AICRPDA-BENGALURU TECHNICAL BULLETIN/01/2015

DRYLAND AGRICULTURE TECHNOLOGY PARK

- A Tool For Dryland Technologies And Contingency Plan

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University of Agricultural Sciences, GKVK, Bengaluru-560 065, Karnataka
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Front cover: **(Clockwise)** Agri-Horti system, Cowpea, Finger millet + Pigeonpea (8:2), Farm pond, Sunflower, Groundnut + Pigeonpea (8:2), Grain Amaranthus, Chilli with mulching, Niger, Agri-Tech Park

Back cover: Best field demonstration awards (2007-2014) during Krishimela at UAS, Bengaluru

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Dr. H. SHIVANNA
Vice-Chancellor

PREFACE

Improving productivity and profitability of dryland crops require adoption of combination of technologies in sequel at different stages of crop growth to harness the synergies. These technologies are demonstrated at the Dryland Technology Park for the benefit of farmers, visitors and dignitaries visiting the campus / center. The Dryland Technology Park comprised of technologies related to agricultural implements, soil and water conservation, efficient utilization of farm pond water, micro-watershed management for sustainable agriculture, contingent crop planning, suitable crop and varieties, soil health management and alternate land use systems. Importance of bioengineering structure *viz.*, live barriers and real time contingent crop plans profitably adopted are showcased for the benefit of farmers. The park is visited by 4-5 lakh farmers from different districts annually during Krishimela and they have been convinced about the technologies showcased.

The bulletin entitled "Dryland Agriculture Technology Park - A tool for Dryland Technologies and Contingency Plan" containing technologies which are demonstrated in Agri-Tech Park will be very useful to farmers, trainees and students. I compliment the efforts of Dryland Agriculture Project team in bringing out this publication. I hope this bulletin will help the researchers, extension workers and farmers in understanding the technologies which were suited to rainfed conditions and cause for further upscaling.

Bengaluru
10.8.2015

(H. SHIVANNA)
Vice - Chancellor

Vasantrao Naik Marathwade Krishi Vidyapeeth

Dr. B. VENKATESWARLU
Vice-Chancellor

FOREWORD

About 70 per cent of the cultivated area in India as well asKarnataka is under dryland agriculture. With yields from irrigated areasplateauing, dryland areas need to play crucial role in meeting thechallenge of future food demand. Accordingly, the productivity ofdryland agriculture need to be increased from the present 1t / ha to 2.5Uper ha.

The All India Co-ordinated Research Project on DrylandAgriculture at Bengaluru has carried out comprehensive research andevolved several technologies and practices for yield enhancement ofdryland crops even under the erratic rainfall conditions. The effectiveness of these technologies have been well demonstrated at theagri{ech park established in the university research farm at GKVK.

Some of the important technologies relate to selection of droughttolerant/shot1 duration crops/varieties, mid-season correctionsdepending on monsoon behaviour, standardization of in situ soil andwater conservation measures and land configuration for draining excesswater during high rainfall. Demonstrations in the technology park havebeen found very useful for convincing the farmers in accepting thetechnologies. The bulletin entitled Technology Park: An effective toolfor dissemination of dryland technologies has been prepared basedresearch results over several years. I congratulate the authors inbringing out this publication. I hope this bulletin will serve as a guide forthe dryland students, scientists, extension workers, policy makers andstudents to understand the importance of improved technologies forstabilizing production in dryland agriculture in Karnataka

Parbhani
August 17,2015

B. Venkateswarlu
(Dr. B. VENKATESWARLU)
Vice-Chancellor

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DRYLAND AGRICULTURE TECHNOLOGY PARK

1.0 Back ground information

Karnataka has the 2nd largest area under dry farming (7.0 m.ha) next to Rajasthan. Five out of ten Agro-Climatic Zones in Karnataka were classified as dry zones on the basis of rainfall, topography, soil types and dominant crops covering 63 per cent of the total geographical area and 70 per cent of the net sown area, with substantial contribution to agricultural production from dry lands. About 57 per cent of food grain production in Karnataka comes from rainfed areas while, 97 per cent of total pulses and 80 per cent oilseeds were produced in dry land areas. Over 68 per cent farmers in the state are small and marginal with poor investment and low risk bearing capacity. Major complexities relating to weather, soil and water conservation, soil health, crop, animal, socio-economic issues in the domain area are menacing the farmers frequently and affecting their existence and sustainability to continue in the present occupation.

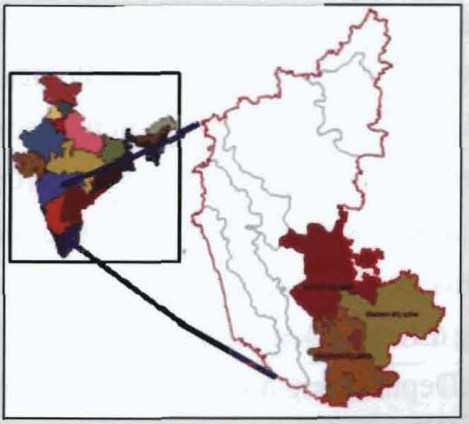


Fig. 1 Agro-climatic Zones of Domain area under AICRPDA, Bengaluru

Technology development needs dedicated efforts of scientists to solve the practical problems and adequate funds. Unlike in other spheres of science including irrigated agriculture and engineering, dryland agriculture technologies are slow to emerge and expand due to the vagaries of monsoon across season resulting in unevenness in conclusions. The horizontal spread of these technologies needs concerted efforts by the state extension machinery, NGO's and other who are directly involved in upscaling of dryland technologies for second green revolution to attain self-sufficiency in food production with comfortable food stocks.

All India Co-ordinated Research project for Dryland Agriculture started in 1971 at UAS, GKVK, Bengaluru to cater the research needs of dryland farmers in *Alfisols* of southern districts in Karnataka comprising of central, eastern and southern dry zones (Zone 4, 5 & 6) (Fig.1). The mandate of the centre is to cater the needs of dryland technologies suiting to the *Alfisols* of 10 domain districts in Southern Karnataka comprising Kolar, Chikkaballapur, Bengaluru (Rural), Bengaluru (Urban), Tumkur, Hassan, Mandya, Mysore, Ramanagara and Chamarajanagar (Fig. 2). Since then the centre has developed number of technologies on watershed management, rain water management, soil health and integrated nutrient management, crops and cropping systems, alternate land use systems, energy management, integrated farming systems and they have been recommended for large scale upscaling through Department of Agriculture, Watershed Development Department and Department of Horticulture. Further, through Operational Research Project on Dryland

Agriculture and National Innovations on Climate Resilient Agriculture, these dryland technologies have been demonstrated on large scale through action research in the farmers fields in the domain districts. The lessons learnt and experiences gained from each cluster have been incorporated for effective perpetuation of dryland technologies in the new clusters.

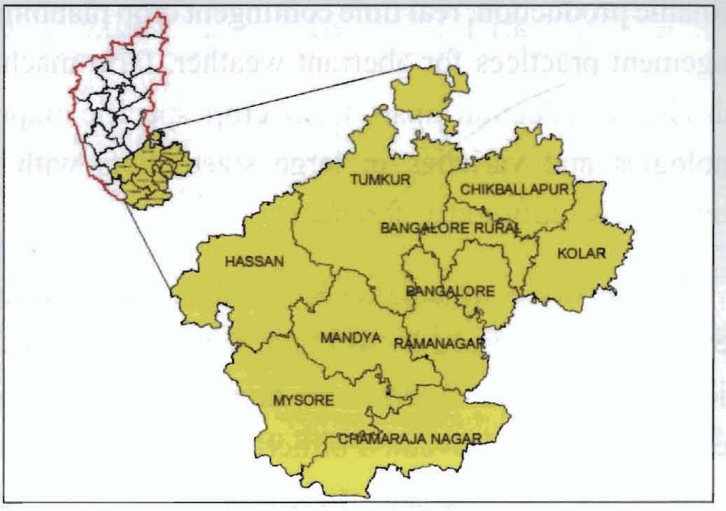


Fig. 2: Domain districts of AICRPDA, Bengaluru

The Agriculture Technologies developed or technologies in pipe line at the Dryland Agriculture Project, GKVK, UAS, Bengaluru or by the University were demonstrated at the Dryland Technology Park for the benefit of farmers, visitors and dignitaries visiting the center. The technologies relating to dryland agriculture evolved over 40 years are conceptualized to demonstrate in crystalized form as 'Dryland Technology Park' at Dryland Agriculture Project during 2007 for the benefit of its stake holders. Since then on annual basis, the Dryland Agri-Tech Park is being commissioned with wide arrey of technologies comprising of

micro watershed management for sustainable agriculture, *in-situ* moisture conservation, farm pond technology for *ex-situ* rain water harvesting and its multiple use in agriculture, *in-situ* and *ex-situ* green manuring for sustainable soil health, balanced fertilization including micronutrients, integrated nutrient management, contingent crops, cropping systems and varieties for different sowing windows, cropping systems for sustainable production, real time contingent crop planning and management practices for aberrant weather, farm machinery for drudgery reduction apart from crop specific improved technologies and varieties in large sized plots with clear convincing visibility and differences.

University is organizing Krishimela - a mega farmer fair every year witnessed by 4-5 lakh farmers from different districts of Karnataka. Apart from farmers, planners, policy makers also visit the event. Further, a number of farmers, students, scientists, extension functionaries, policy makers, entrepreneurs visit the University on several occasions *viz.,* trainings, workshops, seminars, exposure visits *etc.,* for amplification of their knowledge on agriculture in general and Dryland farming in particular. The details of the stakeholders visit to dryland agriculture project are summarized below.

Table 1: Details of the stakeholders visit toDryland Agri-Technology Park

Year	Farmers	Officials / extension workers	Students	Impact
2007	4,00,017	11	122	Convinced about the technology and several farmers have adopted these in their field
2008	3,00,330	53	150	
2009	5,00,064	103	238	
2010	7,19,069	115	176	
2011	4,00,059	186	216	
2012	1,010*	225	356	
2013	22,50,156**	318	554	
2014	5,00,000	379	170	

Note* Krishimela was not organized due to the drought year

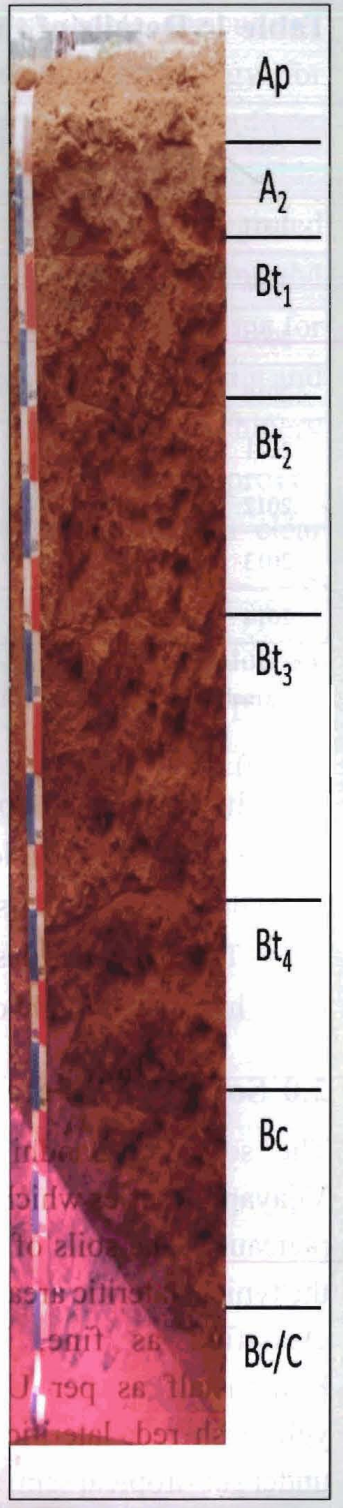
** International Krishimela organized as a part of Golden Jubilee year of the University

It is worthy to note that the "Dryland Agri-Tech Park" bagged the "Best Field Demonstration" award from UAS Bengaluru during Krishimelas successively from 2007 to 2014. The structure, design, operation of "Dryland Agri-Tech Park" has been brought out in this book.

2.0 Soil and Climate at AICRPDA, GKVK

The soils of Gandhi Krishi Vignana Kendra belong to Vijayapura series which is a dominant soil series of Bengaluru plateau. The soils of Dryland Agriculture Project represent the typical lateritic area of Bengaluru plateau. These soils are classified as fine, kaolinitic, isohyperthermic, Typic Kandiustalf as per USDA classification. These soils are yellowish red, lateritic and are derived from granite-gneiss under sub-tropical semi arid climate. They are very deep, well

drained sandy loam to sandy clay loam occurring in nearly level to gently sloping lands. The texture of surface horizon is sandy loam and B horizon is having clay texture, which becomes finer with depth. The soil reaction is acidic in the surface and increases towards alkaline range with depth. The colour is red due to the presence of ferric oxide with varying degrees of hydration in a state of dispersion rather than its content which is of the order of 5 to 8 per cent. The field capacity varies from 14.3 per cent on the top to 21.8 per cent in the sub-soil. The permanent wilting point of the soil ranges from 6.5 to 13.1 per cent. The available water content of the soil is 10.46 cm for the first 90 cm depth. The maximum water holding capacity is about 30 per cent. Bulk density of the soil ranges from 1.59 to 1.42 g/cc and decreases with depth. These soils have high infiltration rate which varies from 4 to 6 cm/hour. The soils are low in available nitrogen, medium to high in available phosphorus and medium in potassium.



The normal annual rainfall of the zone is 928 mm in 57 rainy days ranging from 528 to 1374 mm with 23 per cent co-efficient of variability. The rainfall is received in two peaks during May (100 mm) and August-September (132-201 mm). The major share is from South-West monsoon (June-September) with 518 mm accounting to 55.76 per cent followed by North-East monsoon (October-December) with 234 mm accounting to 25-30 per cent. In the domain area April, May and June are the hot months while, November, December and January are the cold months. Mean daily evaporation was higher during April and May and was lower during October to December. Similar trend was observed with respect to PET, which is maximum during April (6.0 mm) followed by May (5.3 mm) and June (4.8 mm). The rainfall distribution across the months at GKVK and the number of rainy days are indicated in figure 3.

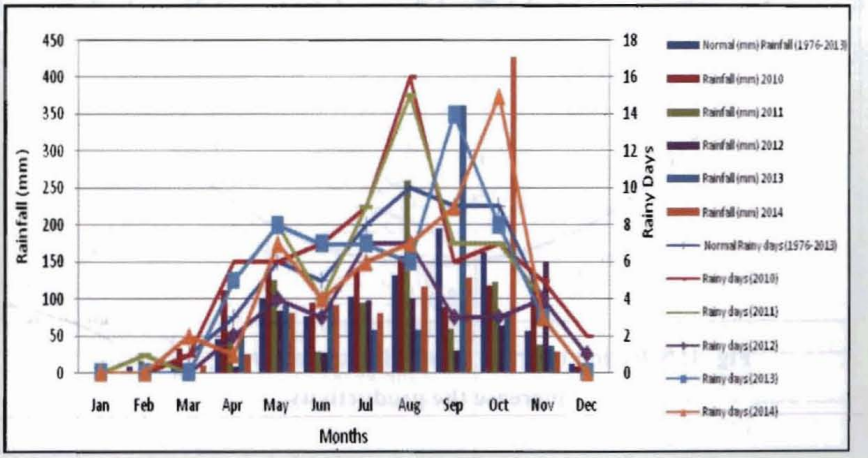


Fig. 3: The normal and actual rainfall at GKVK during 2010 to 2014

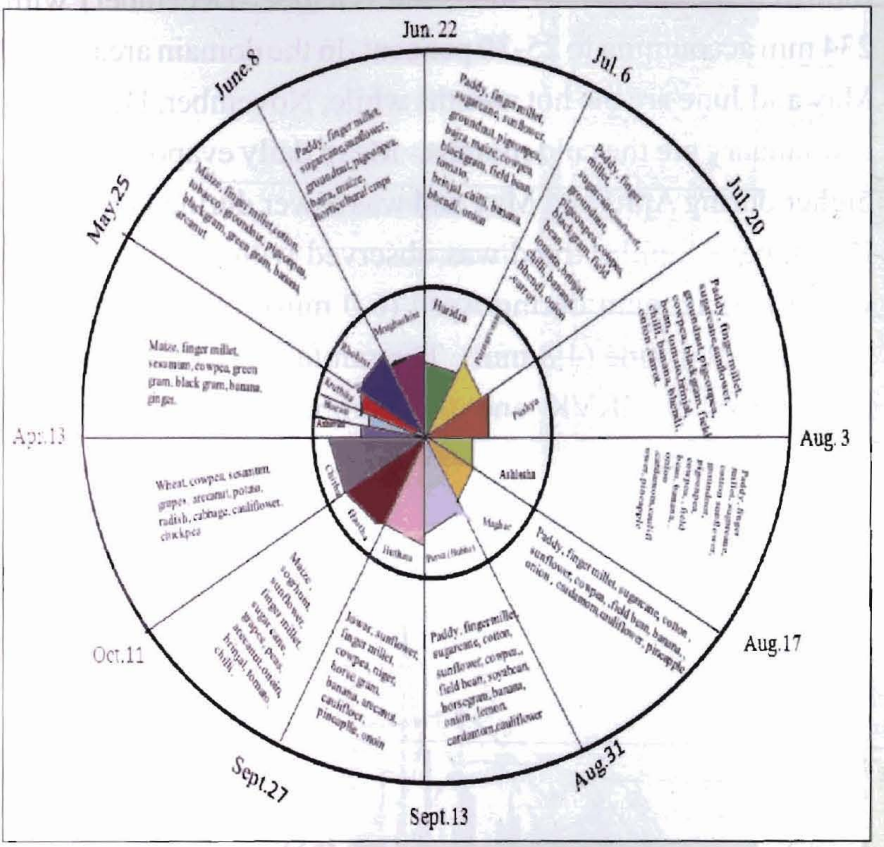


Fig. 4: Selection of crops depending upon sowing widow to increase the productivity

Table 2: Rainfall stars, duration and quantity of rainfall

Sl.No.	Rainfall stars	Rainfall duration	No. of days	Mean rainfall (mm)
1	Purvashada	Dec. 29- Jan.10	13	1.4
2	Uttara bhadrapadha	Jan.11- Jan. 23	13	0.3
3	Sharavan	Jan. 24 - Feb. 5	13	0.1
4	Dhanishta	Feb. 6 - Feb.18	13	4.6
5	Shathabisha	Feb.19-Mar.3	13	4.8
6	Purva bhadrapadha	Mar.4-Mar.17	14	8.5
7	Uttara bhadra	Mar.18-Mar.30	13	6.4
8	Revathi	Mar.31-Apr.13	14	14.4
9	Ashiwini	Apr.14-Apr.26	13	29.2
10	Bharani	Apr.27-May.10	14	31.2
11	Kruthika	May.11-May.24	14	45.0
12	Rhohini	May.25-Jun.7	14	60.1
13	Mrughashira	Jun.8-Jun.21	14	34.5
14	Haridra	Jun.22-Jul.5	14	18.9
15	Purnarvasu	Jul.6-Jul.19	14	50.0
16	Pushya	Jul.20-Aug.2	14	54.5
17	Ashlesh	Aug.3- Aug.16	14	55.1
18	Maghae	Aug.17-Aug.30	14	63.9
19	Hubha	Aug.31-Sep.12	13	79.8
20	Huthara	Sep.13- Sep.26	14	94.0
21	Hastha	Sep.27-Oct.10	14	104.4
22	Chitha	Oct.11-Oct.23	13	55.4
23	Swathi	Oct.24-Nov.5	13	50.1
24	Vishaka	Nov.6- Nov.19	14	26.1
25	Anuradha	Nov.20-Dec.2	13	13.0
26	Jesta	Dec.3- Dec.15	13	6.9
27	Moola	Dec.16-Dec.28	13	4.4

3.0 Components in Dryland Technology Park

The major components demonstrated under dryland agriculture technology park are

1. ***In-situ* moisture conservation:** Contour ploughing, fall ploughing, summer ploughing, contour cultivation, sowing across the slope, opening of moisture conservation furrow.

2. **Soil health management with double cropping / green manuring:** *In-situ* and *Ex-situ* incorporation of green manuring.

3. **Different methods of crop establishment in finger millet and pigeonpea:** Dry sowing of finger millet, Direct and transplanting of finger millet and pigeonpea.

4. **Integrated nutrient management practices for finger millet and groundnut:** Application of organic and inorganic fertilizers including micronutirents and lime.

5. **Contingent crop varieties for different sowing windows in finger millet:** Based on rainfall distribution sowing of long, medium and short duration varieties of finger millet.

6. **Improved varieties in major crops:** Finger millet (MR-1, GPU-28, GPU-48), Groundnut (ICGV91114, JL-24), Pigeonpea (BRG-1, BRG-2, BRG-5), Maize (Hema and Nityashree)

7. **Major intercropping systems for the Zone:** Finger millet+ pigeonpea (8:2), Groundnut+ pigeonpea (8:2), Pigeonpea + Field bean (1:1), Pigeonpea + cowpea (1:1), Pigeonpea + soyabean (1:1).

8. **Contingent crops for delayed sowing:** Sunflower, niger, minor millets, field bean, cowpea, rice bean, horse gram and other pulses.

9. **Nipping in castor:** Castor (DCS-9)

10. **Drought mitigation practices:** Spraying of 1% potassium chloride, Thiourea @ 2 %, 2 % potassium nitrate.

11. **Micro watershed management for sustainable agriculture:** Growing of bio engineering structures, vegetative barriers (*khus* and *nase* grasses).

12. **Farm pond technology and multiple use of water:** Brick lining, Brick compartment technology, azolla cultivation, fish rearing, kitchen garden, protective irrigation for field crops.

13. **Double cropping system using pond water:** Fodder crops followed by chickpea, chilli.

14. **Suitable implements for drudgery reduction in dryland areas:** Use of hand weeders, animal drawn implements and tractor drawn implements.

The technologies emerged under each component in the centre pertaining to the dryland agriculture are demonstrated in a compact block with each technology in 19 X 5.7 m plot size. The plan and layout map of dryland technology park is detailed in Fig. 5.

Apart from these, *Ex-situ* rainwater harvesting though farm pond, lining materials for farm pond, multiple use of harvested farm pond water, dryland mechanization, impact of balanced nutrition and crop rotation, alternate land use systems *viz.*, Agri-horti, Agro-forestry systems were also demonstrated for the visitors with large sized experimental units / demonstrations.

The details of the each technology are discussed here under..

3.1 *In-situ* moisture conservation

Moisture conservation is one of the important practice which increases yield of most of the crops under Dryland condition. Conservation of rainwater received in each plot through various practices are demonstrated here;

A. *Khus* and *Nase* grass as live bunds between contour bunds. Bio engineering structures *viz.*, *Khus* and *Nase* grass were planted at 15 m interval between contour bunds to reduce soil loss by erosion and conserve moisture for longer period and facilitate better yield of crops.

Performance:

- The average yield increase in finger millet : 50.96%
- Reduced soil loss by : 36%
- Reduced runoff by : 11-12%

Table 3: Performance of finger millet under *in-situ* moisture conservation practices

Year	Finger millet yield (kg ha^{-1})				
	Khus	*Nase*	Mean	*State Average	% increase
2007-08	2228	2503	2366	1642	44.09
2008-09	3136	3339	3238	1466	120.87
2009-10	1842	2228	2035	1565	30.03
2012-13	1883	2137	2010	1871	07.43
2013-14	2388	2638	2513	1512	66.20
Average	2295	2569	2432	1611	50.96

Note: 1) *State Average yield includes the pooled yield of rainfed (95%) & irrigated (5%)
2) 2010-11& 2011-12-Finger millet crop was not taken

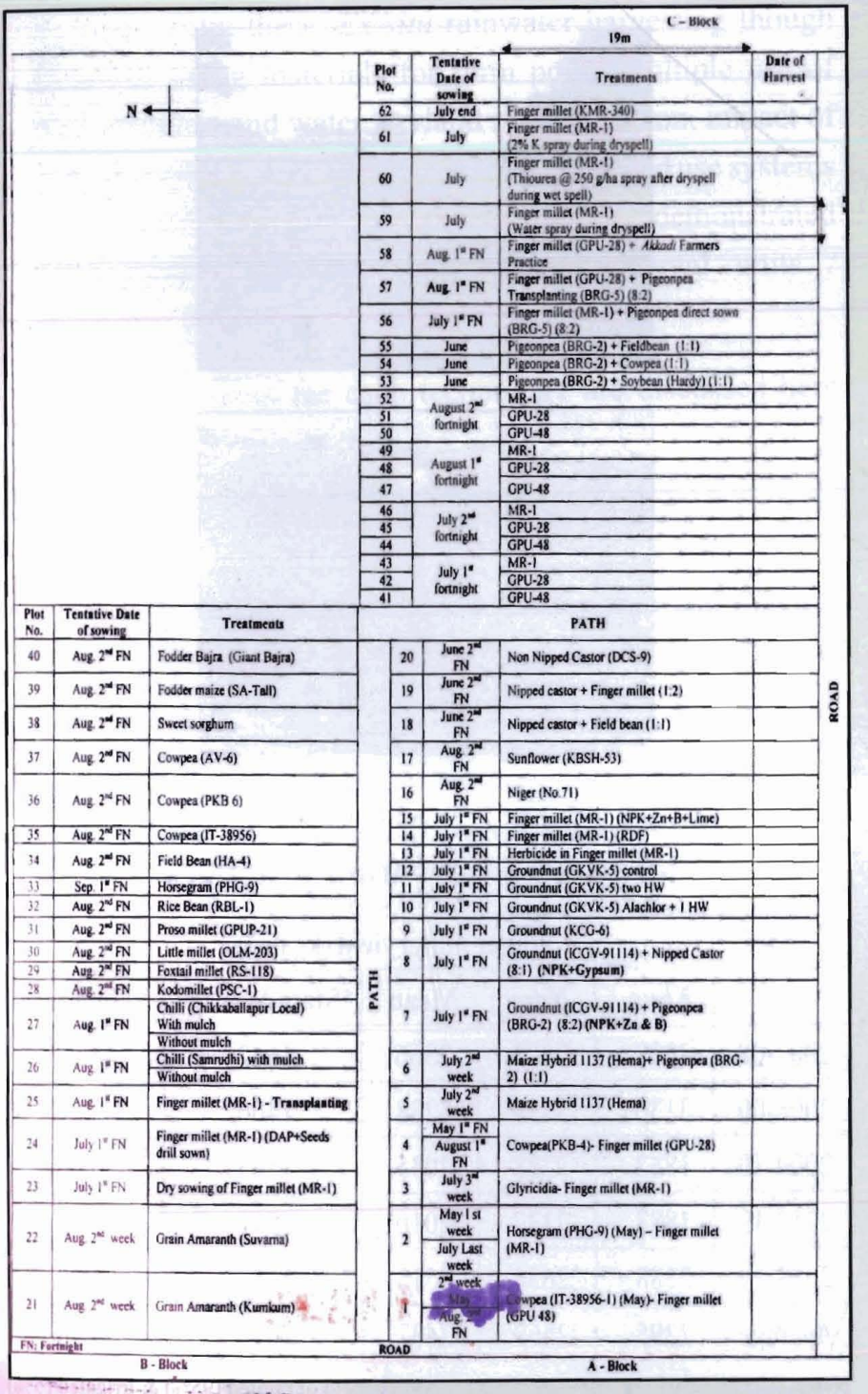


Fig. 5: Plan of Dryland technology park at AICRPDA, Bengaluru

B. **Contour cultivation practices *viz.*, sowing, inter-cultivation *etc*:** Contour farming involves aligning plant rows and tillage lines at right angles to normal flow of runoff. It creates storage space in the soil surface horizon and slows down the runoff, thus giving the water time to infiltrate into the soil. Contour farming is envisaged in all the demonstrations, whose effect is 15-20% higher yield across the crops.

C. **Tied ridging and Mulching:** Tied ridging is practiced in widely spaced crop by earthing up soil from inter-row and placing to the base of crop row with staggered bunds. Opening of ridges and furrows with addition of cross ties in the furrow creates a series of individual basins that increases the surface retention capability to hold surface water. This system allows more time for water to infiltrate into the soil and increases crop growth and yield. Mulching is the practice of "retaining crop residues on the soil surface". After harvest of the *kharif/rabi* crops, all the residues of sunflower, pigeonpea straws with leaf litter, stubbles of sorghum, straw of chickpea etc. Tied ridges were formed at 20-25 DAT and organic mulches available in the farm *viz.*, thinned excess plants, weeds before seed setting are mulched in chilli with an intension to curtail evaporation losses, increase infiltration, reduce soil loss and improve the soil health.

Samrudhi chilli with and without mulch at 39 DAT

Samrudhi chilli with and without mulch at 61 DAT

Table 4: Performance of chilli under mulching

Year	Chilli fruit yield (kg ha^{-1})		
	Demo	State Average	% increase
2011-12	1883	1115	68.88
2012-13	1840	898	104.90
2013-14	2077	1140	82.19
Average	1933	1051	83.92

Performance:

- Increased fruit yield :30%
- Incremental net returns : 102%

D. Ridges and furrows in widely spaced crops: The ridges and furrows are formed using ridger at spacing of 45 cm across the slope. These ridges and furrows are retained till the crop harvest. The rainwater is conserved in the furrows where it falls as the ridges and furrows provide more opportunity time for water to infiltrate into the soil. Ridges and furrows were demonstrated in widely spaced crops *viz.*, maize, sunflower, chilli, castor, pigeonpea etc with an intension of better anchorage to the crop and to prevent lodging, conservation of rain water and safe disposal of excess rain water. The practice is accepted by more farmers in dry regions as the impact of the practice is more during sub-optimal rainfall years.

Performance:

- Increased crop yield: 20-25%

Maize with ridges and furrow

Sunflower with ridges and furrow

Chilli with ridges and furrow

Castor with ridges and furrow

E. **Moisture conservation furrow:** Paired row planting of pigeonpea (60 cm rows) under finger millet and groundnut (30 cm rows) intercropping in 8:2 row proportion was demonstrated with moisture conservation furrow between paired rows of pigeonpea. The conservation furrow was opened during inter-cultivation at 25-30 DAS using a bullock drawn plough to a depth of 15-20 cm and 45 cm width. The conservation furrow helps for *in-situ* moisture conservation by reducing runoff, soil loss and increasing infiltration. Further, it also helps in draining excess water under high rainfall situation.

Finger millet + Pigeonpea (8:2) with conservation furrow

Groundnut + Pigeonpea (8:2) with conservation furrow

Table 5: Performance of moisture conservation furrow

Year	Moisture conservation furrow		
	Finger millet + Pigeonpea (8:2)		Groundnut + Pigeonpea (8:2)
	Grain/seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Grain/seed yield (kg ha^{-1})
2010-11	1902 (163)*	4484	-
2011-12	4130 (487)*	-	642 (365)*
2012-13	3000	4000	1076 (139)*
2013-14	4000 (166)*	-	646 (351)*
2014-15	2650 (286)*	-	480 (840)*
Average	3136 (275)*	4242	711 (424)*

*Figures in parenthesis indicates intercrop grain/seed yield (kg ha^{-1})

The average yield of finger millet + pigeonpea (8:2) system recorded grain yield of 3136 kg ha^{-1}, where as Groundnut + Pigeonpea (8:2) recorded 711 kg ha^{-1}.

3.2 Soil health management with double cropping / green manuring

Maintenance of soil health is another thrust to be addressed under dryland situation considering the pro-verb 'dryland soils are not only thirsty but also hungry'. Legumes as green manures or in crop rotation help in maintaining soil health and fertility. Bi-modal distribution of rainfall in the southern part of the state encourages double cropping. Hence, the following demonstrations were attempted under dryland technology park.

A. Double cropping of cowpea - finger millet:

Cowpea for grain purpose followed by finger millet helps in efficient utilization of available natural resources besides, atmospheric nitrogen fixation (25-30 kg ha^{-1}) and addition of residual biomass. Short duration cowpea (IT 38956-1 / PKB 4) can be sown during May-June and harvested during July-Aug.

First crop: Cowpea (April-May)

Second crop: Finger millet (Aug-Sep)

The haulm of cowpea can be used as a fodder or else can be incorporated into the soil. Nitrogen dosage can be reduced by 50 per cent to the finger millet if the cowpea haulm after harvest is incorporated and sown with medium / short duration variety (GPU-28 / GPU 48) during Aug-Sep.

Performance:

- Average system yield increment: 99.25%
- Nitrogen application for finger millet: 50% reduction
- Sustained soil health

Table 6: Performance of cowpea - finger millet double cropping system

Year	Crop yield (kg ha^{-1})					
	Cowpea	Finger millet	Straw	Finger millet equivalent	*State Average	% increase
2011-12	1423	3179	-	6341	1871	69.91
2013-14	972	3800	3500	6230	1512	151.32
Average	1197.5	3485	3500	6285	1751	99.25

B. ***In-situ* green manuring of horse gram - finger millet:** Encashing the early showers of rain during April / May, horse gram can be grown for *in-situ* green manuring. After 60-65 DAS during peak vegetative growth, horse gram is incorporated in to the same field followed by sowing of medium / short duration varieties of Finger millet during July with 50 per cent less nitrogen.

Incorporation of Horsegram in to the soil with rotovator

Finger millet (MR-1) after Green manuring of horse gram

Performance:

- Average finger millet yield increment: 92.25%
- Nitrogen application for finger millet : 50 % medium
- Sustained soil health

Table 7: Yield of finger millet with horse gram *in-situ* green manuring

Year	Crop yield (kg ha^{-1})			
	Finger millet	Straw	*State Average	% increase
2008-09	2682	6300	1466	82.95
2009-10	3958	2521	1565	57.00
2011-12	4482	-	2015	122
2012-13	3000	3300	1871	60.34
2013-14	3000	3000	1988	50.90
Average	3424	3780	1781	92.25

C. *Ex-situ* incorporation of glyricidia - finger millet:

Under low rainfall situation, biomass can be generated as ex-situ in drylands for soil health management through glyricidia on bunds at 2 m interval, pruning of crop residues can be incorporated. In an year biomass at 25kg/plant can be harvested three times and incorporation of 7.5 MT ha^{-1} of choffings 10-15 days prior to finger millet sowing with 50% reduced N dosage enhances yield of finger millet.

Performance

- *Glyricidia* plants on bunds / boundaries : 300- 325 plants ha^{-1}
- Atmospheric N fixation : 30-50 Kg ha^{-1}
- Green biomass equivalent N ha^{-1} : 25- 35 Kg
- Yield advantage in finger millet : 90.55%
- Improved soil health

Glyricidia Green manure on the bund

Incorporation of Glyricidia with rotovator

Finger millet after incorporation of glyricidia

Table 8: Yield of finger millet with *ex-situ* green manuring of glyricidia

Year	Crop yield (kg ha^{-1})			
	Finger millet	Straw	*State Average	% increase
2011-12	4192	-	2015	124.05
2012-13	4000	6500	1871	113.79
2013-14	3000	4000	1988	50.91
Average	3731	5250	1958	90.55

3.3 Different methods of establishment in finger millet, pigeonpea

Rainfall is uncertain and the sowing window for each rain is very narrow as the water holding capacity of soil is low under drylands of southern Karnataka. Further, shortage of labour, bullock pair and implements for sowing in the short period makes it difficult for timely sowing of finger millet. Further, finger millet + pigeonpea intercropping is more remunerative and to be sown in June - July. Early season drought weakens the selection of long duration, high yielding finger millet, pigeonpea varieties and their intercropping. Finger millet can be established through dry sowing, drill sowing and transplanting. Even, pigeonpea shows better response under transplanting with flexibility and high development plasticity. Hence, the following demonstrations were exhibited under dryland technology park.

A. Dry seeding of finger millet : Under the conditions of delayed rainfall and prediction of rainfall within 8-10 days, finger millet can be sown in large areas with 50% higher seed rate (19 kg ha^{-1}). This technology is practicable and successful when the soil is completely dry (soil moisture 10-15%) and seeds are sown in anticipation of rain in 8-10 days. This practice can reduce the drudgery, advance the season and timely establishment of the crop is possible.

Performance

- Yield advantage : 65.83%
- Timely sowing & Advancement of season
- Reduced drudgery

Table 9: Performance of finger millet under dry seeding

Year	Crop yield (kg ha^{-1})			
	Finger millet	Straw	*State Average	% increase
2011-12	3991	-	2015	133.31
2012-13	2250	2500	1871	20.25
2013-14	3500	5500	1988	76.06
Average	3247	4000	1958	65.83

B. **Drilling with DAP :** Mixing of finger millet seeds (15 kg ha^{-1}) with Di-Ammonium Phosphate (50 kg ha^{-1}) for sowing with seed drill at optimum moisture helps to improve the phosphorous use efficiency. Care should be taken to sieve the DAP as the large sized particles may block the seed bowl. The dosage of DAP needs to be reduced depending up on the soil moisture content.

Performance

- Yield advantage : 70.98%
- Improved phosphorus use efficiency

Table 10: Yield of finger millet under drilling with DAP

Year	Crop yield (kg ha^{-1})			
	Finger millet	Straw	*State Average	% increase
2012-13	3100	5500	1871	65.69
2013-14	3500	4000	1988	76.06
Average	3300	4750	1930	70.98

C. **Transplanting in finger millet :** Delayed sowing time due to delayed monsoon, farmers preference to a specific variety, ability to withstand transplanting shock by finger millet provides an opportunity to establish seedlings in the nursery and transplanting. Nursery beds were prepared in $1/10^{th}$ of total sowing area by sowing finger millet seeds on seedbeds with the available water source. After attaining age of 20 - 25 days, seedlings are transplanted in the main field. Community staggered nurseries are preferable considering the vagaries of monsoon. 120 m^2 of nursery bed is recommended for 1 acre with seed rate of 5 kg ha^{-1}

Finger millet at Nursery

Finger millet seedling preparation for transplanting

Finger millet transplanting

Finger millet at milky stage 104 DAT

Performance:

- Incremental grain yield : 60.34%
- Timely establishment of required variety
- Contingencies *viz*; delayed rains can be used

Table 11: Performance of finger millet under transplanting

Year	Crop yield (kg ha^{-1})			
	Finger millet	Straw	*State Average	% Increase
2012-13	3000	4100	1871	60.34
Average	3000	4100	1871	60.34

D. Transplanting in pigeonpea: Sole crop of pigeonpea and finger millet + pigeonpea (8:2) intercropping are the dominant and viable cropping systems for dryland areas of southern Karnataka. However, delayed onset of monsoon / early season drought affects the system as the crop is of long duration nature and doesn't fit for late sowing. Under these circumstances, seedlings can be established in polybags and transplanted in the main field at 30-45 days age.

Performance:

- Better and timely establishment
- Increase in system productivity

Table 12: Yield of pigeonpea under transplanting

Year	Transplanting	
	Sole Pigeonpea (kg ha^{-1})	Intercrop Pigeonpea (kg ha^{-1})
2010-11	854	-
2011-12	1397	-
2014-15	-	588
Average	1126	588

3.4 Integrated nutrient management practices

A. INM in finger millet: Imbalanced nutrition in dryland is the wide spread syndrome which has made the soil hungry. Balanced nutrition through integration of organic and inorganics is essential to maintain soil health and productivity. Application of FYM @10 t ha^{-1} with 100% Recommended NPK (50:40:37.5 kg ha^{-1}) resulted in sustained finger millet productivity and soil health followed by a similar treatment with 50% Recommended NPK as compared to continuous use of Recommended NPK alone. Rotation of finger millet + Groundnut resulted in 20% increased yield of finger millet.

FYM (10t/ha)+100% RDF

FYM (10t/ha)+ 50% RDF

100% RDF only

Performance

- Increased yield: 102.37%
- Sustained soil health and productivity

Table 13: Performance of finger millet and groundnut under INM

Year	Crop yield (kg ha^{-1})			
	Finger millet	**Straw**	***State Average**	**% increase**
2007-08	2734	4665	1642	66.50
2009-10	4004	6592	1565	155.85
2011-12	4314	6896	1871	130.57
2013-14	3244	5143	1988	63.17
Average	3574	5824	1766	102.37
	Groundnut pod	**Haulm**	***State Average**	**% increase**
2008-09	684	2783	493	38.74
2010-11	965	2066	898	7.46
2012-13	1074	2921	889	20.80
Average	908	2590	760	22.33

B. **Application of lime and micro-nutrients in finger millet:** Reduced organic matter use in crop production caused wide spread deficiency of micro-nutrients. Application of FYM @ 10 t ha^{-1} with 100% recommended NPK (50:40:37.5 kg ha^{-1}) and recommended zinc sulphate (12.5 kg ha^{-1}) + Borax (10 kg ha^{-1}) resulted in sustained finger millet (GPU -28) productivity and soil health as compared to continuous use of Rec.NPK alone. The micro-nutrient application is advocated once in 2-3 years. Lime @ 30% calcium saturation (~300-400 kg ha^{-1}) helps for sustaining production under slightly acidic condition.

Performance

- Increased yield : 113.26 %
- Sustained soil health and productivity

Table 14: Yield of finger millet with application of lime + micronutrients

Year	Crop yield (kg ha^{-1})			
	Finger millet	Straw	*State Average	% increase
2009-10	3059	6377	1565	95.46
2010-11	3341	8291	1715	65.81
2011-12	3386	6789	2015	80.97
2012-13	4800	6000	1871	156.54
2013-14	5000	6500	1988	151.50
Average	3917	6791	1831	113.26

3.5 Contingent crop varieties for different sowing windows

The sowing window under drylands are largely dependent on onset of monsoon. The sowing time for different varieties with different duration needs to be adjusted for sustainable crop yield. Selection of right variety for right sowing time reduces half of the risk under dryland situation.

Early season drought due to delay in onset of monsoon is directly responsible for shortfalls in area sown under major crops compared to normal situation. In rainfed areas, as a general rule, early sowing of crops with the onset of monsoon is the best-bet practice that gives higher realizable yield. Major crops affected due to monsoon delays are those that have a narrow sowing window and therefore cannot be taken up if the delay is beyond this cut-off date for sowing. Crops with wider

sowing windows can still be taken up till the cut-off date without major reduction in crop yield and only the change warranted could be the choice of short duration cultivars.

Loss of food grain, livelihood and shortage of fodder for animals are the critical issues to be addressed under early season drought. Hence, appropriate contingency crop planning is demonstrated combining possible cereals, pulses, oilseeds and fodder crops for late sowing situation (August end to September).

A. Small millets: They are known for their less water requirement, drought tolerant and suitable for to dryland areas and contribute to food and nutritional security. Foxtail, Barnyard, Little, Proso and Kodo millet are more productive under conditions of less fertile soils, intense heat, scanty rainfall and can withstand the vagaries of monsoon. Thus, these crops are low water requiring, can withstand harsh farming situations and have resilience capacity to adjust weather aberrations and can be sown till the end of September in the domain districts.

Barnyard millet

Little millet

Foxtail millet

Proso millet

Table 15: Performance of Small / Minor millets

Year	Small / Minor Millets (kg ha^{-1})				
	Foxtail millet	Little millet	Kodo millet	Barnyard millet	Proso millet
2010-11	394	-	2989	394	164
2011-12	729	986	2508	501	494
2012-13	486	972	368	-	226
2013-14	1579	1080	869	-	659
Average	797	1013	1684	448	386

Note: State average yield of total minor millet for the year 2013-14 : 449 kg ha^{-1}

B. Contingent varieties in finger millet: Wide array of finger millet varieties with different duration have been developed and released. Farmers have the option of choosing a right variety for right time of sowing depending upon onset of monsoon under real time contingent cropping. Selection of long duration varieties (Indaf-8, MR-1, MR-6, L-5) for early sowing (June-July), medium duration (GPU-28, HR-911, GPU-66, ML-365) for mid sowing (July end / Aug 1st Fortnight) and short duration (GPU-48, GPU-26) for late sowing (Aug end / Sep 1st week) helps in efficient utilization of natural resources and sustained productivity.

July 1st Fortnight Sown
Finger millet (MR-1)

July 2nd Fortnight Sown
Finger millet (MR-1)

July 1st Fortnight Sown
Finger millet (GPU-28)

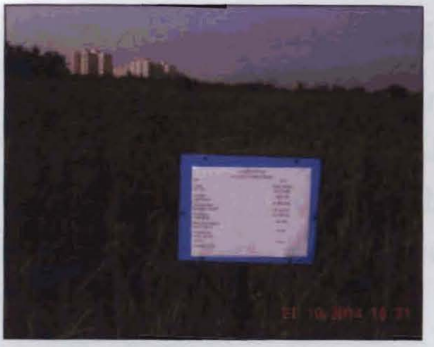
July 2nd Fortnight Sown
Finger millet (GPU-28)

July 1st Fortnight Sown
Finger millet (GPU-48)

July 2nd Fortnight Sown
Finger millet (GPU-48)

August 1st Fortnight Sown
Finger millet (MR-1)

August 2nd Fortnight Sown
Finger millet (MR-1)



August 1st Fortnight
Sown Finger millet (GPU-28)

August 2nd Fortnight
Sown Finger millet (GPU-28)

August 1st Fortnight
Sown Finger millet (GPU-48)

August 2nd Fortnight
Sown Finger millet (GPU-48)

Table 16: Productive performance of improved varieties of finger millet

Variety	Duration (days)	Sowing time	Yield (kg ha^{-1})
MR-1	120-125	June-July	3200
MR-6	120-125	June-July	3200
L-5	115-120	June-July	3000
GPU-28	110-115	July- August	3000
HR-911	115-120	July	3200
GPU-48	100-105	August-October	2600
GPU-26	100-105	August-October	2600

3.6 Improved varieties in major crops

A. Maize: Single cross maize hybrids released by UAS (B) *viz.*, NAH 1137 (Hema) and NAH-2049 (Nithyashree) and composites *viz.*, NAC-6004 and NAC-6002 are not only high yielding but also resistant to *downy mildew* and *turticum* leaf blight disease.


Nithyashree


Hema

Table 17: Improved varieties of maize

Year	Maize Yield kg ha^{-1}	
	NAH 1137 (Hema)	NAH-2049 (Nithyashree)
2011-12	2639	2083
2012-13	4851	3812
2013-14	5540	4155
Average	4343	3350

Note: State average yield is 3259 kg ha^{-1}

B. Grain amaranth: Suvarna (White) a photo insensitive crop grown throughout the year and matures in 80-90 days with an yield potential of 1200-1500 kg ha^{-1} KBGA-1 (Red) a short duration variety (75-85 days) with attractive purple colour inflorescence. It is one of the Nutricereal in real time contingent crop planning.

Suvarna (White)

KBGA-1 (Red)

Table 18: Performance of Grain amaranth

Year	Grain amaranth Yield (kg ha^{-1})	
	Suvarna (White)	KBGA-1 (Red)
2010-11	2604	-
2011-12	1875	-
2012-13	1806	1076
2013-14	1177	852
Average	1866	964

The average yield of Suvarna (White) recorded 1866 kg ha^{-1} as compared to KBGA-1 (Red) with 964 kg ha^{-1}.

C. Pulses: Pigeonpea, field bean, cowpea, horsegram, chickpea and rice bean are the predominant pulses in the domain area. The improved varieties in these crops are

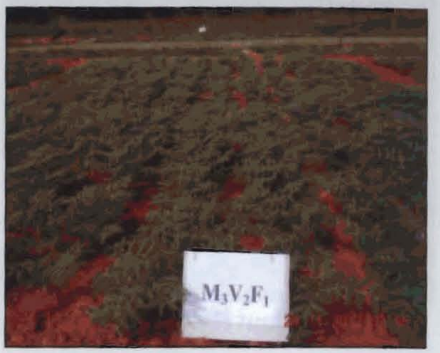
Table 19: Improved varieties of pulses

Crops	Variety	Duration (days)	Yield (kg ha^{-1})	Special characters
Pigeonpea	BRG-1	170-190	1200-1500	Dhal, Intercropping in early *kharif*
	BRG-2	150-170	1250-1600	Dual, Intercropping in early *kharif*
	BRG-5	140-150	1200-1500	Wilt resistant, late sowing
Vegetable cowpea	PKB-4	80-85	1000-1200	Double cropping in early *kharif*
	PKB-6	80-85	1000-1200	Contingency late crop
Cowpea	IT-38956-1	80-85	1000-1200	White lustrous & bold seeds, suitable for early and late *Kharif* season
Field bean	HA-3 HA-4	95-105	1000-1250	Short duration, photo- insensitive suitable for inter/double cropping
Horsegram	PHG-9	90-100	800-1000	Seed purpose under late *Kharif* and green manure early *Kharif*
Rice bean	RBL-1	80-85	1000	Delayed sowing
Chickpea	A-1	95-100	800-1000	Drought resistant
	JG-11	95-100	800-1000	Wilt and drought resistant

Pigeonpea (BRG-2)

Vegetable cowpea (PKB-6)

Field bean (HA-4)



Chickpea (JG-11)

D. Oilseeds : Sunflower, groundnut, castor and niger are the important oilseeds in the dryland areas of the domain districts.

Table 20: Improved varieties of oilseeds

Crop	Varieties/ hybrids	Yield (kg ha^{-1})	Duration (days)	Remarks
Sunflower	KBSH-53	1000-1200	95-100	Late sown situation
Niger	No. 71	375-500	85-90	Short duration, low water requiring
Groundnut	ICGV 91114	750-1000	95-100	Drought tolerant and early maturity
	KCG - 6	750-1000	110-115	Drought tolerant, medium duration
Castor	DCS-9	1000-1200	90-150	Drought tolerant, high yielding

Sunflower (KBSH-53)

Niger (No. 7)

Groundnut (ICGV-91114)

Castor (DCS-9)

E. Chilli : Samruddhi is a high yielding open pollinated variety yielding 10-12 t ha^{-1} of green chillies in drylands. The variety is having medium pungency, attractive fruit colour and shape.

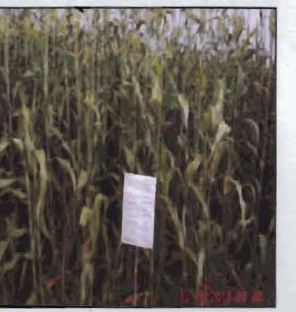
Table 21: Performance of Chilli (Samruddhi)

Year	Chilli dry Yield (kg ha^{-1})	
	Samruddhi	Chikkaballapur local
2010-11	958	-
2011-12	1883	1050
2012-13	1840	694
2013-14	2077	1274
Average	1689	1006

F. Fodder crops : Fodder maize (South African Tall), Sweet sorghum (SSV-74) and Fodder bajra (Giant Bajra) during early and late *kharif* with bimodel distribution to meet the fodder requirement.

Fodder maize (South African Tall)

Fodder Bajra (Gaint Bajra)



Fodder Sorghum (Sweet Sorghum)

Performance

- Increased yield in maize (33.3% & 2.8%), Cowpea (149.1% & 206.1%), Horsegram (123.9%) Castor (26.7%) and chilli (89.7 %)
- Reduced risk of weather, pest and disease incidence

Table 22: Yield of improved varieties of different crops under dryland technology park

Crop		Crop yield (kg ha^{-1}) (Average of 3 Years)		
		Crop	State Average	% increase
Maize	Hema	4343	3259	33.3
	Nithyashree	3350	3259	2.8
Cowpea	IT 38956-1	979	393	149.1
	PKB-6	1038	339	206.1
Horsegram (PGH-9)		1220	545	123.9
Chilli (Samruddhi)		1933	1019	89.7
Castor (DCS-9)		1183	934	26.7

3.7 Major intercropping systems

Mono-cropping / intercropping with akkadi crops are the predominant system in dryland areas of Karnataka. Intercropping of legumes in cereals helps in soil sustainability, nutritional security and also serve as insurance against the crop failure under aberrant weather situation. Viable intercropping systems demonstrated in the dryland technology park are

A. **Finger millet + Pigeon pea (8:2) inter cropping system:** Sowing of eight rows of Finger millet and two rows of pigeonpea using seed drill and maintaining 60 cm spacing between paired rows of pigeon pea. Opening of conservation furrow between paired rows of pigeonpea is part of the technology.

B. **Maize + Pigeonpea (1:1):** Simultaneous sowing of pigeonpea at 60 cm x 22.5 cm and maize on the same field. By this technology pigeonpea sheds 2-3 t ha^{-1} of

leaf litter which improves the soil fertility and also helpful in improving the productivity of next season cereal crop. It also serves as an insurance against total crop failure under extreme situations.

Finger millet + Pigeonpea (8:2)

Maize + Pigeonpea (1:1)

C. **Pigeonpea + Field bean (1:1):** Simultaneous sowing of pigeon pea at 90 cm x 22.5 cm and short duration photo-insensitive field bean (HA-4) in 1:1 row proportion (additive series). Pigeonpea is a long duration crop and slow growing in early stages, growing of field bean as additive series increases the land use productivity.

D. **Pigeon pea + Cowpea (1:1):** Simultaneous sowing of pigeonpea at 90 cm x 22.5 cm and short duration cowpea (IT 38956-1) in 1:1 row proportion (additive series) improves total productivity.

E. **Pigeonpea + Soybean (1:1):** One row each of pigeonpea and soybean alternatively helps to utilize the space between pigeonpea rows efficiently, reduce weed menace and improve the system productivity.

Pigeonpea + Field bean (1:1)

Pigeon pea + Cowpea (1:1)

Pigeonpea + Soybean (1:1)

F. **Groundnut + Pigeonpea (8:2):** Simultaneous sowing of groundnut and pigeonpea in 8:2 row proportions with 60 cm between paired row and opening of conservation furrow between paired rows of pigeon pea for *in-situ* moisture conservation and safe disposal of excess water.

G. **Groundnut + Nipped Castor (8:1):** Simultaneous sowing of eight rows of groundnut and one row of castor and nipping in castor

Groundnut + Pigeonpea (8:2)

Groundnut + Nipped Castor (8:1)

Performance

- Increased yield of crops : 18.4 to 131.5 %
- Reduced risk of weather, pest and disease incidence

Table 23: Different crops under intercropping system and its performance

Crop	Crop yield (kg ha^{-1}) (Average of 3 Years)				
	Base Crop	Intercrop	Base crop equivalent	State Avg.	% increase
Finger millet + Pigeonpea (8:2)	3710	301	4532	1958	131.5
Maize + Pigeonpea (1:1)	3543	376	4637	3259	42.3
Pigeonpea + Field bean (1:1)	693	248	861	727	18.4
Groundnut + Pigeonpea (8:2)	788	285	1023	787	30.0
Groundnut + Castor (8:1)	678	607	1130	787	43.6

3.8 Nipping in rainfed castor: Removing of apical meristem by using hand/ knife to encourage only one apical bud to grow robustly at a time. First nipping is to be carried out at 45-50 DAS and subsequently nipping is done at one-week interval, by retaining primary branch and primary spike and removing all other branches. This has to be done in a staggered manner till 5-6 spikes were retained per plant. This will reduce the bushyness of composite varieties and reduces humidity by creating better micro-climate resulting in reduced incidence of *botrytis,* ease of harvesting, 50% higher yield and increased oil content.

Method of Nipping in Castor

Nipped Castor

Non-Nipped Castor

Performance

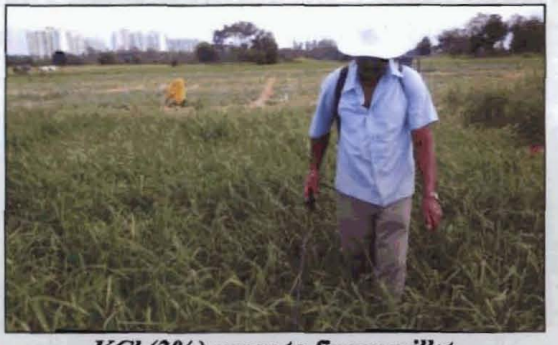
- Increased yield : 50%
- Reduced *botrytis* disease
- Ease and reduced number of harvests

Table 24: Performance of nipped castor

Year	Castor yield (kg ha^{-1})		
	Demonstration	*State Average	% increase
2011-12	1459	926	57.55
2013-14	1846	942	95.96
Average	1653	934	76.98

3.9 Drought mitigation practices: Midseason / intermittent drought are very common under dryland tracts of domain districts, inducing drought tolerance through osmoregulation in stomatal guard cells and hastening growth rate after the release of stress are targeted for the demonstration under drought mitigation strategy.

It is very well established that, potassium is known to induce drought tolerance through osmoregulation. Application of 2% KCl (MOP) during drought when the plant start expressing wilting symptom, thiourea @ 2% after retrieving drought in comparison with water spray (control) was demonstrated in finger millet. Plant tolerance up to 15-20 days under potassium spray was better compared to thiourea and water spray.



KCl (2%) spray to finger millet

Thiourea (250 g/ha) spray to finger millet

Among different lining materials *viz.*, stone dust + cement, soil + cement, brick, granite slabs which were executed as part of study, lining of farm pond with 400-500 micron gauge LDPE (Low Density Poly Ethylene) sheet with 8:1 ratio of soil-cement plastering to 5 cm thickness mortar in $1m^2$ rectangular brick compartments on all the four sides of the farm pond and brick lining over LDPE sheet performed better its stability and minimizing water loss.

Performance:

- Reduced seepage losses
- Longer storage of water

B. Multiple use of farm pond water: Efficient use of farm pond water for different activities is demonstrated. The activities include

- Utilization for protective irrigation of field crops
  - ✓ **Protective irrigation:** Can be irrigated $1/3^{rd}$ of the area with surface methods, entire catchment to a depth of 2.5 cm once with sprinkler.
  - ✓ **Double cropping:** Bi-modal rainfall distribution encourages double cropping in southern Karnataka. Double cropping of fodder crops / cowpea / sesame in early season (May-June) followed by chickpea / baby corn / chilli transplanting (Sep-Oct) with a protective irrigation during flowering / maturity in second crop resulted in improved rain water use efficiency and net income by Rs. 10,244 to Rs. 64,168 ha^{-1}

- **Nourishing fruit trees / plantations:** Water stored in one of the pond is used for nourishing the fruit trees / plantations planted in the catchment / outside specially during *rabi* / summer.

- **Pisciculture:** Fish fingerlings reared @ 1 m^2 with water storage for 6-8 months of water storage due to bi-modal rainfall distribution. An additional income of Rs. 3000-5000 was documented with fish culture.

- Nutritional / kitchen garden: Vegetables, fruits, spices, flower crops were raised around the pond, which has resulted in an additional income of Rs. 591 to 2000.

- Azolla cultivation: Reducing evaporation losses and harnessing fodder for animals are possible through azolla cultivation in the farm pond.

C. Alternate land use

Agro-forestry with silver oak on bunds and field crops in the catachment - storage - command relationship as an inter-terrace management strategy. Agri-horti systems with pomelo, custard apple, amla based intercropping systems were also exhibited as a long term strategy for climatic aberrations.

D. Mechanization

In India, operations carried out by human and animal draught constitute an important source of farm power. Industrialization and urbanization reduced the availability of labour force for agriculture sector. Further, the animal population in the country has come down considerably because of shrunken community lands for grazing and reduced caring

population, reduced human force and animal draught especially in dryland areas needs attention to develop energy saving machineries to take up the operation timely and precisely. In this context, AICRPDA has initiated design, development, evaluation, modification and fabrication work with the help of village artisans and local industries. Most of which are released through the University of Agricultural Sciences, Bengaluru and popularized through Operational Research Project (ORP), NICRA and Krishi Vignana Kendra's (KVKs). These equipments were also exhibited for the benefit of farmers in dryland technology park during krishimela. The important equipments which attracted farmers / students / policy makers / extension personnel are

i) **Modified Bullock Drawn Seed drill:** The local seed drill has been modified to reduced weight (12 kg) with maximum width coverage of 150 cm with a provision for an additional row for pigeonpea sowing as an inter crop. The implement is pulled by the local draught animals whose pulling strength is low and requires one labour and drudgery is being reduced, maintaining the recommended row spacing of 30 cm between the rows. Time of operation has reduced to 40 per cent and optimum depth of sowing is about 4–5 cm, it covers 1.5-2.0 ha/day. The cost of the modified seed drill is Rs.3000/-.

ii) Bullock Drawn Multi-furrow Opener: Groundnut being traditionally sown using country plough which involves more time where operator has to walk long distance because only one row is formed at a time. Multi-furrow opener with four shovels to open four furrows at a time and open conservation furrow in between two rows for conserving soil and moisture.

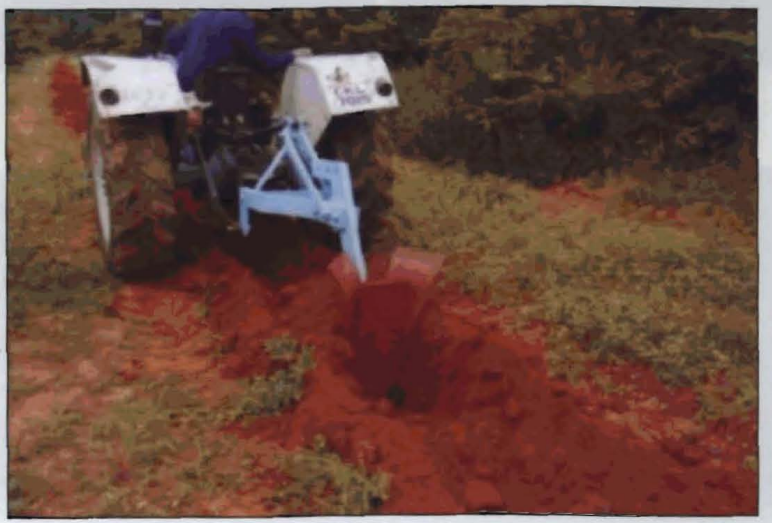
Multi furrow opener can cover an area of 1.5-2.0 ha/day with a pair of bullocks and it is having adjustable row to row distance with light weight. Cost of Operation is Rs. 100-125/ha and cost of the implement is Rs. 1500/-.

iii) Hand Weeders in Dry Farming: Farmers use locally available 'Kurpi' and 'Varvari' to carry out weeding which requires about 25 labourers to cover an hectare of finger millet crop. The improved hand weeders helps to reduce drudgery at reduced weeding cost (70%) and it covers 0.14-0.16 ha/day. The cost of operation is Rs. 500-600 ha^{-1}.

iv) Tractor Drawn Rotovator: Rotovator helps for uprooting of green manure plants / weeds, chopping and incorporating in to the soil simultaneously, maintains a uniform seed bed and facilitates decomposition of incorporated plants like horse gram. Hence, energy costs are reduced to 50-60% as compared to other implements used for this operation and it can cover one hectare in 90 minutes by using 35HP tractor and having yield advantage of 32.6% with additional income of Rs. 4112/- per hectare.

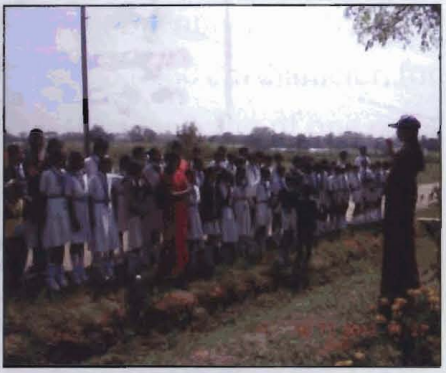
.v) Tractor Mounted Post hole digger: Introduction of tractor mounted post hole digger play an important role to reduce dependence on costly labour for opening pits. Pits upto a depth of 1.0m can be opened with 22.5 to 60 cm diameter, for planting horticultural crops. The cost for opening of one pit is around Rs.14/-

vi) Tractor Drawn Deep trencher: Newly designed deep trencher helps in opening the trenches of depth upto 30-60 cm and a width of 50-60 cm. Trenches opened by using tractor drawn deep trencher was found to be suitable for conserving runoff water as compared to other implements.







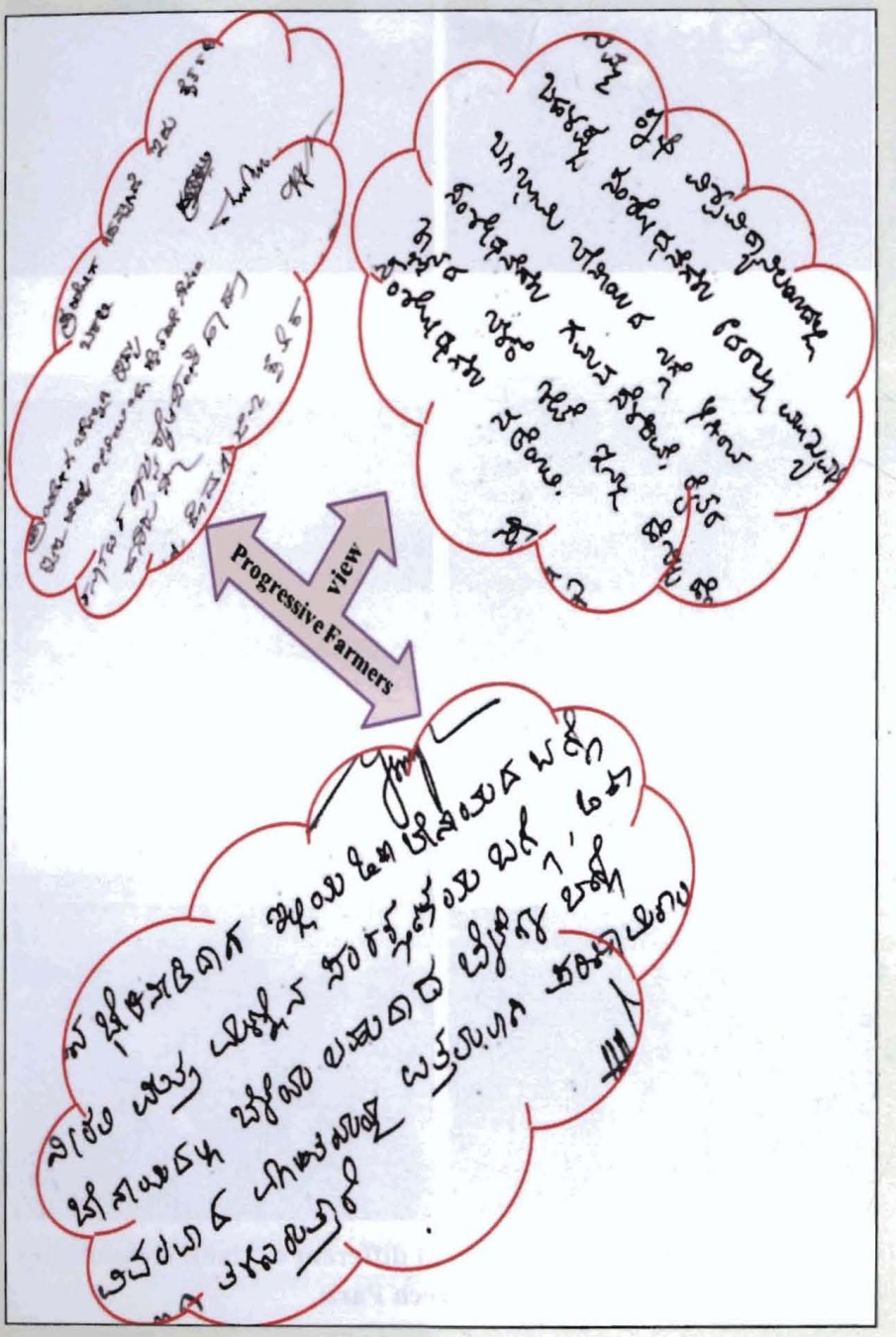
Students gathering the information on dryland technologies from resource persons at Agri-Tech Park

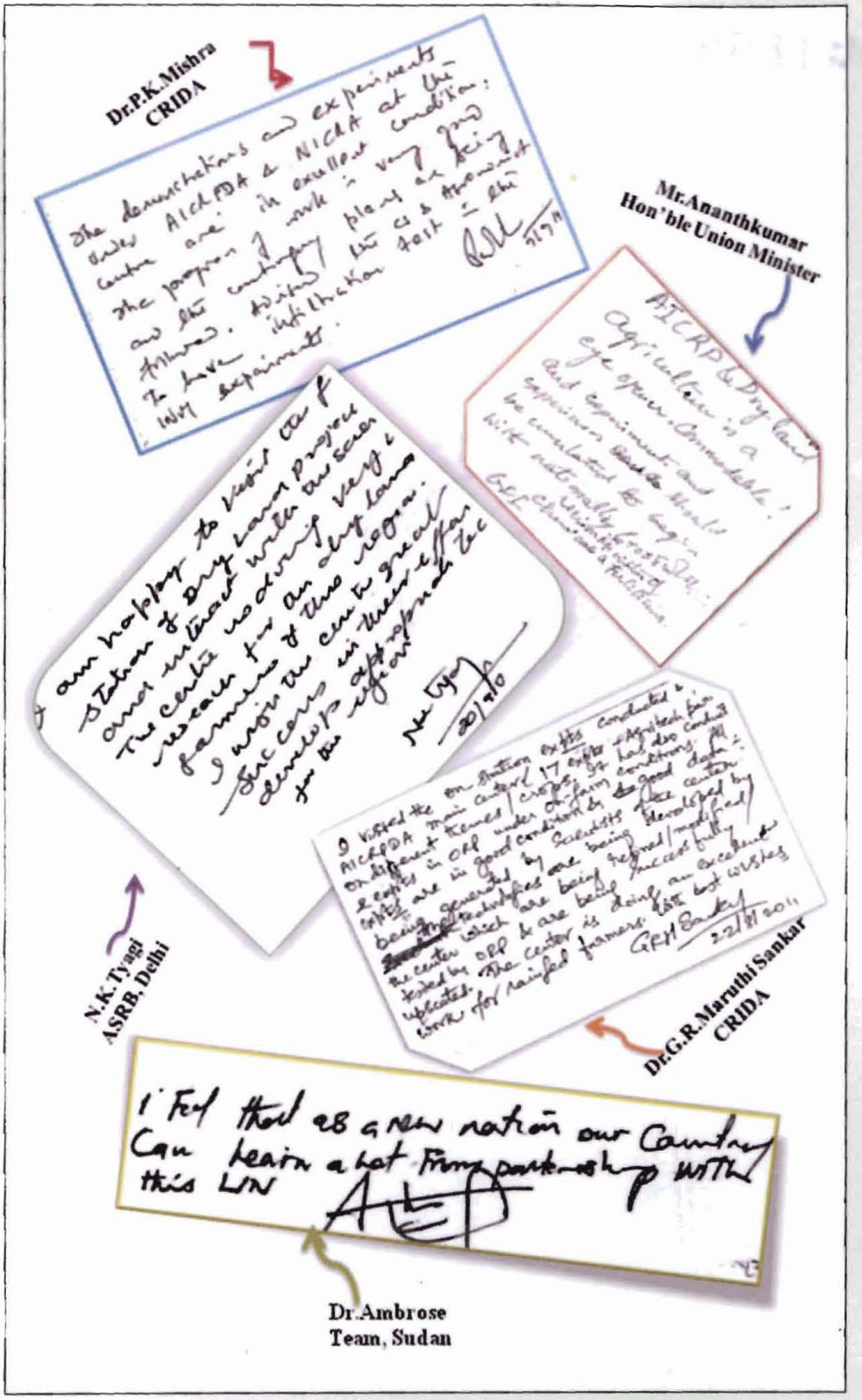





Farmers viewing demonstration of different dryland technologies at Agri-Tech Park

5. Feed back on the technologies demonstrated at Dryland Agri-Tech Park

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Mr.Ananthkumar
Hon'ble Union Minister
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Best Field Demonstration Awards (2007-2014) for Dryland Agri-Tech Park during Krishimela