrow	Irrigation depth: 4 cm, Irrigation interval: As per requirement, No. of irrigations: 4, I: 160, R: 170, T: 330.	1.21	Demonstrated at farmers' field in Tamil Nadu
Kerala	Kayamkulam-1	Check basin	Irrigation depth: 3 cm, Irrigation interval: 4-6 leaf stage & flowering stage, No. of irrigations: 2, I: 60, R: 30, T: 90.	5.22	Adopted by department of Agriculture and recommended to the farmers (POP recommendation of KAU p.117)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Irrigation scheduling was optimized in sesame crop in agro-ecological regions 4, 8 and 19 covering the states of Madhya Pradesh, Tamil Nadu and Kerala. Three sesame varieties were grown using surface irrigation methods of furrow, ridge and furrow and check basin. The optimized irrigation schedules

led to 10.6 to 52.0% increase in yield, upto 28.6% water saving and 9.8 to 65.0% higher income compared to the conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



(b)

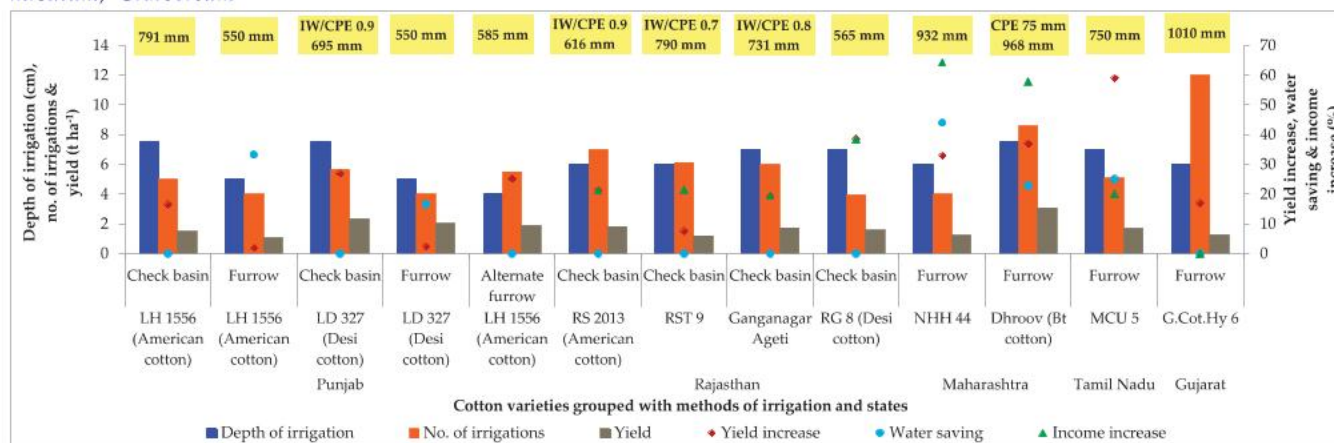
Sesame under (a) ridge and furrow irrigation in Tamil Nadu and (b) furrow irrigation in Madhya Pradesh

Irrigation Scheduling in Cotton

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	LH 1556 (American cotton [†])	Check basin	Irrigation depth: 7.5 cm, Irrigation interval: 1 st irrigation at 4-6 weeks after sowing and subsequent irrigations at 2-3 weeks interval, No. of irrigations: 5. I: 375, R: 416, T: 791.	1.87	Farmers of Punjab have started applying 1 st irrigation to cotton after 4 to 6 weeks of sowing depending upon soil type and climatic conditions
	LH-1556 (American cotton [†])	Furrow	Irrigation depth: 5 cm. Irrigation interval: 1 st irrigation at 4-6 weeks after sowing and subsequent irrigations at 2-3 weeks interval, No. of irrigations: 4. I: 200, R: 350, T: 550.	1.96	Farmers have started the practice of growing cotton on ridges owing to its multiple benefits like water saving, no crust formation at the time of sowing, water stagnation during rains, besides higher seed cotton yield
	LD-327 (Desi cotton*)	Check basin	At IW/CPE 0.9. Irrigation depth: 7.5 cm, Irrigation interval: 1 st irrigation at 4-6 weeks after sowing and subsequent irrigations at 2-3 weeks interval, No. of irrigations: 5-6. I: 425, R: 270, T: 695.	3.38	At present, there is negligible area under this crop in Punjab. The technology was extensively adopted by the desi cotton growers during 1980s and 90s.
	LD-327 (Desi cotton*)	Furrow	Irrigation depth: 5 cm, Irrigation interval: 1 st irrigation at 4-6 weeks after sowing and subsequent irrigations at 2-3 weeks interval, No. of irrigations: 4-5. I: 200-250, R: 350, T: 550-600.	3.65	
	LH-1556 (American cotton [†]), RCH 134 (Bt cotton)	Alternate furrow	Pre-sowing irrigation with canal water and subsequent irrigations with poor quality (saline-sodic) tubewell water. Irrigation depth: 4 cm, Irrigation interval: 1 st irrigation 4-6 weeks after sowing and subsequent irrigations at 2-3 weeks interval, No. of irrigations: 5-6, I: 220, R: 365, T: 585.	3.23	For judicious use of underground poor quality water, farmers are preferring ridge planting of cotton, applying pre-sowing irrigation with canal water, and alternate furrow irrigation for sustainable cotton yield

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	RS 2013 (American cotton [†])	Check basin	At IW/CPE 0.9. Irrigation depth: 6 cm, Irrigation interval: 35, 55, 75, 90, 105, 120 & 135 DAS, No. of irrigations: 7, I: 420, R: 196, T: 616.	2.97	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
	RST 9 (American cotton [†])	Check basin	At IW/CPE 0.7. Irrigation depth: 7 cm, Irrigation interval: 50, 65, 80, 96, 115 & 135 DAS, No. of irrigations: 6, I: 430, R: 360, T: 790.	1.53	
	Ganganagar Ageti	Check basin	At IW/CPE 0.8. Irrigation depth: 7 cm, Irrigation interval: At 30, 72, 94, 108, 123 & 135 DAS, No. of irrigations: 6, I: 420, R: 311, T: 731.	2.37	
	RG 8 (Desi cotton*)	Check basin	At 30 DAS, bud development & boll development stages. Irrigation depth: 7 cm, Irrigation interval: At 30, 80 & 125 DAS, No. of irrigations: 4, I: 275, R: 290, T: 565.	2.78	
Maharashtra	NHH 44 (Desi cotton*)	Furrow	Irrigation depth: 6 cm, Irrigation interval: As per requirement, No. of irrigations: 4, I: 240, R: 692, T: 932.	1.31	Technology was disseminated by line department and adopted by farmers of Marathwada region
	Dhruv (Bt cotton hybrid)	Furrow	At CPE 75 mm. Irrigation depth: 7.5 cm, Irrigation interval: 8-9 days, No. of irrigations: 9, I: 644, R: 324, T: 968.	3.18	Approved in Joint AGRESCO meet of four agril. universities of Maharashtra. These technologies have been passed on to line departments for dissemination to farmers.
Tamil Nadu	MCU 5 (American cotton [†])	Furrow	Irrigation depth: 7 cm, Irrigation interval: As per requirement, No. of irrigations: 5 (stream 1.0 L/s, slope 0.2%, length 30 m), I: 356, R: 394, T: 750.	2.27	Demonstrated at farmers' field in Tamil Nadu
Gujarat	G.Cot.Hy-6	Furrow	Irrigation depth: 6 cm, Irrigation interval: 1 st irrigation at 7 DAS, subsequent irrigations at 25 days interval (DI) from September to February and 15 DI during March-April, No. of irrigations: 12, I: 720, R: 290, T: 1010.	1.27	Over 60% farmers have adopted the recommendation in south Gujarat

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R); [†]*Gossypium hirsutum*, **G. arboreum*



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in cotton crop was done for cotton crop in agro-ecological regions 2, 4, 6, 8 and 10 involving Gujarat, Tamil Nadu, Rajasthan, Maharashtra and Punjab. Ten cotton varieties were studied with improved irrigation methods like check basin, furrow and alternate furrow irrigation, resulting

in 1.9 to 59.0% higher yield, water saving upto 44.0% and higher income upto 64.4% compared to the conventional practice. The technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



(b)



(c)



(d)

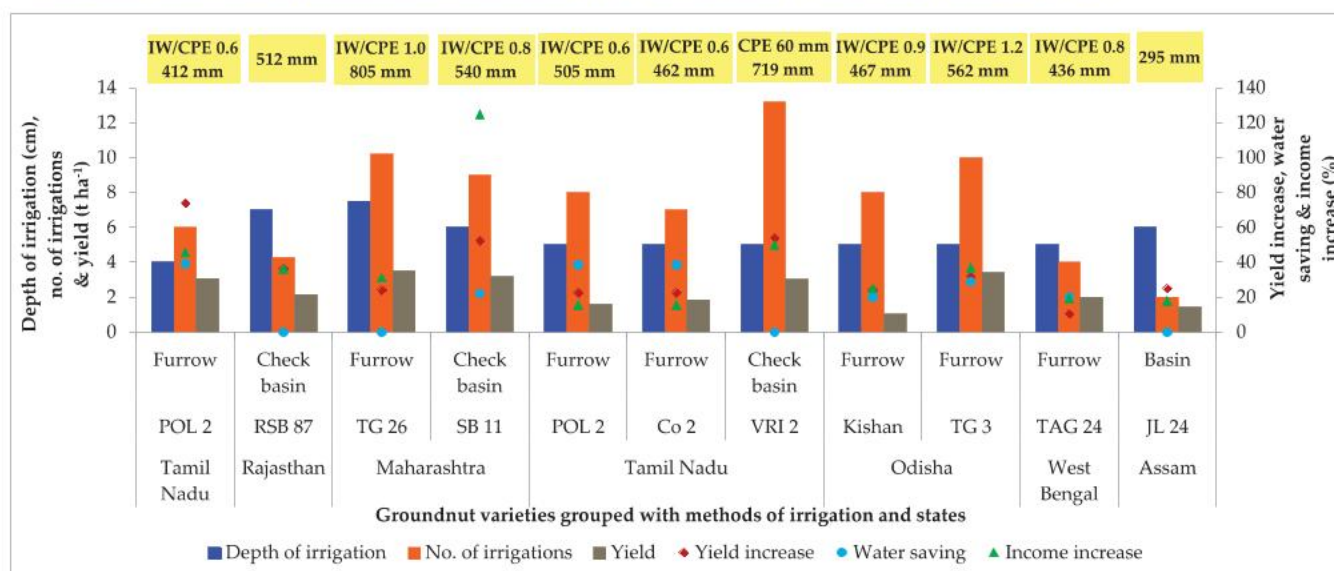
Cotton under furrow irrigation in (a) Tamil Nadu, (b) Punjab and (c) Maharashtra, and (d) check basin irrigation in Punjab

Irrigation Scheduling in Groundnut

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Tamil Nadu	POL 2	Furrow	At IW/CPE 0.6 Irrigation depth: 4 cm, Irrigation interval: 13 days, No. of irrigations: 6, I: 280, R: 132, T: 412.	7.48	Demonstrated at farmers' field in Tamil Nadu
Rajasthan	RSB 87	Check basin	Irrigation depth: 7 cm, Irrigation interval: At 25, 45, 72 & 110 DAS, No. of irrigations: 4 (at vegetative, flowering, pegging & pod development), I: 300, R: 212, T: 512.	4.20	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
Maharashtra	TG 26	Raised bed & furrow	At IW/CPE 1.0 Irrigation depth: 7.5 cm, Irrigation interval: 8-9 days, No. of irrigations: 10, I: 765, R: 40, T: 805.	4.35	Approved in the Joint AGRESKO meet of four agricultural universities of Maharashtra. The technologies are passed on to the line departments for dissemination to farmers.
	SB 11	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 12-15 days, No. of irrigations: 9, I: 540, R: 0, T: 540.	5.85	Recommendations provided through state agriculture department during 1981-82
Tamil Nadu	POL 2	Furrow	At IW/CPE 0.6. Irrigation depth: 5 cm, Irrigation interval: 12-14 days, No. of irrigations: 8, I: 400, R: 105, T: 505.	3.13	Demonstrated at farmers' field in Tamil Nadu
	CO 2	Furrow	At IW/CPE 0.6. Irrigation depth: 5 cm, Irrigation interval: 8-10 days, No. of irrigations: 7, I: 350, R: 112, T: 462.	3.96	

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
	VRI 2	Check basin	At CPE 60 mm. Irrigation depth: 5 cm, Irrigation interval: As per requirement, No. of irrigations: 13, I: 660, R: 59, T: 719.	4.17	
Odisha	Kisan	Furrow	At IW/CPE 0.9. Irrigation depth: 5 cm, Irrigation interval: 11 days, No. of irrigations: 8-9, I: 400, R: 67, T: 467.	2.18	40% of groundnut farmers in Odisha are using this technology
	TG 3	Furrow	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 8 days, No. of irrigations: 10-11, I: 500, R: 62, T: 562.	6.05	
West Bengal	TAG 24	Furrow	At IW/CPE 0.8 with Sulphur @ 20 kg ha ⁻¹ . Irrigation depth: 5 cm, Irrigation interval: 15-18 days, No. of irrigations: 4, I: 200, R: 236, T: 436.	4.59	Recommended to New Alluvial Zone (WB-4) for adoption
Assam	JL 24	Basin	Irrigation depth: 6 cm, Irrigation interval: 40 days (1 st at pre-sowing & 2 nd at pegging or nut formation stage), No. of irrigations: 2, I: 120, R: 175, T: 295.	4.78	Technology approved for recommendation through state "POP for rabi crops of Assam, 2019" published by AAU, Jorhat (Page 68-71)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling of groundnut crop was optimized for agro-ecological regions 2, 6, 8, 12, 15 and 19 involving six states. Ten groundnut varieties were grown with improved methods of irrigation like check basin and furrow irrigation. It was found that there was 10.5 to 74.1% higher yield, upto 39.2%

water saving and 15.4 to 124.8% higher income compared to conventional practice. The technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



(b)



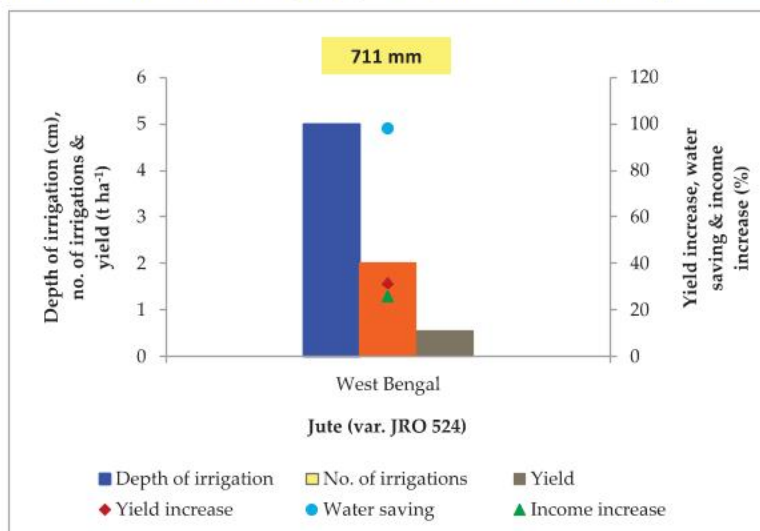
(c)

Groundnut under furrow irrigation in (a) West Bengal, (b) Tamil Nadu and (c) Odisha

Irrigation Scheduling in Jute

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
West Bengal	JRO 524 or Navin	Furrow	Irrigation depth: 5 cm, Irrigation interval: 30 days (at pre-flowering & pod filling stages), No. of irrigations: 2, I: 100, R: 611, T: 711.	0.79	Recommended to New Alluvial Zone (WB-4) for adoption

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow box in the chart

Irrigation scheduling of jute crop was optimized for agro-ecological region 15. Improved surface irrigation method i.e. furrow irrigation was used to grow jute variety JRO 524, resulting in 31.4% higher yield, 98% water saving and 26%

higher income compared to the conventional practice of flood irrigation. The technology has been recommended to New Alluvial Zone of West Bengal for adoption by line department and jute farmers of the state.

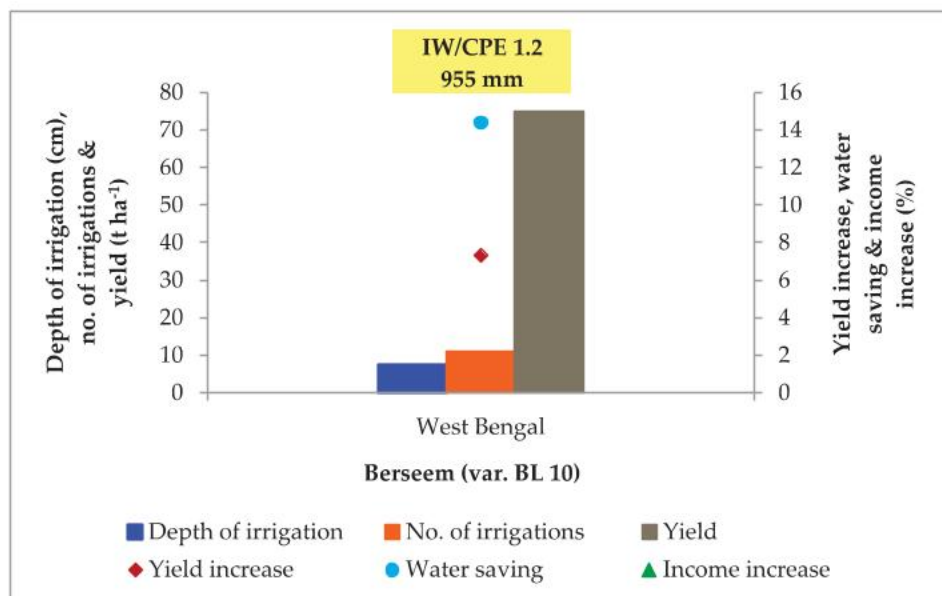


Jute under furrow irrigation in West Bengal

Irrigation Scheduling in Berseem

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	BL 10	Check basin	At IW/CPE 1.2. Irrigation depth: 7.5 cm, Irrigation interval: As per requirement, No. of irrigations: 11-12 days, I: 830, R: 125, T: 955.	78.43	Widely adapted throughout Punjab

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow box in the chart

Irrigation scheduling of berseem crop was optimized for agro-ecological region 2. Improved surface irrigation method i.e. check basin was used to grow berseem variety BL-10, resulting

in 7.3% higher yield and 14.4% water saving compared to the conventional practice of flood irrigation. The recommendation has been widely adopted by Punjab farmers.

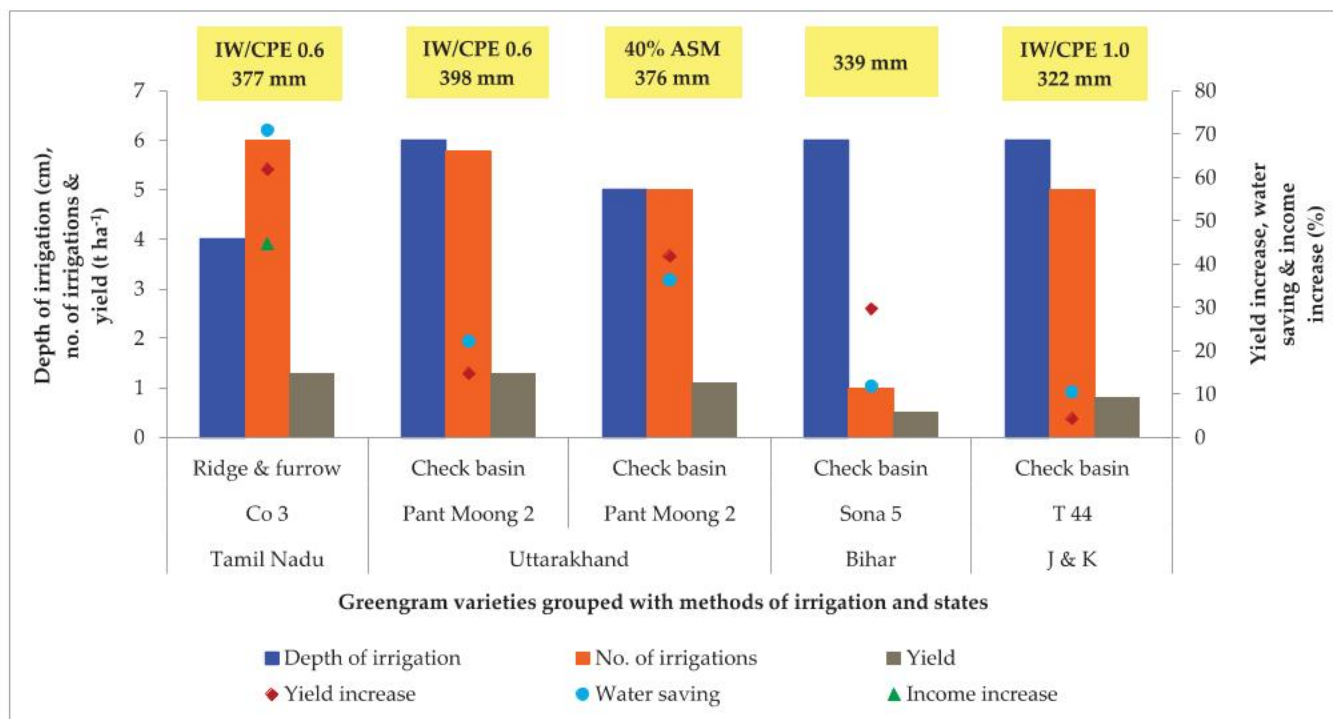


Berseem under furrow irrigation in Punjab

Irrigation Scheduling in Greengram

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Tamil Nadu	Co-3	Ridge & Furrow	At IW/CPE 0.6 with phosphorus @ 33 kg ha ⁻¹ . Irrigation depth: 4 cm, Irrigation interval: 10 days, No. of irrigations: 6, I: 240, R: 137, T: 377.	3.45	Demonstrated at farmers' field in Tamil Nadu
Uttarakhand	Pant Moong 2	Check basin	At IW/CPE 0.6. Irrigation depth: 6 cm, Irrigation interval: 1 st irrigation at 15 DAS, thereafter at 10 days interval, No. of irrigations: 5, I: 348, R: 50, T: 398.	3.27	Recommendation has been passed on to line department and extension department
	Pant Moong 2	Check basin	At 40% available soil moisture in 0-30 cm soil depth. Irrigation depth: 5 cm, Irrigation interval: 1 st irrigation at 20 DAS, thereafter at 10 days interval, No. of irrigations: 5, I: 250, R: 126, T: 376.	2.93	Recommendation has been passed on to line department and extension department
Bihar	Sona 5	Check basin	Irrigation depth: 6 cm, Irrigation interval: At 30 DAS only, No. of irrigations: 1, I: 60, R: 279, T: 339.	1.47	-
Jammu & Kashmir	T 44	Check basin	At IW/CPE 1.0 (after one pre- & one post-sowing irrigations) Irrigation depth: 6 cm, Irrigation interval: 9 days, No. of irrigations: 3, I: 300, R: 22, T: 322.	2.55	The technology was passed on through university ZREAC meeting

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow box in the chart

Irrigation scheduling of four greengram varieties were optimized for agro-ecological regions no. 8, 9, 13 and 14 covering the states of Tamil Nadu, Uttarakhand, Bihar and Jammu & Kashmir. The improved irrigation scheduling for four greengram varieties using irrigation methods like check basin

and ridge and furrow irrigation resulted in 4 to 62% increased yield, 10 to 71% water saving and upto 44.8% higher income compared to conventional practice by farmers. The technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.

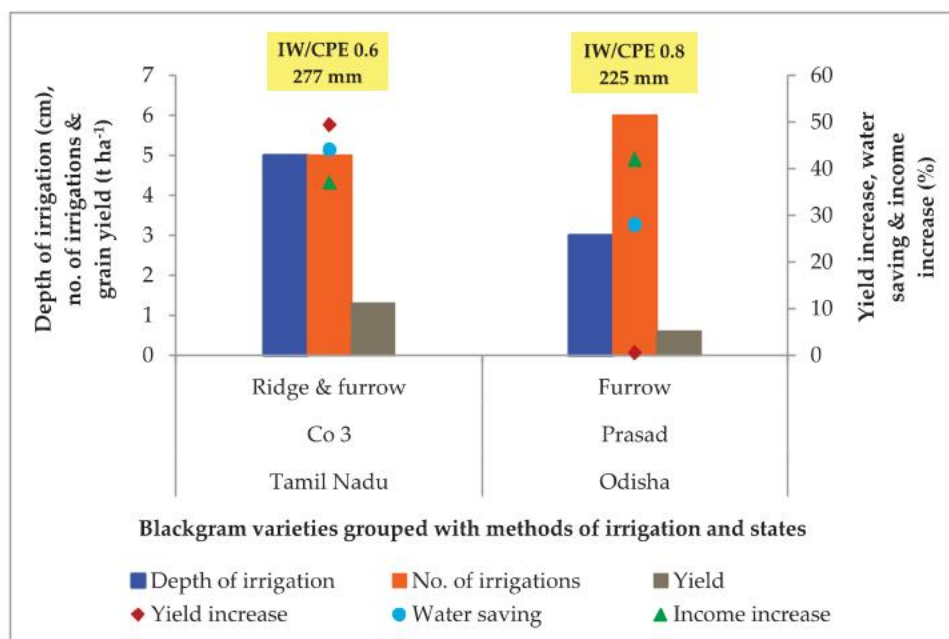


Greengram under (a) check basin irrigation in Bihar, and (b) ridge and furrow irrigation in Tamil Nadu

Irrigation Scheduling in Blackgram

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Tamil Nadu	CO 3	Ridge & furrow	At IW/CPE 0.6 with phosphorus @ 33 kg ha ⁻¹ . Irrigation depth: 5 cm, Irrigation interval: 10 days, No. of irrigations: 5, I: 250, R: 27, T: 277.	4.70	-
Odisha	Prasad	Furrow	At IW/CPE 0.8. Irrigation depth: 3 cm, Irrigation interval: 10 days. No. of irrigations: 5-6, I: 150-180, R: 45, T: 195-225.	4.67	Technology has been transferred to the State Government and KVKs through ZAREC and SLREC meeting

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow box in the chart

Irrigation scheduling in blackgram crop was optimized for two varieties in agro-ecological region 8 and 12 covering the states of Tamil Nadu and Odisha. Irrigation scheduling in two blackgram varieties using surface irrigation methods like ridge

and furrow and furrow irrigation, resulting in 0.6 to 49.5% higher yield, 28 to 44% water saving and 37 to 42% income increase as compared to farmers' practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



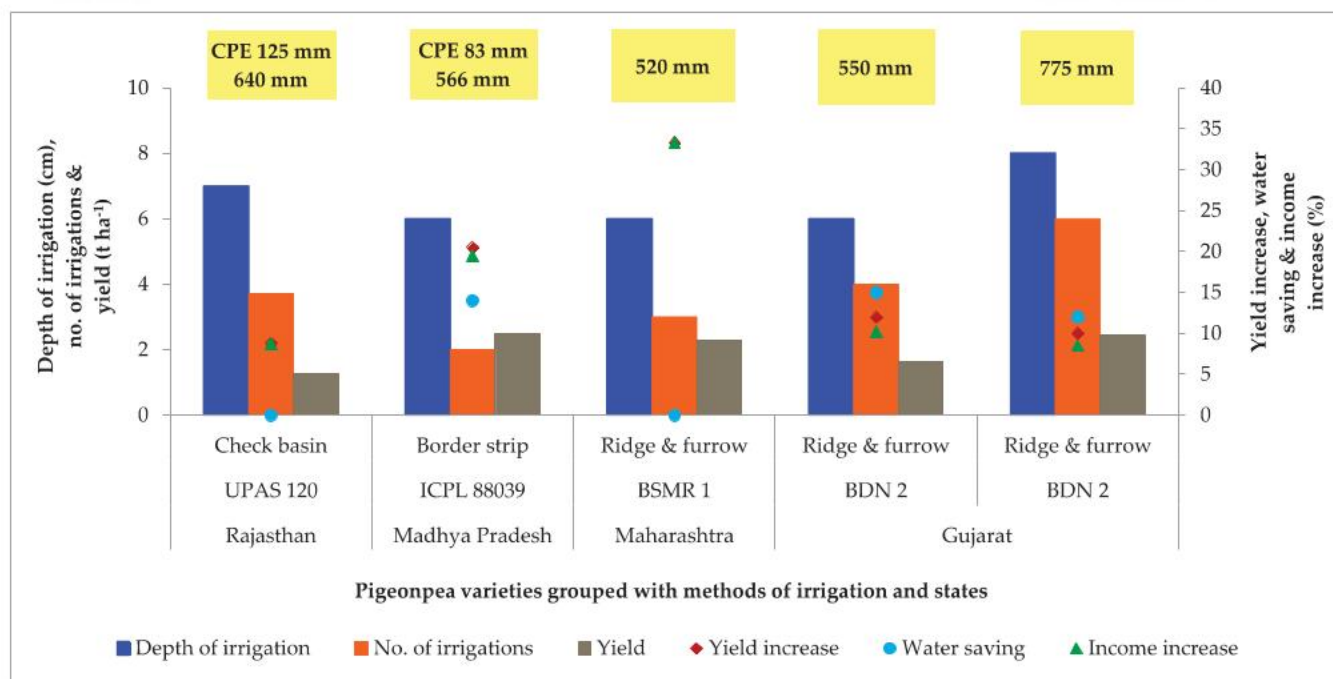
(b)

Blackgram under (a) ridge and furrow irrigation in Tamil Nadu and (b) furrow irrigation in Odisha

Irrigation Scheduling in Pigeonpea (Arhar)

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	UPAS 120	Check basin	At CPE 125 mm. Irrigation depth: 7 cm, Irrigation interval: 45, 67, 88 & 100 DAS, No. of irrigations: 4, I: 260, R: 380, T: 640.	2.00	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
Madhya Pradesh	ICPL 88039	Border strip (Irrigation in 4-5 m broad bed and 70-80 m long strip with 85-90% cut-off length)	At CPE 83 mm. Irrigation depth: 6 cm, Irrigation interval: 12 days after withdrawal of rain, No. of irrigations: 2 (at flowering & pod formation stages) I: 120, R: 446, T: 566.	4.43	The recommendation gave higher yield and economic benefit and adopted by farmers of ORP area as well as ATMA. Dept. of Agriculture, KVK through demonstrations, training, etc.
Maharashtra	BSMR 1	Ridge & Furrow	Irrigation depth: 6 cm, Irrigation interval: 8-10 days (at bud initiation, flowering & pod development stages), No. of irrigations: 3, I: 180, R: 340, T: 520.	4.38	Technology was disseminated by line department and adopted by farmers of Marathwada region
Gujarat	BDN 2	Ridge & furrow	Irrigation depth: 6 cm, Irrigation interval: 30 days (at monthly interval after cessation of monsoons), No. of irrigations: 4, I: 240, R: 310, T: 550.	2.98	Over 60% farmers have adopted the recommendation in south Gujarat
	BDN 2	Ridge & furrow	Irrigation depth: 8 cm, Irrigation interval: 20-30 days (after sowing, thereafter at 30, 60, 90, 120 & 140 DAS), No. of irrigations: 6, I: 480, R: 295, T: 775.	3.15	25% farmers have adopted the irrigation schedule in Narmada command area

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for pigeonpea crop in agro-ecological regions 2, 4, 6 and 19 involving four states. Optimized irrigation schedule for four pigeonpea varieties using surface irrigation methods, resulted in 8 to 33% increase

in yield, 12-15% water saving and 8 to 33% higher income compared to the conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



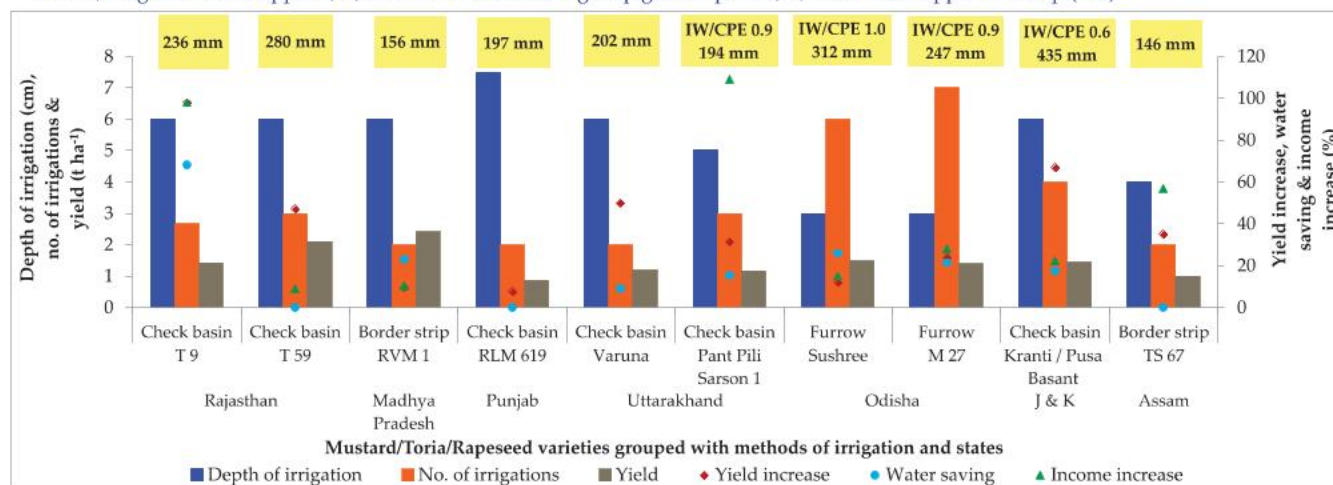
(b)

Pigeonpea under (a) ridge and furrow irrigation in Gujarat and (b) border strip irrigation in Madhya Pradesh

Irrigation Scheduling in Mustard/Rapeseed (Toria)

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	T 9 (toria)	Check basin	Irrigation depth: 6 cm, Irrigation interval: 55 days (at branching i.e. 55 DAS & siliqua development i.e. 110 DAS stages), No. of irrigations: 2, I: 160, R: 76, T: 236.	6.02	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
	T 59 or Varuna (black mustard)	Check basin	Irrigation depth: 6 cm, Irrigation interval: 30 days (at 30, 60 & 90 DAS), No. of irrigations: 3, I: 280 (including 100 mm pre-sowing irrigation), R: 0, T: 280.	7.54	Recommendation verified
Madhya Pradesh	RVM 1 (black mustard)	Border strip (Irrigation with 85-90% cut-off)	Irrigation depth: 6 cm, Irrigation interval: 40 days, No. of irrigations: 2 (at flower initiation i.e. 30 DAS & siliqua development stage i.e. 70 DAS), I: 120, R: 36, T: 156.	15.51	As per RRA data this technology adopted in 3.5 lakh hectare in Madhya Pradesh
Punjab	RLM 619 (black mustard)	Check basin	Irrigation depth: 7.5 cm, Irrigation interval: 21-30 days, No. of irrigations: 2 (two irrigations at 3-4 weeks after sowing and at flowering), I: 150 (including 100 mm of pre sown irrigation), R: 47, T: 197.	4.42	Included in the zone V rabi crops package of practices
Uttarakhand	T 59 or Varuna (black mustard)	Check basin	Irrigation depth: 6 cm, Irrigation interval: 1st at 21 DAS or 42 DAS (flowering stage) & 2 nd at 84 DAS (pod development stage), No. of irrigations: 2, I: 120, R: 82, T: 202.	5.94	Adopted by farmers in the south-western region of Punjab
	Pant Pili Sarson 1 (toria)	Check basin	At IW/CPE 0.9. Irrigation depth: 5 cm, Irrigation interval: 20-25 days, No. of irrigations: 3, I: 150, R: 44, T: 194.	6.03	Information has been passed on to line department and extension department
Odisha	Sushree (toria)	Furrow	At IW/CPE 1.0. Irrigation depth: 3 cm, Irrigation interval: 11 days, No. of irrigations: 5-6, I: 200, R: 112, T: 312.	4.81	Technology has been transferred to the State Government and KVKs through ZAREC and SLREC meetings
	M 27 (toria)	Furrow	At IW/CPE 0.9. Irrigation depth: 3 cm, Irrigation interval: 10 days, No. of irrigations: 6-7, I: 200, R: 47, T: 247.	5.67	
Jammu & Kashmir	Kranti, Pusa Basant (black mustard)	Check basin	At IW/CPE 0.6 after two post-sowing irrigations at 7 DAS & at branching. Irrigation depth: 6 cm, Irrigation interval: 10 days, No. of irrigations: 4, I: 240, R: 195, T: 435.	3.31	Technology passed on through university ZREAC meeting
Assam	TS 67 (toria)	Border strip	Irrigation depth: 4 cm, Irrigation interval: 20 days, No. of irrigations: 2 (at flowering i.e. 40 DAS & siliqua formation stage i.e. 60 DAS), I: 80, R: 86, T: 146.	6.85	Technology approved for state as POP of rabi crops. Proceedings of POP of field & horticultural crops, 2015.

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in mustard/rapeseed/toria was optimized for seven agro-ecological regions *viz.*, 2, 4, 5, 9, 12, 14 and 15 involving eight states. Improved surface irrigation methods to 10 varieties of mustard/rapeseed/toria led to 8 to 98% increase in

yield, water saving upto 68% and 9 to 114% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



(b)



(c)



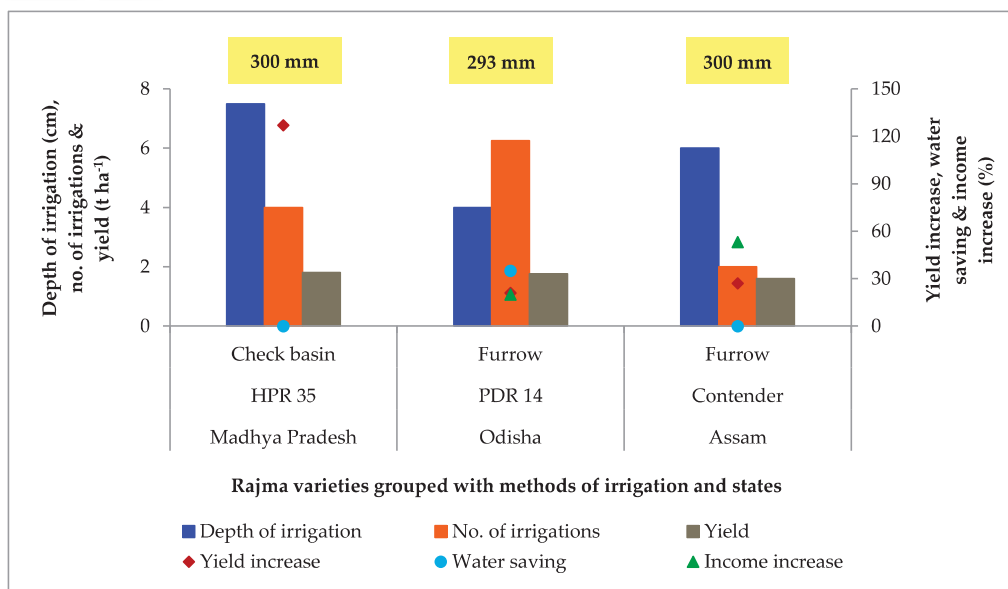
(d)

Mustard under (a) border strip irrigation in Assam, check basin irrigation in (b) Punjab and (c) Rajasthan, and (d) furrow irrigation in Odisha

Irrigation Scheduling in Rajma

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Adoption
Madhya Pradesh	HPR 35	Check basin	Irrigation depth: 7.5 cm. Irrigation interval: 20 days (at 20, 40, 60 & 80 days after sowing), No. of irrigations: 4, I: 300, R: 0, T: 300.	6.03	-
Odisha	PDR 14	Furrow	At 30% depletion of available soil moisture along with paddy straw mulch. Irrigation depth: 4 cm, Irrigation interval: 13 days, No. of irrigations: 5-6, I: 250, R: 43, T: 293.	6.04	Technology has been transferred to the State Government and KVKs through ZAREC and SLREC meeting
Assam	Contender	Furrow	Irrigation depth: 6 cm, Irrigation interval: 25 days, No. of irrigations: 2 (at flowering & pod formation stages), I: 120, R: 180, T: 300.	5.33	Technology has been approved for recommendation through "Package of practices for <i>rabi</i> crops of Assam, 2019" published by AAU, Jorhat (Page no. 53-54)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow boxes in the chart

Irrigation scheduling in rajma was optimized for three agro-ecological regions *viz.*, 10, 12 and 15 involving three states. Irrigation scheduling with improved surface irrigation methods led to increase in yield by 127%, water saving of 35%

only in Chiplima and 20 to 53% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



(b)



(c)



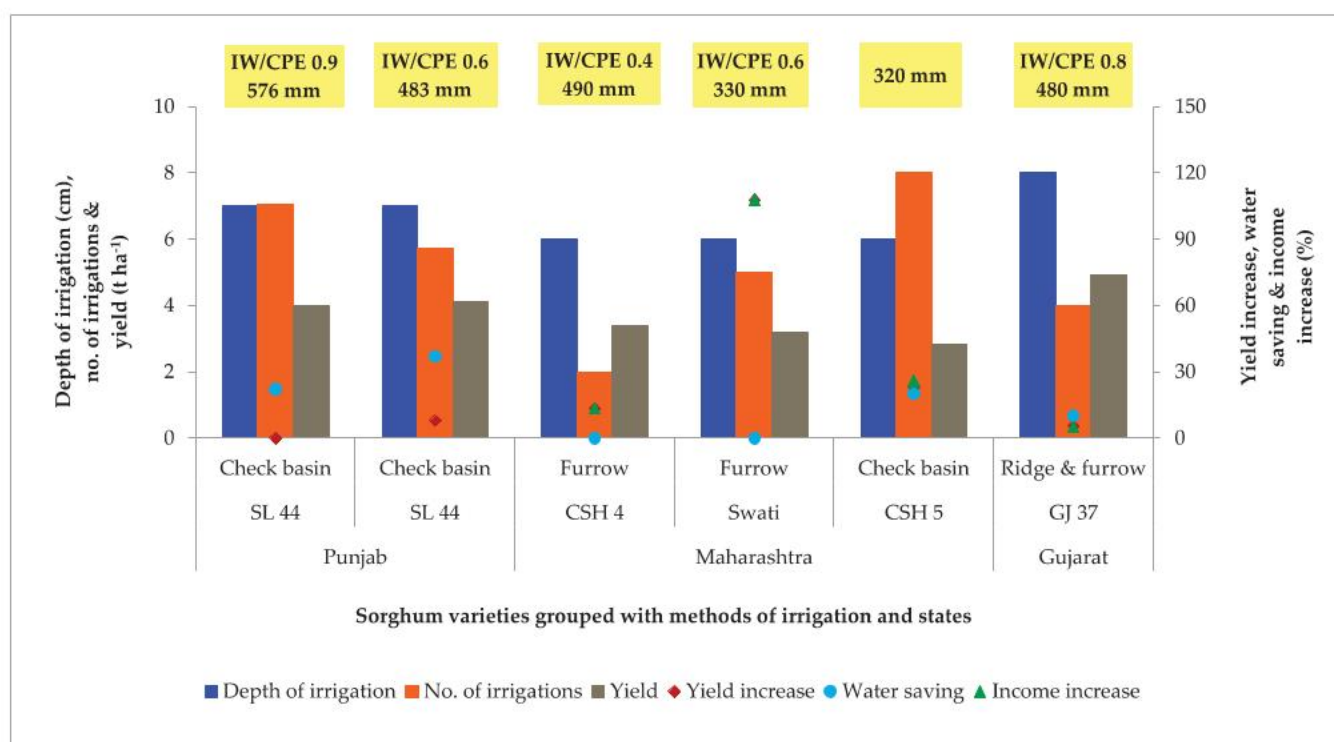
(d)

Rajma under furrow irrigation along with (a) & (b) plastic, (c) paddy straw (d) sugarcane trash mulching in Odisha

Irrigation Scheduling in Sorghum (Jowar)

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	SL 44	Check basin	At IW/CPE 0.9. Irrigation depth: 7 cm, Irrigation interval: 7-10 days, No. of irrigations: 6-7, I: 493, R: 83, T: 576.	6.91	Widely adopted by Punjab farmers growing sorghum in the summer season
	SL 44	Check basin	At IW/CPE 0.6, with straw mulch. Irrigation depth: 7 cm, Irrigation interval: 10-14 days, No. of irrigations: 5-6, I: 400, R: 83, T: 483.	8.49	-
Maharashtra	CSH 5	Furrow	At IW/CPE 0.4. Irrigation depth: 6 cm, Irrigation interval: 10-12 days, No. of irrigations: 2, I: 120, R: 370, T: 490.	6.90	Technology disseminated by line department and adopted by farmers of Marathwada region
	Swati	Furrow	At IW/CPE 0.6. Irrigation depth: 6 cm, Irrigation interval: 8-10 days, No. of irrigations: 5, I: 300, R: 30, T: 330.	9.70	
	CSH 5	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 12-16 days, No. of irrigations: 8, I: 480, R: 0, T: 480.	5.90	Recommendations are provided through state agriculture department during 1981-82.
Gujarat	GJ 37	Ridge & furrow	Irrigation depth: 8 cm, Irrigation interval: 25-30 days, No. of irrigations: 4 (after sowing, knee high, flowering and grain filling stages). I: 320, R: 0, T: 320.	15.38	40% farmers have adopted the irrigation schedule in Narmada command area

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in sorghum crop was optimized for three agro-ecological regions *viz.*, 4, 6 and 19 involving three states. Irrigation scheduling with improved irrigation methods of check basin, furrow and ridge and furrow irrigation for four sorghum varieties resulted in higher yield upto 107.8%, water

saving upto 37% and 5-108% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.

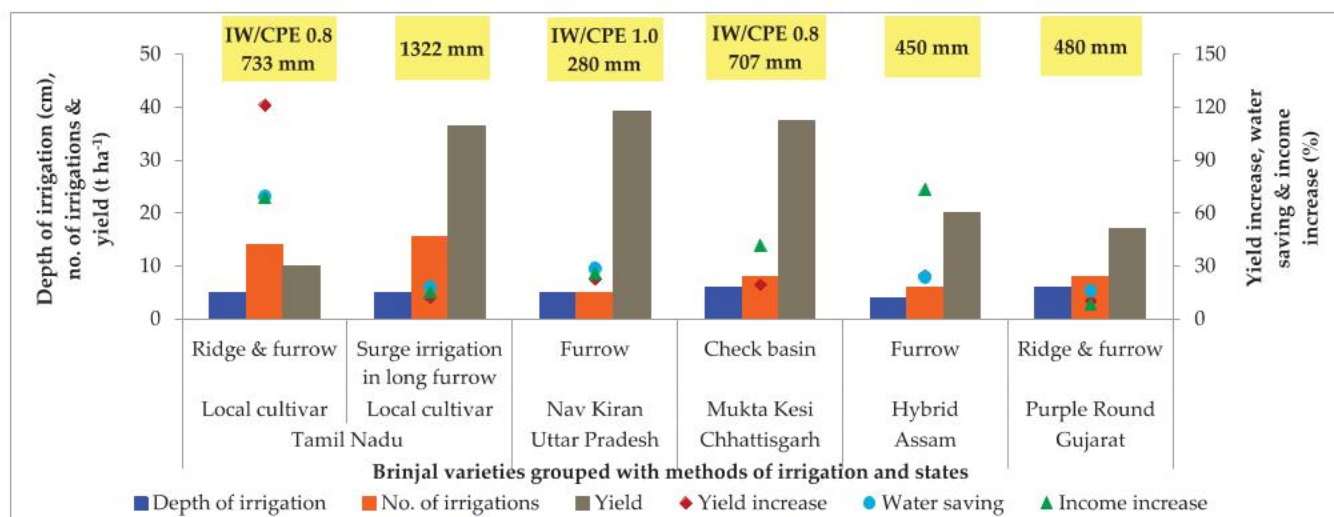


Sorghum under ridge and furrow irrigation in Gujarat

Irrigation Scheduling in Brinjal

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Tamil Nadu	Local cultivar	Ridge & furrow	At IW/CPE 0.8. Irrigation depth: 5 cm, Irrigation interval: 4 days, No. of irrigations: 14, I: 700, R: 33, T: 733.	13.78	Demonstrated at farmers' field in Tamil Nadu
	Local variety	Surge irrigation @ 2 L/s in 100 m long furrow	Irrigation depth: 5 cm, No. of irrigations: 11, I: 776, R: 546, T: 1322.	27.46	
Uttar Pradesh	Navkiran	Furrow (paired row planting)	At IW/CPE 1.0 Irrigation depth: 5 cm, Irrigation interval: 20-25 days, No. of irrigations: 5, I: 250, R: 30, T: 280.	140.00	Technology is being adopted by the farmers in flat bed planted brinjal in tubewell command
Chhattisgarh	Mukta Kesi	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 24 days, No. of irrigations: 8, I: 480, R: 227, T: 707.	52.79	-
Assam	Hybrid	Furrow	Irrigation depth: 4 cm, Irrigation interval: 13-18 days, No. of irrigations: 6, I: 240, R: 210, T: 450.	44.44	Technology approved for recommendation through "POP of field and horticultural crops, 2015"
Gujarat	Purple Round	Ridge & furrow	Irrigation depth: 6 cm, Irrigation interval: 15-27 days (after sowing, 15 days after sowing and remaining at 22-27 days interval), No. of irrigations: 8, I: 480, R: 0, T: 480.	35.41	80% farmers have adopted the irrigation schedule in south Gujarat

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for brinjal crop for agro-ecological region *viz.*, 8, 9, 11, 15 and 19 involving five states. Improved irrigation methods of ridge and furrow, check basin and furrow irrigation for four brinjal varieties resulted in 10 to

121% increase in yield, upto 16 to 69% water saving and 8 to 73% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



(a)



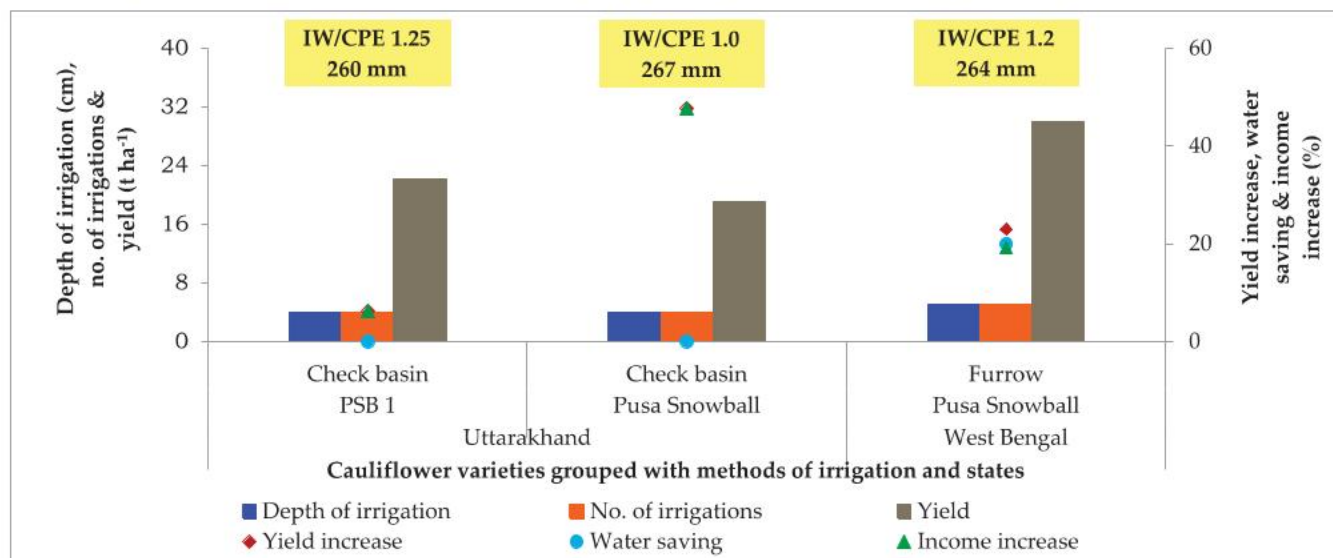
(b)

Brinjal under (a) surge irrigation in Tamil Nadu, and (b) furrow irrigation in Assam

Irrigation Scheduling in Cauliflower

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Uttarakhand	PSB 1	Check Basin	At IW/CPE 1.25. Irrigation depth: 4 cm, Irrigation interval: 33 days (approximately), No. of irrigations: 4, I: 160, R: 100, T: 260.	85.00	-
	Pusa Snowball	Check basin	At IW/CPE 1.0. Irrigation depth: 4 cm, Irrigation interval: 30 days (approximately), No. of irrigations: 4, I: 160, R: 107, T: 267.	71.40	
	PSB 16	Check basin	75% pan evaporation (PE) Irrigation depth & irrigation interval: variable as per evaporation, I: 100, R: 74, T: 174.	160.06	
West Bengal	Pusa Snowball	Furrow	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 15 days, No. of irrigations: 5, I: 250, R: 14, T: 264.	113.20	Recommended to New Alluvial Zone (WB-4) for adoption

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for cauliflower crop for agro-ecological region *viz.*, 14 and 15 involving two states. Irrigation scheduling with improved irrigation methods of check basin and furrow irrigation for two cauliflower varieties

resulted in 6-48% increase in yield, water saving upto 20% and 6-48% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in local areas.

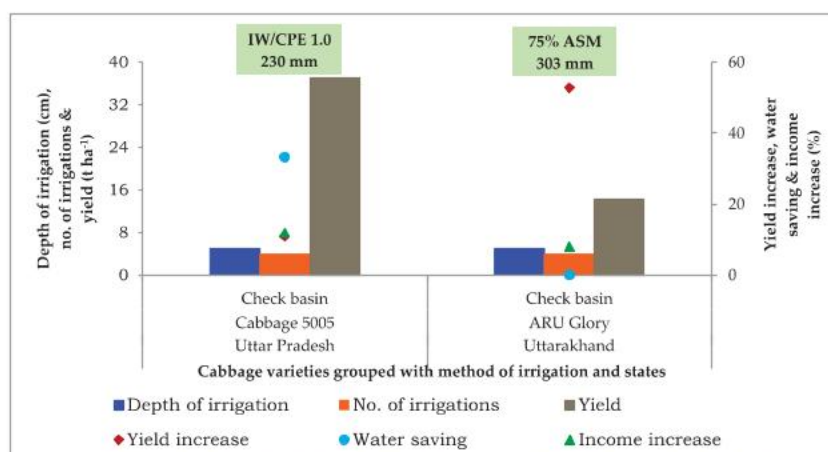


Cauliflower under improved surface irrigation at Uttarakhand

Irrigation Scheduling in Cabbage

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Uttar Pradesh	Sungro Cabbage 5005	Check basin	At IW/CPE 1.0. Irrigation depth: 5 cm, Irrigation interval: 25 days, No. of irrigations: 4, I: 200, R: 30, T: 230.	161.43	Technology is being adopted by the farmers of tubewell command
Uttarakhand	ARU Glory	Check basin	At 75% of available soil moisture (ASM). Irrigation depth: 5 cm, Irrigation interval: 30 days, No. of irrigations: 4, I: 200, R: 103, T: 303.	46.93	-

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for cabbage crop for agro-ecological regions 9 and 14 involving two states. Irrigation scheduling with improved irrigation method of check basin for two cabbage varieties led to 11-53% higher yield, water saving upto 33% and 8-12% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.

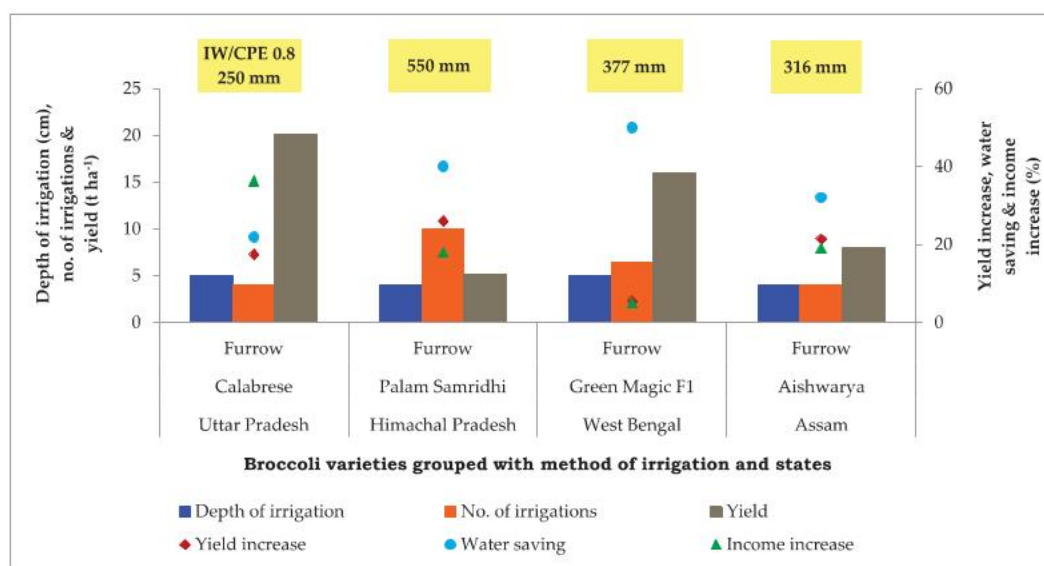


Cabbage crop under check basin irrigation in Uttar Pradesh

Irrigation Scheduling in Broccoli

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Uttar Pradesh	Calabrese	Furrow	At IW/CPE 0.8 with INM (75% RDF + 25% N through biocompost). Irrigation depth: 5 cm, Irrigation interval: 20-25 days, No. of irrigations: 4, I: 200, R: 50, T: 250.	80.44	Technology is being adopted by the farmers of tubewell command
Himachal Pradesh	Palam Samridhi	Furrow	Irrigation depth: 4 cm, Irrigation interval: 10-15 days, No. of irrigations: 10, I: 424, R:126, T: 550.	9.45	Farmers and extension functionaries were trained
West Bengal	Green Magic (F1 hybrid)	Furrow	50% arsenic contaminated shallow tubewell + 50% fresh pond water. Irrigation depth: Pre-sowing 2 cm and remaining 5 cm depth, Irrigation interval: 8-9 days, No. of irrigations: 6, I: 320, R: 57, T: 377.	42.18	Recommended to New Alluvial Zone (WB-4) for adoption
Assam	Aishwarya	Furrow	Irrigation depth: 4 cm, Irrigation interval: 15-18 days, No. of irrigations: 4, I: 160, R: 156, T: 316.	25.32	Technology approved for recommendation through POP (vide Proceeding of Package of Practices of field and horticultural crops, 2015, Vide Order No.7(133)/02/DRA (T)/2015-16/19489-19501 dated 19.01.2016)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for broccoli crop for three agro-ecological regions viz., 9, 14 and 15 involving four states. Irrigation scheduling with improved irrigation method i.e. furrow irrigation for four broccoli varieties led to 5-26% increase in yield, 22-50% water saving and 5-36% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.



Broccoli under furrow irrigation at Himachal Pradesh

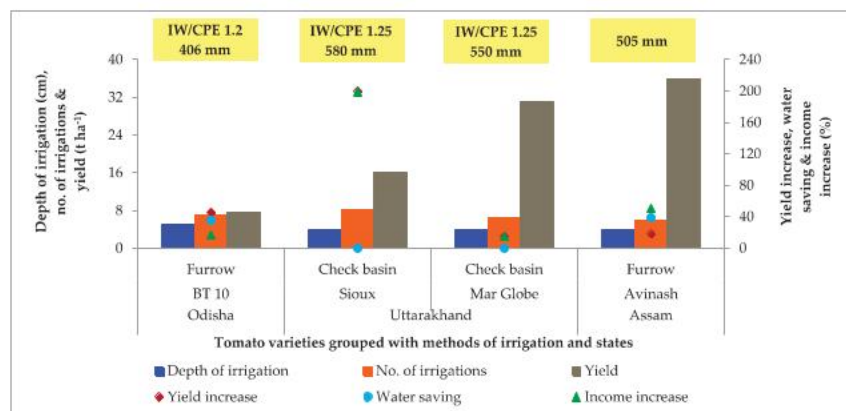


(a) Broccoli under furrow irrigation at (a) Assam and (b) Uttar Pradesh

Irrigation Scheduling in Tomato

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Odisha	BT 10 (<i>Utkal Kumari</i>)	Furrow	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 15 days, No. of irrigations: 7-8, I: 350, R: 56, T: 406.	18.72	Technology has been transferred to the State Government and KVKs through ZAREC and SLREC meetings
Uttarakhand	Sioux	Check basin	At IW/CPE 1.25. Irrigation depth: 4 cm, Irrigation interval: 11 days, No. of irrigations: 8, I: 330, R: 250, T: 580.	27.86	-
	Marglobe	Check basin	At IW/CPE 1.25. Irrigation depth: 4 cm, Irrigation interval: 17 days, No. of irrigations: 7, I: 260, R: 290, T: 550.	56.55	-
Assam	Avinash	Furrow	Irrigation depth: 4 cm, Irrigation interval: 13-15 days, No. of irrigations: 6, I: 240, R: 265, T: 505.	71.29	Technology approved for recommendation through POP ("Proceeding of POP of field and horticultural Crops, 2015" vide order no. 7(133)/02/DRA (T)/2015-16/19489-19501 dated 19.01.2016)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for tomato crop for agro-ecological regions 12, 14 and 15 involving the states of Assam, Odisha and Uttarakhand. Irrigation scheduling with improved irrigation methods of furrow and check basin irrigation in four tomato varieties led to 15 to 200% higher yield, water saving of 0 to 39% and 15 to 200% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.

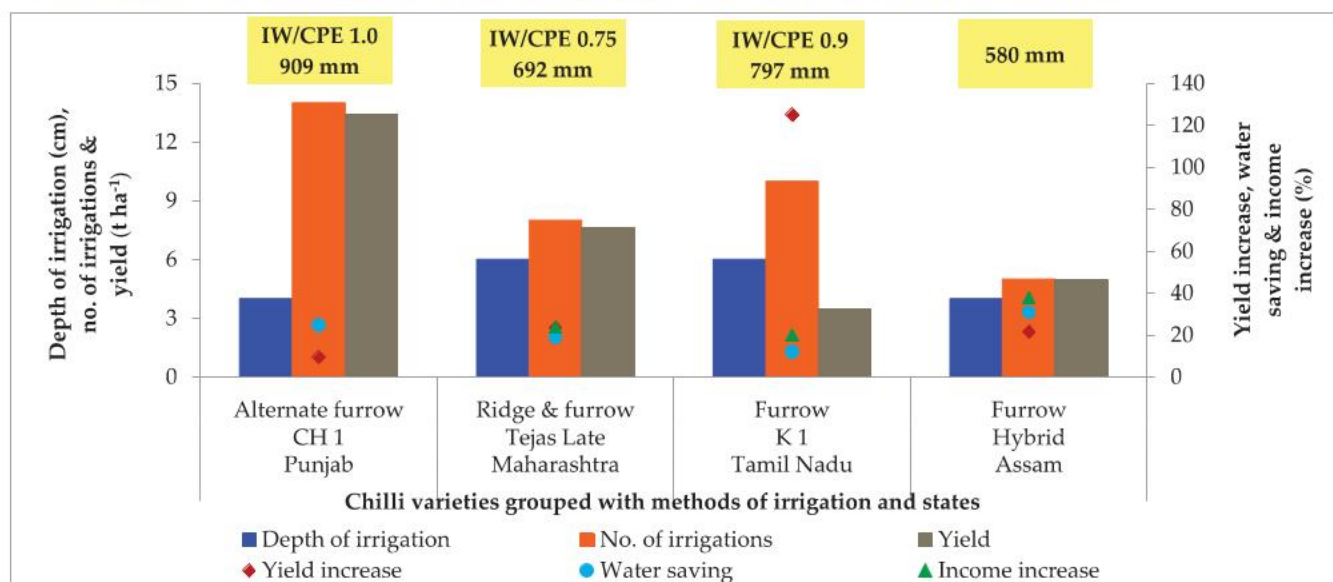


(a) (b)
Tomato under furrow irrigation at (a) Assam and (b) Odisha

Irrigation Scheduling in Chilli

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	CH 1	Alternate furrow	At IW/CPE 1.0. Irrigation depth: 4 cm, Irrigation interval: 4-7 days, No. of irrigations: 14, I: 560, R: 349, T: 909.	14.74	Adopted in smaller pockets of Punjab
Maharashtra	Teja	Ridge & Furrow	At IW/CPE 0.75. Irrigation depth: 6 cm, Irrigation interval: 7-8 days, No. of irrigations: 8, I: 480, R: 212, T: 692.	11.04	Technology was disseminated by line department and adopted by farmers of Marathwada region
Tamil Nadu	K 1	Furrow	At IW/CPE 0.9. Irrigation depth: 6 cm, Irrigation interval: as per requirement, No. of irrigations: 10, I: 600, R: 197, T: 797.	4.39	Demonstrated at farmers' field in Tamil Nadu
Assam	Hybrid	Furrow	Irrigation depth: 4 cm, Irrigation interval: 18-20 days, No. of irrigations: 5, I: 200, R: 380, T: 580.	8.62	Technology approved for recommendation through POP. (Proceeding of package of practices of field and horticultural crops, 2015, vide order no.7(133)/02/DRA (T)/2015-16/19489-19501 date:19.01.2016)

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for chilli crop for agro-ecological regions 2, 6, 8 and 15 involving the states of Assam, Punjab, Maharashtra and Tamil Nadu. Irrigation scheduling with improved irrigation methods of alternate furrow, furrow and ridge and furrow irrigation in four chilli varieties led to 9-

125% increase in yield, 12-31% water saving and 20-38% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption in the local areas.

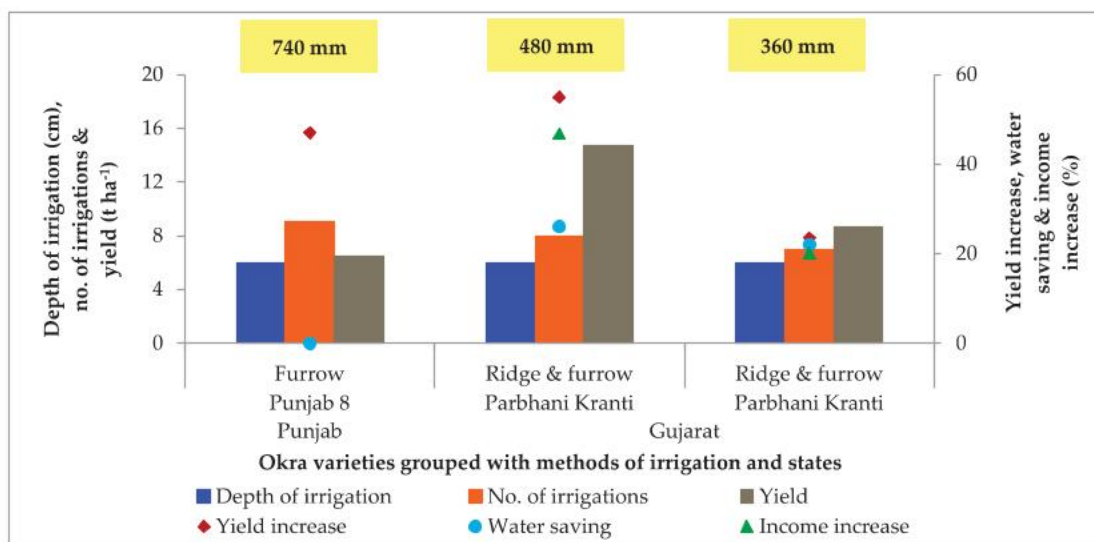


Chilli under furrow irrigation in Tamil Nadu

Irrigation Scheduling in Okra

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	Punjab 8	Furrow	Alternate use of canal and tubewell water. Irrigation depth: 6 cm, Irrigation interval: 7-8 days, No. of irrigations: 8-10, I: 480-560, R: 260, T: 740-820.	7.88 to 8.73	Farmers are using canal water and tube well water in cyclic mode to fetch better returns and to maintain soil health
Gujarat	Parbhani Kranti	Ridge & furrow	Irrigation depth: 6 cm, Irrigation interval: 8-9 days, No. of irrigations: 8, I: 480, R: 0, T: 480.	30.63	60% farmers in south Gujarat have adopted the irrigation schedule
	Parbhani Kranti	Ridge & furrow	Irrigation depth: 6 cm, Irrigation interval: After sowing, at 15 DAS, 30 DAS, rest at 10 days interval, No. of irrigations: 8, I: 360, R: 0, T: 360.	23.97	

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for okra crop for agro-ecological regions 2 and 19 involving the states of Punjab and Gujarat. Irrigation scheduling with improved irrigation methods of furrow and ridge and furrow irrigations in two okra varieties resulted in 23-47% increase in yield, 0-26% water saving and about 20% higher income compared to conventional practice. Technologies have been successfully extended to line departments and farmers with wide adoption. About 60% farmers have adopted the technology in south Gujarat. Farmers of Punjab are adopting furrow irrigation and applying irrigation through conjunctive use of canal and tubewell water in order to maintain soil health for better performance of crop and gain higher profit.

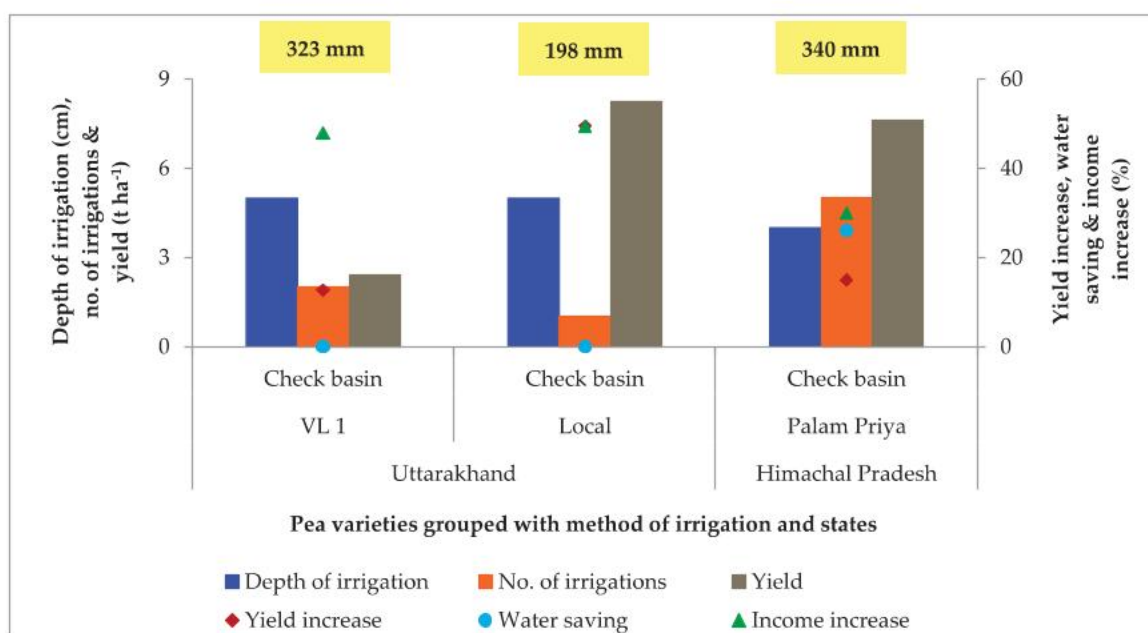


Okra under furrow irrigation in Gujarat

Irrigation Scheduling in Pea/Vegetable Pea

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Uttarakhand	VL 1	Check basin	Irrigation depth: 5 cm, Irrigation interval: At flowering initiation & seed development stages, No. of irrigations: 2, I: 100, R: 223, T: 323.	7.40	-
	Local	Check basin	Irrigation depth: 5 cm, Irrigation interval: Supplementary irrigation at crop maturity, No. of irrigations: 1, I: 50, R: 148, T: 198.	41.67	-
Himachal Pradesh	Palam Priya	Check basin	Irrigation depth: 4 cm, Irrigation interval: 10-15 days, No. of irrigations: 5, I: 200, R: 140, T: 340.	22.35	Training to farmers and extension functionaries

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for pea crop for agro-ecological region 14 involving the states of Uttarakhand and Himachal Pradesh. Irrigation scheduling with improved irrigation method of check basin irrigation for three pea varieties resulted in 12 to 50% higher yield, water saving of 0-26% and 12 to 50% higher income compared to conventional practice. Optimized irrigation scheduling has been demonstrated in farmers' field and training has been imparted to farmers and extension functionaries.

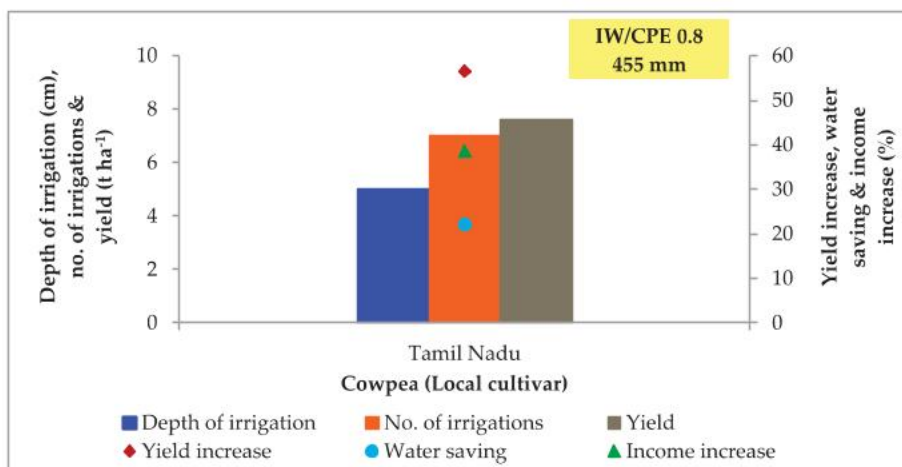


Pea under check basin irrigation in Himachal Pradesh

Irrigation Scheduling in Cowpea

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Tamil Nadu	Local cultivar	Furrow	At IW/CPE 0.8. Irrigation depth: 5 cm, Irrigation interval: 8 days, No. of irrigations: 7, I: 350, R: 105, T: 455.	16.77	Demonstrated in farmers' field in Tamil Nadu

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow box in the chart

Irrigation scheduling was optimized for cowpea crop for agro-ecological region 8 in the state of Tamil Nadu. Irrigation scheduling with furrow irrigation resulted in 57% higher yield of cowpea, 22% water saving and 39% higher income compared to conventional practice. The technology has been successfully demonstrated in farmers' field.

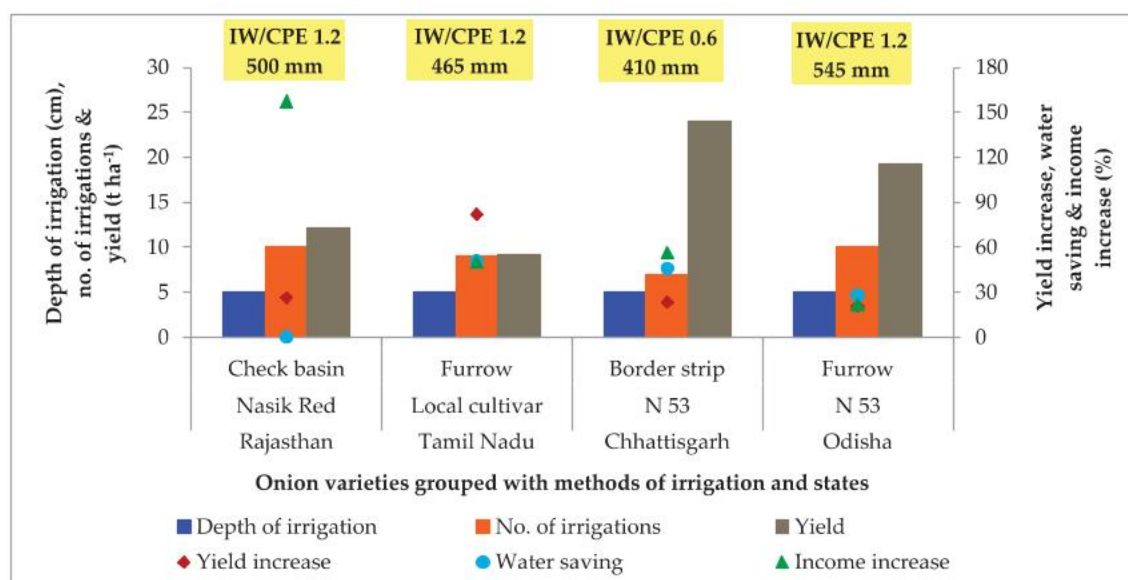


Cowpea under furrow irrigation in Tamil Nadu

Irrigation Scheduling in Onion

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha ⁻¹ mm ⁻¹)	Extension
Rajasthan	N 53 (Nasik Red)	Check basin	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 20-22 days (1 st irrigation: 15-20 days; 2 nd : 16-18 days; 3 rd : 12-14 days; 4 th : 9-10 days; 5 th : 9-10 days; 6 th : 7-9 days; 7 th : 6-7 days; 8 th : 6-7 days; 9 th : 6-7 days and 10 th : 5-6 days), No. of irrigations: 9-10. I: 500, R: 0, T: 500.	24.20	Included in the zone V rabi crops package of practices
Tamil Nadu	Local variety (Small onion)	Furrow	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 7-9 days, No. of irrigations: 9, I: 430, R: 35, T: 465.	19.57	Demonstrated at farmers' field in Tamil Nadu
Chhattisgarh	N 53 (Nasik Red)	Border strip	At IW/CPE 0.6. Irrigation depth: 5 cm, Irrigation interval: 15 days, No. of irrigations: 7. I: 350, R: 60, T: 410.	58.58	-
Odisha	N 53 (Nasik Red)	Furrow	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 11 days, No. of irrigations: 9-10, I: 500, R: 45, T: 545.	35.41	Technology has been transferred to the State Government and KVKs through ZAREC and SLREC meetings

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for onion crop for agro-ecological regions no. 5, 8, 11 and 12 involving the states of Rajasthan, Tamil Nadu, Chhattisgarh and Odisha, respectively. Irrigation scheduling with improved irrigation method of check basin, furrow and border strip irrigations for three onion varieties resulted in 20 to 82% higher yield, water saving upto 50.7%, and 22 to 157% higher income compared to conventional practice. The recommendation has been successfully extended to line departments and farmers with wide adoption in the local areas.

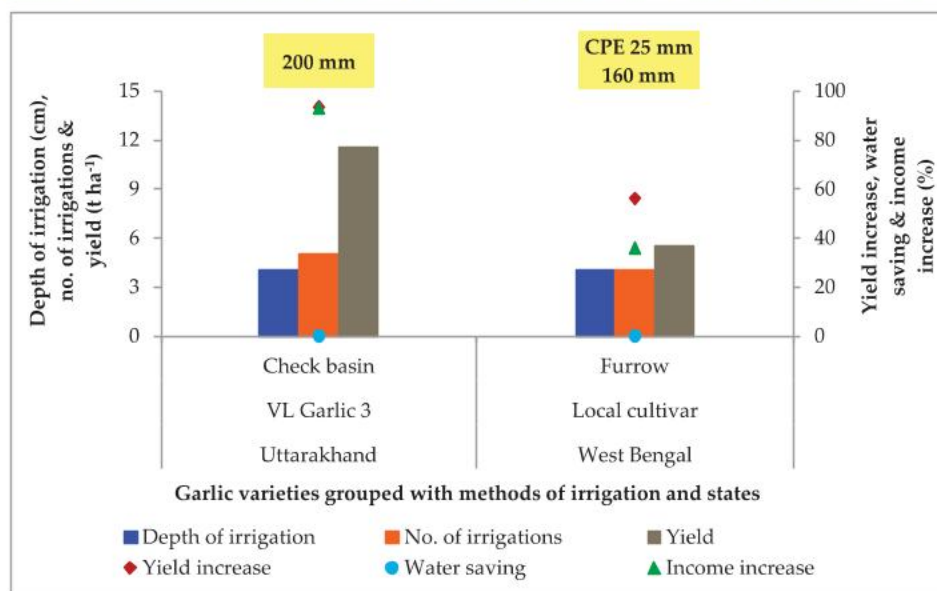


Onion under furrow irrigation in Tamil Nadu

Irrigation Scheduling in Garlic

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Uttarakhand	VL Garlic 3	Check basin	Irrigation depth: 4 cm, Irrigation interval: 12 days, No. of irrigations: 5, I: 200, R: 0, T: 200.	57.95	-
West Bengal	Local cultivar	Furrow	At CPE 25 mm with paddy straw mulch. Irrigation depth: 4 cm, Irrigation interval: 14-15 days, No. of irrigations: 4, I: 160, R: 0, T: 160.	34.38	Recommended to New Alluvial Zone (WB-4) for adoption

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for garlic crop for agro-ecological region 14 and 15 involving the states of Uttarakhand and West Bengal, respectively. Irrigation scheduling with improved irrigation method of check basin and furrow irrigations for two garlic varieties resulted in 56 to 93% higher yield and 36 to 93% higher income compared to conventional practice. The technology has been recommended for New Alluvial Zone of West Bengal.

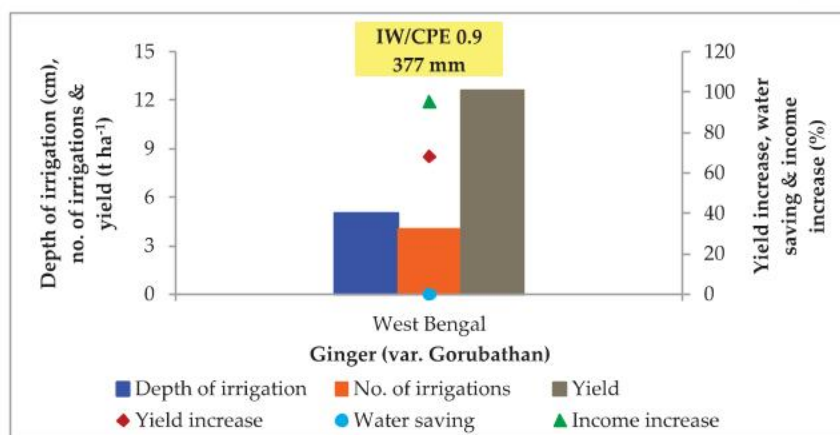


Garlic under furrow irrigation in West Bengal

Irrigation Scheduling in Ginger

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
West Bengal	Gorubathan	Furrow	At IW/CPE 0.9 with NPK 56:38:38 kg ha ⁻¹ as fertilizer and NPK 19:12:12 in form of vermicompost. Irrigation depth: 5 cm, Irrigation interval: 25-30 days, No. of irrigations: 4, I: 200, R: 177, T: 377.	33.42	Recommended to New Alluvial Zone (WB-4) for adoption

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow box in the chart

Irrigation scheduling was optimized for ginger crop for agro-ecological region 15 for the state of West Bengal. Irrigation scheduling with improved irrigation method of furrow irrigation resulted in 68% higher tuber yield and 96% higher income compared to conventional practice. The technology has been recommended for New Alluvial Zone of West Bengal.

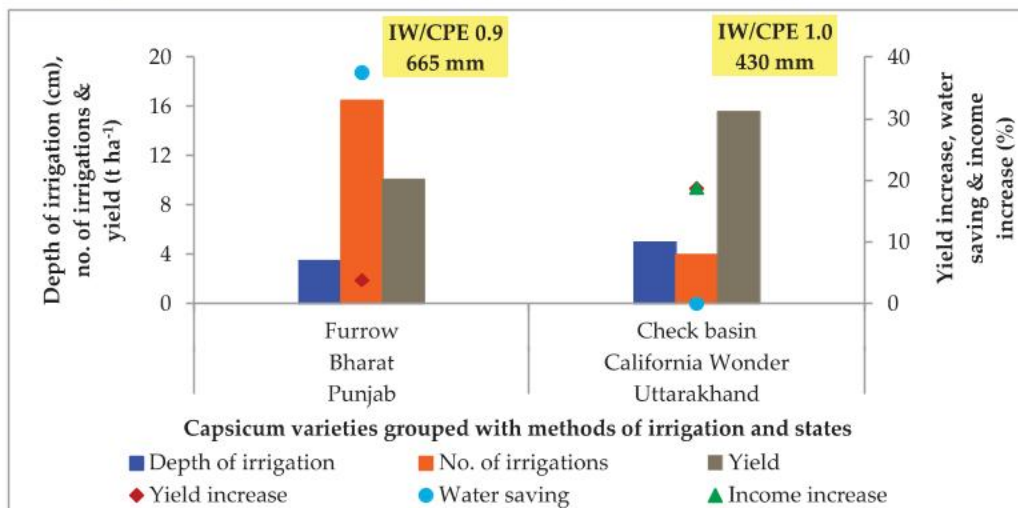


Ginger under check basin irrigation in West Bengal

Irrigation Scheduling in Capsicum

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	Bharat	Furrow	At IW/CPE 0.9 with straw mulch. Irrigation depth: 3.5 cm, Irrigation interval: 7-9 days (February-March), 3-5 days (April-June). No. of irrigations: 15-17, I: 578, R: 87, T: 665.	15.19	Adopted for water conservation and other allied benefits
Uttarakhand	California Wonder	Check basin	At IW/CPE 1.0. Irrigation depth: 5 cm, Irrigation interval: 33 days, No. of irrigations: 4, I: 200, R: 230, T: 430.	36.28	-

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling was optimized for capsicum crop for agro-ecological regions 4 and 14 involving the states of Punjab and Uttarakhand, respectively. Irrigation scheduling with improved irrigation method of check basin and furrow irrigations for two capsicum varieties resulted in 3 to 19%

increase in yield, water saving of 0-38% and about 19% higher income compared to conventional practice. The technology has been adopted by farmers of Punjab for water conservation and allied benefits.

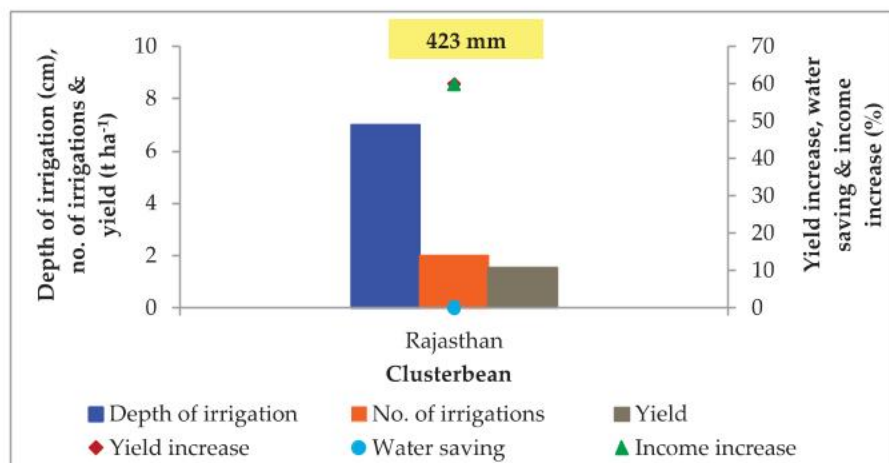


Capsicum under furrow irrigation in Punjab

Irrigation Scheduling in Clusterbean (Guar)

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	Maru Guar (2470/12)	Check basin	Irrigation depth: 7 cm, Irrigation interval: 30-40 days, No. of irrigations: 2 (at branching & pod development stages), I: 240 (including 100 mm pre-sowing irrigation), R: 183, T: 423.	3.66	Included in POP after verification on ATC as well as on farmers' field in Rajasthan

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow box in the chart

Irrigation scheduling was optimized for clusterbean crop for agro-ecological region 2 in the state of Rajasthan. Irrigation scheduling with improved irrigation method of check basin irrigation resulted in 60% higher yield as well as income compared to the conventional practice. The technology has been included in the package of practices and adopted by farmers.

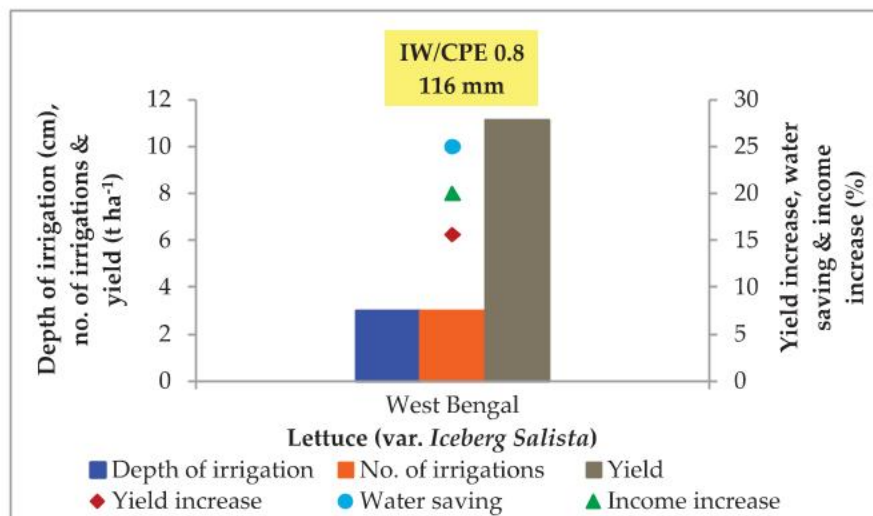


Clusterbean under check basin irrigation at Rajasthan

Irrigation Scheduling in Lettuce

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
West Bengal	Iceberg Salista (F1 hybrid)	Furrow	At IW/CPE 0.8 with N @ 50 kg ha ⁻¹ as fertilizer and N @ 50 kg ha ⁻¹ as vermicompost. Irrigation depth: Pre-planting irrigation 2 cm and remaining 3 cm depth, Irrigation interval: 25-30 days, No. of irrigations: 3, I: 110, R: 6.4, T: 116.4.	96.03	Recommended to New Alluvial Zone (WB-4) for adoption

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow box in the chart

Irrigation scheduling was optimized for lettuce crop for agro-ecological region 15 involving the state of West Bengal. Irrigation scheduling with furrow irrigation resulted in 16% higher yield, 25% water saving and 20% higher income compared to the conventional practice. The technology has been recommended for New Alluvial Zone 4 of West Bengal.

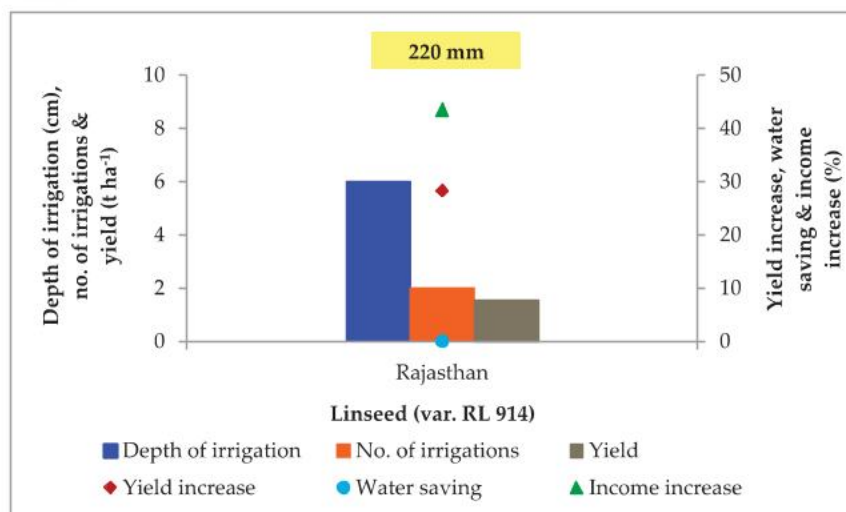


Lettuce under furrow irrigation in West Bengal

Irrigation Scheduling in Linseed

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	RL 914	Check basin	Irrigation depth: 6 cm, Irrigation interval: 45 days, No. of irrigations: 2 (at branching & capsule formation), I: 220 (including 100 mm pre-sowing irrigation), R: 0, T: 220.	7.05	Included in package of practices for <i>rabi</i> crops for Agro-climatic Zone V

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Total water applied given in yellow box in the chart

Irrigation scheduling was optimized for linseed crop for agro-ecological region 5 in the state of Rajasthan. Irrigation scheduling with check basin irrigation resulted in 28% higher yield and 44% higher income compared to the conventional practice. The technology has been included in the package of practices for Agro-climatic Zone V of Rajasthan.

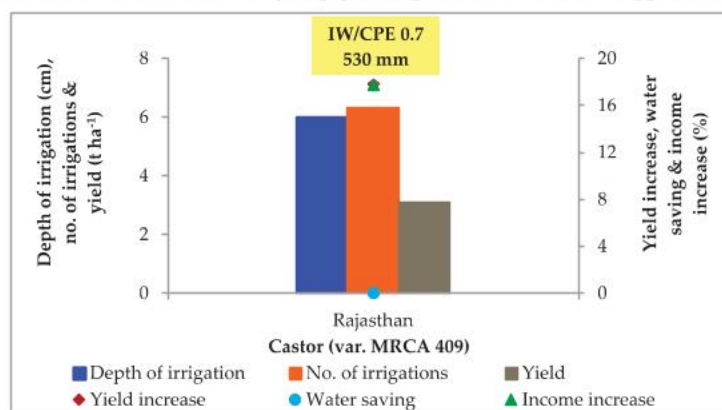


Linseed under check basin irrigation in Rajasthan

Irrigation Scheduling in Castor

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	MRCA 409 (<i>Dhal</i>)	Check basin	At IW/CPE 0.7. Irrigation depth: 6 cm, Irrigation interval: 30, 45, 85, 110, 145, 205 DAS, No. of irrigations: 6, I: 380, R: 150, T: 530.	5.85	Included in POP after verification on ATC as well as on farmers' field in Rajasthan

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow box in the chart

Irrigation scheduling was optimized for castor crop for agro-ecological region 2 involving the state of Rajasthan. Irrigation scheduling with check basin irrigation resulted in 18% higher yield as well as income compared to the conventional practice. The technology has been included in the package of practices and also adopted by farmers in Rajasthan.

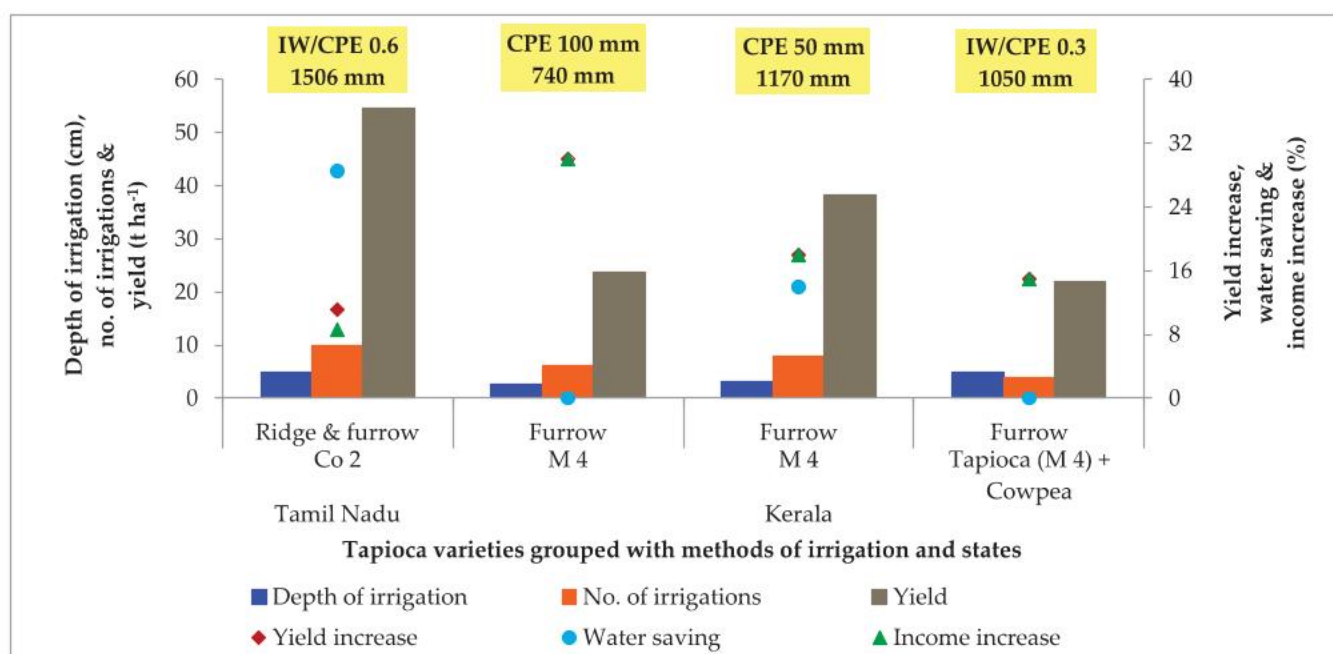


Castor under check basin irrigation at Rajasthan

Irrigation Scheduling in Tapioca/Cassava

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Tamil Nadu	CO 2	Ridge & furrow	At IW/CPE 0.6. Irrigation depth: 5 cm, Irrigation interval: 15 days, No. of irrigations: 10, I: 500, R: 1006, T: 1506.	36.32	Demonstrated at farmers' field in Tamil Nadu
Kerala	M4	Furrow	At CPE 100 mm. Irrigation depth: 2.5 cm, Irrigation interval: 27 days, No. of irrigations: 6, I: 150, R: 590, T: 740.	31.91	Adopted by department of Agriculture and recommended to the farmers (POP recommendation of KAU, p-65)
	M4	Furrow	Surge irrigation at CPE 50 mm. Irrigation depth: 3 cm, Irrigation interval: 12 days, No. of irrigations: 8, I: 240, R: 930, T: 1170.	32.85	
	M4 (Intercropped with cowpea)	Furrow	At IW/CPE 0.3. Irrigation depth: 5 cm, Irrigation interval: 36 days, No. of irrigations: 4 I: 200, R: 850, T: 1050.	20.93	

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the chart

Irrigation scheduling in tapioca was optimized in the states of Tamil Nadu and Kerala. Irrigation scheduling with improved surface irrigation methods like furrow and ridge and furrow irrigation to two tapioca varieties resulted in 11 to 30% increase in yield, 0-29% water saving and 8 to 30% higher income compared to the conventional practice. Recommendations have been successfully transferred to line departments and farmers with wide adoption in the local areas. In Tamil Nadu, the technology has been demonstrated on farmers' field. In Kerala, the technology has been adopted by the Department of Agriculture and included in recommended package of practices of the state.



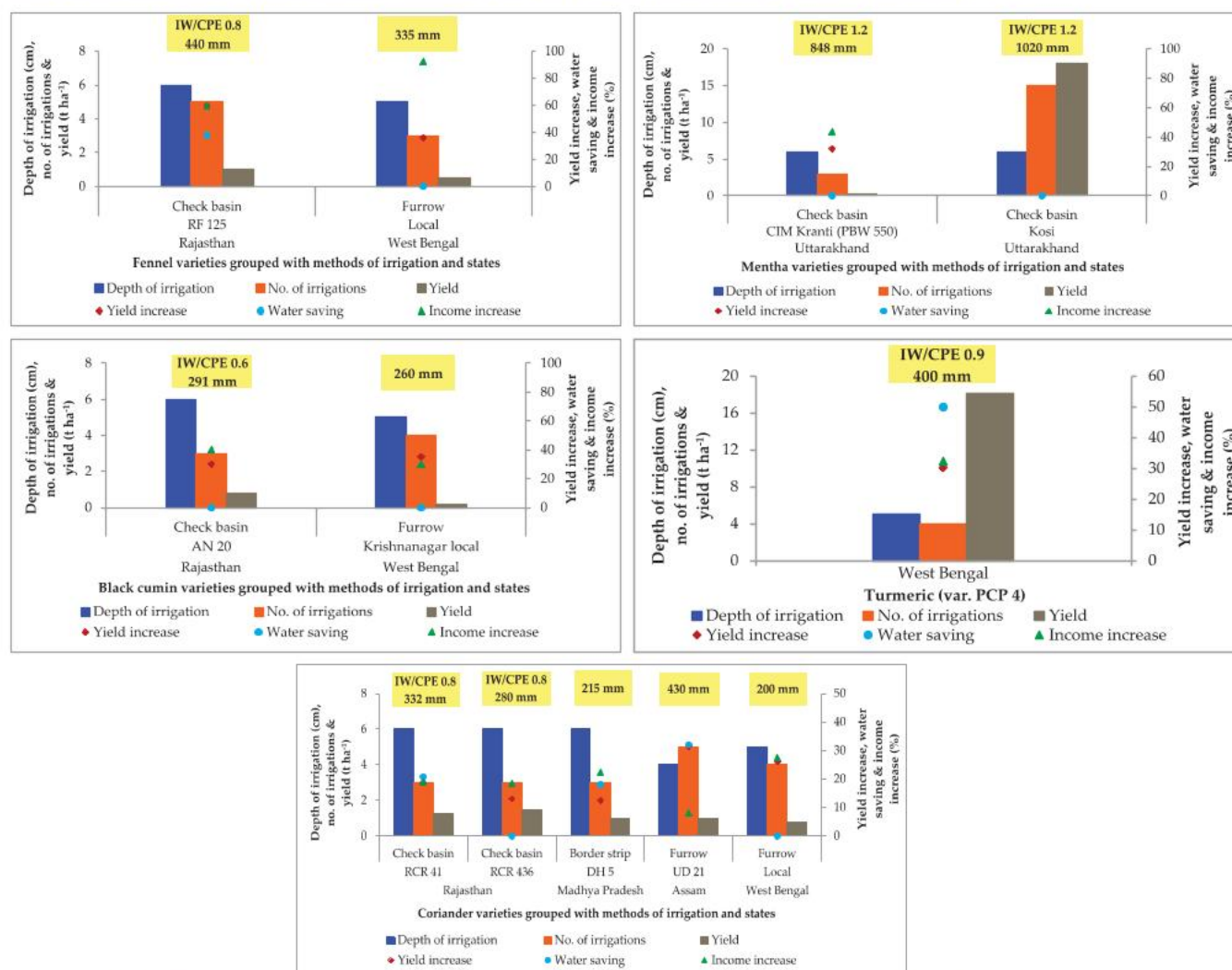
Tapioca under ridge and furrow irrigation in Tamil Nadu

Irrigation Scheduling in Spices and Medicinal Crops

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	Fenugreek (RMT 143)	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: At 25, 65, 88 & 120 DAS, No. of irrigations: 4, I: 310 (Including 70 mm pre-sowing irrigation), R: 39, T: 349.	7.88	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
Rajasthan	Fennel (RF 125)	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: At 15, 48, 100, 140 & 160 DAS, No. of irrigations: 5, I: 400 (Including 100 mm pre-sowing irrigation), R: 40, T: 440.	2.36	
West Bengal	Fennel (Local cultivar)	Furrow	Irrigation depth: 5 cm, Irrigation interval: 25-28 days, No. of irrigations: 3, I: 150, R: 185, T: 335.	1.43	Recommended to New Alluvial (WB-4) for adoption
Uttarakhand	Mentha (CIM Kranti)	Check basin	At IW/CPE 1.2. Irrigation depth: 6 cm, Irrigation interval: 15-20 days interval in February-March; 10 days interval in April; 7 days interval in May-June, No. of irrigations: 10-11, I: 609, R: 239, T: 848.	0.27 (for oil)	Information has been passed on to line department and extension department
Uttarakhand	Mentha (Kosi)	Check basin	At IW/CPE 1.2. Irrigation depth: 6 cm, Irrigation interval: 15-20 days interval in February-March; 10 days interval in April; 7 days interval in May-June, No. of irrigations: 15, I: 900, R: 120, T: 1020.	17.75 (for herbage)	
Rajasthan	Coriander (RCR 41)	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: At 28, 80, 125 DAS, No. of irrigations: 3, I: 260 (including 80 mm pre-sowing irrigation), R: 72, T: 332.	3.64	Included in POP after verification on ATC as well as on farmers' field in Rajasthan
Rajasthan	Coriander (RCR 436)	Check basin	At IW/CPE 0.8. Irrigation depth: 6 cm, Irrigation interval: 23-43 days, No. of irrigations: 3, I: 280 (Including 100 mm of pre-sowing irrigation), R: 0, T: 280.	5.25	Included in package of practices for <i>rabi</i> crops for Agro-climatic Zone V
Madhya Pradesh	Coriander (DH 5)	Border strip (85-90% cut-off)	Irrigation depth: 6 cm, Irrigation interval: 20 days (at 20, 40 & 60 DAS), No. of irrigations: 3, I: 180, R: 35, T: 215.	4.47	As per RRA data this technology adopted in more than 24,000 hectares in Gird region of MP
Assam	Coriander (UD 21)	Furrow	Irrigation depth: 4 cm, Irrigation interval: 15-18 days, No. of irrigations: 5, I: 200, R: 230, T: 430.	2.33	Technology approved for recommendation through POP of field and horticultural crops.
West Bengal	Coriander (Local cultivar)	Furrow	Irrigation depth: 5 cm, Irrigation interval: 12-15 days, No. of irrigations: 4, I: 200, R: 0, T: 200.	3.95	Recommended to New Alluvial Zone (WB-4) for adoption

State	Variety	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Rajasthan	Black cumin (Ajmer Nigella 20)	Check basin	At IW/CPE 0.6. Irrigation depth: 6 cm, Irrigation interval: 35-40 days, No. of irrigations: 3, I: 280 (Including 100 mm pre-sowing irrigation), R: 11, T: 291.	2.82	Included in package of practices for <i>rabi</i> crops for Agro-climatic Zone V
West Bengal	Black cumin (Krishnanagar local)	Furrow	Irrigation depth: 5 cm, Irrigation interval: 18-29 days, No. of irrigations: 4, I: 200, R: 60, T: 260.	0.58	Recommended to New Alluvial Zone (WB-4) for adoption
West Bengal	Turmeric (PCP 4)	Furrow	At IW/CPE 0.9. Irrigation depth: Pre-sowing irrigation of 2 cm and remaining irrigations 5 cm depth, Irrigation interval: 25-30 days, No. of irrigations: 4, I: 220, R: 180, T: 400.	45.25	
West Bengal	Sarpagandha (Nadia local)	Furrow	At IW/CPE 0.9 along with N @ 40 kg/ha as fertilizer + N @ 40 kg/ha as vermicompost. Irrigation depth: 5 cm, Irrigation interval: 20-50 days, No. of irrigations: 6, I: 300, R: 964, T: 1264.	1.00	
Uttarakhand	European dil (Improved local variety)	Check basin	At 80% available soil moisture. Irrigation depth: 7 cm, Irrigation interval: 25-20 days interval in February-March; 15 days interval in April, No. of irrigations: 3, I: 220, R: 145, T: 365.	6.58	Information has been passed on to line department and extension department

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the above charts

Irrigation scheduling has been done for a wide range of spices and medicinal plants for different agro-ecological region (AER) viz., 2, 4, 5, 9 and 15. Irrigation scheduling with surface irrigation methods like furrow, check basin and border strip irrigation were used for fenugreek (*Trigonella foenum-graecum*), fennel (*Foeniculum vulgare*), coriander (*Coriandrum sativum*), European dill (*Anethum graveolens*), mentha (*Mentha sp.*), black cumin (*Nigella sativa*), turmeric (*Curcuma longa*) and sarpagandha or Indian snakeroot (*Rauvolfia serpentina*). Most of the crops have shown improved yield, water saving and higher net return compared to conventional practice. Fenugreek crop grown in AER 2 with check basin irrigation showed 108% higher yield, 35% water saving and 108% higher net return. Fennel crop grown in AER 2 and 15 with check basin and furrow irrigation, respectively resulted in 26-59% higher yield, 59-92% higher income and upto 38% water saving

compared to conventional practice of flood irrigation. Coriander crop in AER 2, 4, 5 and 15 grown with check basin, border strip, furrow irrigation methods showed 12-31% higher yield, 8-28% higher net income and 0- 32% water saving against conventional practice. Black cumin crop grown in AER 5 and 15 with check basin and furrow irrigation resulted in 30-35% higher yield and 28-40% higher income compared to the conventional flood irrigation. Mentha crop grown with check basin irrigation in AER 9 showed 32% higher oil yield, 356% higher herbage yield and 43% higher profit from menthe oil compared to flood irrigated mentha. Turmeric crop grown in AER 15 was grown with furrow irrigation gave 30% higher yield, 50% water saving and 32% more profit than turmeric grown with flood irrigation. The technologies have been successfully extended to line departments and farmers with wide adoption in the states.



Check basin irrigation in mentha
(Uttarakhand)



Furrow irrigation in turmeric
(West Bengal)



Check basin irrigation in coriander
(Rajasthan)

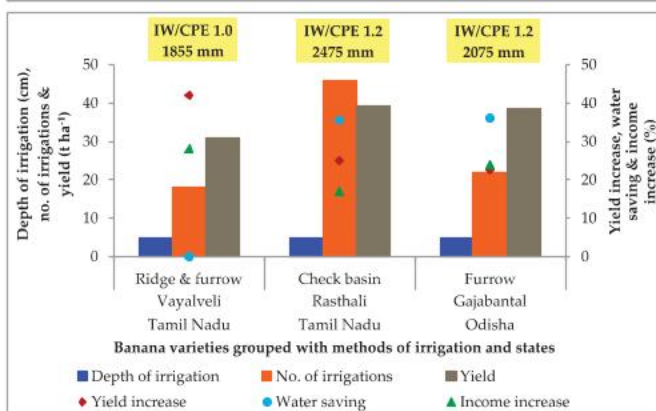
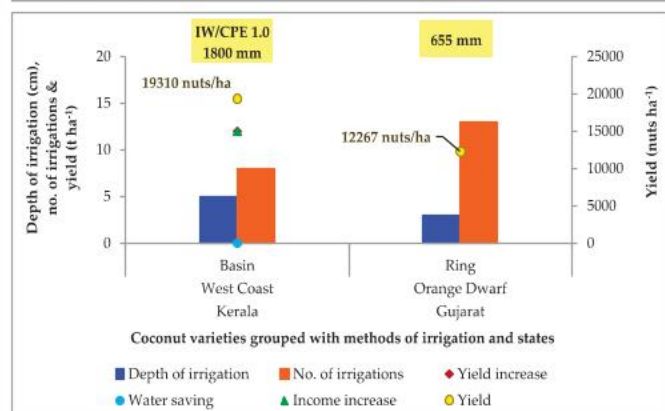
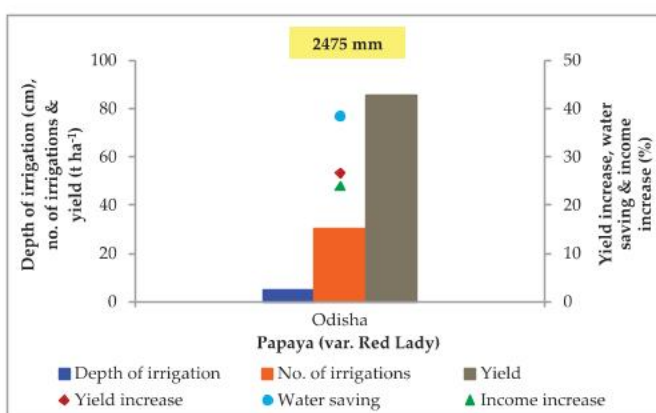
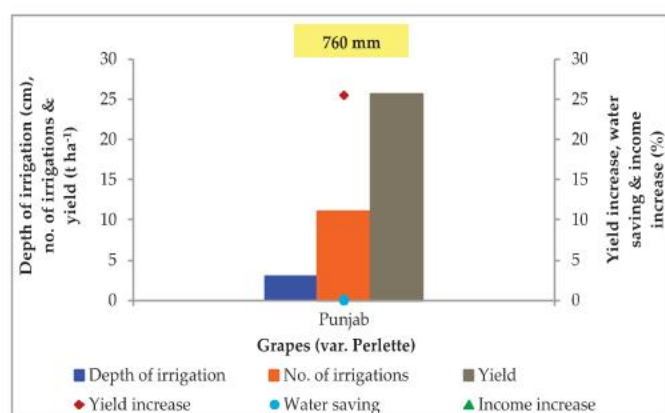
Spices and medicinal crops under improved surface irrigation methods

Irrigation Scheduling in Fruit Crops

State	Crop (Variety)	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Punjab	Grapes (Perlette)	Furrow	Alternate irrigation with canal water and tubewell water. Irrigation depth: 3 cm; Irrigation interval: 1 st fortnight of February- 1 irrigation, 1 st week of March- 1 irrigation, April- irrigation at 10 days interval, May- irrigation every week, June- 3-4 irrigations depending upon rainfall, Other months- need-based; No. of irrigations: 11 per year; I: 330-350; R: 430-480; T: 760-830.	33.68	Farmers have started adopting conjunctive use of canal water and tubewell water (1:1) in Punjab
Odisha	Papaya (Red Lady)	Basin	Irrigation depth: 5 cm, Irrigation interval: 7 days, No. of irrigations: 30 per year, I: 1500, R: 975, T: 2475.	34.46	Technology has been transferred to the State Government and KVKs through ZAREC and SLREC meetings
Kerala	Pineapple (Kew)	Furrow	At IW/CPE 0.6. Irrigation depth: 5 cm, Irrigation interval: 22 days, No. of irrigations: 5-6, I: 300, R: 1190, T: 1490.	30.70	Adopted by Department of Agriculture and recommended to the farmers (POP recommendation of KAU, p-223)

State	Crop (Variety)	Irrigation method	Recommended irrigation schedule and water applied (I, R, T in mm)	WUE (kg ha-mm ⁻¹)	Extension
Kerala	Coconut (West Coast)	Basin	At IW/CPE 1.0 Irrigation depth: 5 cm, Irrigation interval: 15 days, No. of irrigations: 8, I: 400, R: 1400, T: 1800.	10728 nuts per ha-mm	Adopted by Dept. of Agriculture and recommended to the farmers (POP recommendation of KAU, p-103)
Gujarat	Coconut (Orange Dwarf)	Ring	Irrigation depth: 3 cm, Irrigation interval: 25 days during summer & 20 days during winter, No. of irrigations: 13, I: 390, R: 265, T: 655.	18728 nuts per ha-mm	25% farmers have adopted the irrigation schedule
Tamil Nadu	Banana (Vayalveli)	Ridge & furrow	At IW/CPE 1.0. Irrigation depth: 5 cm, Irrigation interval: 15-20 days in different months depending on rainfall, No. of irrigations: 18, I: 929, R: 926, T: 1855.	16.60	Demonstrated at farmers' field in Tamil Nadu
Tamil Nadu	Banana (Rasthali)	Check basin	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 5-6 days, No. of irrigations: 46, I: 2300, R: 175, T: 2475.	15.80	
Odisha	Banana (Gajabantal)	Furrow	At IW/CPE 1.2. Irrigation depth: 5 cm, Irrigation interval: 12 days, No. of irrigations: 20-22, I: 1100, R: 975, T: 2075.	18.66	Technology has been transferred to the state government and KVKs through ZAREC and SLREC meetings

Note: I, Irrigation water applied; R, Effective rainfall during crop growth period; T, Total water applied to crop (I+R)



Note: Recommended irrigation schedule and total water applied given in yellow boxes in the above charts

Irrigation scheduling has been done for fruit crops for different agro-ecological region (AER) viz., 2, 12 and 19. Irrigation scheduling with surface irrigation methods like ring, basin and furrow irrigation were used for grapes, papaya, pineapple and coconut. Grapes were grown with conjunctive use of canal

water and groundwater using furrow irrigation method. There was 25.5% higher yield of grapes compared to irrigation with only groundwater. Farmers of Punjab are adopting the conjunctive use strategy of irrigating grapes crop with canal water and groundwater in the ratio 1:1 using furrow irrigation

method. Under AER 12, papaya crop was grown with basin irrigation and use of straw mulch. It showed about 27% higher yield, 38% water saving and 24% higher net income compared to basin irrigation without straw mulch. The technology has been transferred to the State Government line departments and KVKs for extension to farmers. Coconut was grown in AER 19 involving Kerala and Gujarat. The methods of irrigation employed were basin and ring irrigation. In Kerala, coconut showed 12% higher yield and income over rainfed cultivation. The technology has been adopted by the Department of Agriculture, Kerala, included on package of practices and recommended to farmers of the state. In Gujarat, the technology on coconut has been adopted by 25% farmers of the state. Pineapple crop was grown in AER 19 in the state of

Kerala. Furrow irrigation was applied with 99% yield and income gains over the rainfed crop. The technology has been adopted by the Department of Agriculture, Kerala, included on package of practices and recommended to farmers of the state. Irrigation scheduling of banana crop was optimized for agro-ecological regions 8 and 12 involving the states of Tamil Nadu and Odisha. Irrigation scheduling using check basin, furrow and ridge and furrow irrigation methods led to 22.5 to 42.0% increase in yield, upto 36.0% water saving and 17.0 to 28.0% higher income compared to the conventional flood irrigation. Technologies have been successfully demonstrated in farmers' fields in Tamil Nadu. In Odisha, the technology on banana has been transferred to the state government and KVKs through zonal and state level meetings.



Furrow irrigation in grapes (Punjab)



Basin irrigation in papaya (Odisha)



(a)



(b)

Banana crop under check basin irrigation in (a) Tamil Nadu and (b) furrow irrigation in Odisha

Conclusion

Irrigation scheduling is a crucial part of crop cultivation which determines the efficient use of water by crops. Employment of improved methods of surface irrigation along with irrigation scheduling facilitates efficient use of water and nutrient inputs. Extensive research has been conducted under the All India Coordinated Research Project on Irrigation Water Management (AICRP on IWM) to find out efficient surface irrigation schedule for a wide variety of crops across different network centres covering 14 agro-ecological regions of the country. This includes crops like wheat, rice, maize, sugarcane, cotton, potato, soybean, sunflower, safflower, groundnut, banana, greengram, blackgram, sorghum, brinjal, cauliflower, cabbage, tomato, okra, chilli, onion, fruit crops, spices, medicinal plants, etc.

This bulletin provides comprehensive information on irrigation schedules for 53 crops developed at different network centers of AICRP on IWM. This includes the information on location, soil texture, crop season, variety, irrigation method, irrigation depth, irrigation interval, total water applied, yield increase, water saving and increase in income. The irrigation schedules developed for different crops in different agro-ecological regions will help farmers to adopt suitable irrigation schedules. So there can be efficient agricultural water management apart from increasing crop yield and income of farmers. This is an extensive document that may be used as a reference by state governments, extension workers and farmers for preparation irrigation

schedule for irrigation water management. The irrigation schedules will facilitate economic use of water on farms, as well as to obtain potential crop yields along with higher income generation for farmers.

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