

## Indigenous technical knowledge on drought mitigation techniques on yield of groundnut and adoption of farmers in semi-arid regions of Andhra Pradesh

Mitnala Jayalakshmi<sup>a,\*</sup>, Boya Hussainammagari Chaithanya<sup>a</sup>, Koduri Raghavendra Chowdary<sup>b</sup> & Gerketi Prasad Babu<sup>c</sup>

<sup>a</sup>Regional Agricultural Research Station, Nandyal 518 502, ANGRAU

<sup>b</sup>Krishi Vigyan Kendra, Banavasi 518 323, ANGRAU

<sup>c</sup>ICAR-Central Tobacco Research Institute, KVK 523 105, Kandukur

\*E-mail: m.jayalakshmi@angrau.ac.in

Received 18 July 2024; revised 07 May 2025; accepted 08 May 2025

Frontline demonstrations were conducted to evaluate and promote Indigenous Technical Knowledge (ITK) related to drought mitigation strategies in groundnut cultivation. The demonstrated ITK practices included summer deep ploughing, sub-soiling with a chisel plough following summer showers, application of farmyard manure, sowing across the slope, and the creation of dead furrows at 2-meter intervals with a depth of 30 cm. A total of ten demonstrations were organized each year during the *khariif* season of 2018, 2019 & 2020 in farmers' fields of Bodabanda and Venkatapuram villages in western part of Kurnool district, Andhra Pradesh to showcase the effectiveness of these traditional techniques. The results from the frontline demonstrations indicated that groundnut demo plot recorded the highest number of pods (22, 18.1 and 22.3) and yield (1498, 1511 and 1496 kg ha<sup>-1</sup>) in the years 2018, 2019 and 2020 respectively. In the demo plot, an extra income of Rs. 16587/- ha<sup>-1</sup>, Rs. 19375/- ha<sup>-1</sup> and Rs 17687/- ha<sup>-1</sup> were recorded in the years 2018, 2019 and 2020, respectively. The technology gap of demonstration field was 177 kg ha<sup>-1</sup>, 156 kg ha<sup>-1</sup> and 166 kg ha<sup>-1</sup> and an average technology index of 8.32% was observed with demonstration fields during three consecutive years. The highest per cent change in adoption was recorded for summer deep ploughing (79.17). The degree of effectiveness of summer deep ploughing ITK practice ranks first with 2.29 mean score and lowest was recorded in forming dead furrows at intervals of every 2 meters, each with a depth of 30 cm with mean 1.88.

**Keywords:** Chisel plough, Dead furrows, Groundnut, ITKs, Subsurface tillage

**IPC Code:** Int<sup>25</sup>: A01G 22/40

The two most important resources, soil and water needs to be conserved for as long as possible. In India, small and marginal farmers account for 86.2% of agricultural community but own just 47.3% of the cropped area (Agriculture Census 2015-16). Smallholder farmers encounter various constraints which restrict enhancing productivity levels and livelihood enhancement.

Andhra Pradesh is one of India's leading states in terms of both area under cultivation and production of important oilseed crops. Among the nine annual oilseeds grown in the state, groundnut and sesame hold the largest share in terms of acreage and output. These crops are significant not only at the state level but also nationally and globally, owing to their substantial contribution to the production of edible oils, which are vital for human consumption and industrial use. The western parts of the Kurnool

district occupying major area of groundnut in Kurnool district. Majorly, the groundnut is grown under rainfed situations in this part of the district. Due to numerous factors, the trends of area and production of the crop declined. The reason for this declining trend in area under the groundnut crop was mainly inadequate and uneven rainfall in the region, small holding rainfed farmers and unawareness among farmers on indigenous drought mitigation techniques during drought situations.

Indigenous Technical Knowledge (ITK) refers to the cumulative body of knowledge, practices, and beliefs developed by local communities over generations. It is acquired through direct interaction with the environment and passed down orally or through practical demonstration from one generation to the next. Often synonymous with *local knowledge*, ITK is defined as “the sum total of knowledge based on the life experiences and acquired skills of people in dealing with problems and specific situations across various

\*Corresponding author

aspects of life". This knowledge system evolves through continuous observation, experimentation, and adaptation, shaped by the collective wisdom and experiences of older generations. It encompasses a wide range of domains including agriculture, health care, natural resource management, and cultural practices and plays a crucial role in the sustainability and resilience of traditional communities<sup>1</sup>. Indigenous knowledge acquired from generations should be disseminated rather than being accumulated within a group. Dissemination of knowledge is of significance as exchange of ideas and practices would contribute to providing solution to farmer's problems, enhance resource potential and livelihood status of farmers<sup>2</sup>.

Most of farmers were cultivating groundnut crop under rainfed conditions in the western part of Kurnool district which witness dry spells for few days to over a month, where moisture conservation is must needed for its sustainable production. We noticed that some of the farmers under this cropping situation were practicing several documented indigenous practices in groundnut cultivation to mitigate drought, which have led to profitable yields. Among those few ITKs were validated through research and were selected for the present demonstrations.

Though, few farmers were adopting the techniques, the lack of awareness on these indigenous technologies was observed in among the farming community in the western part of the Kurnool. During the participatory rural appraisal (PRA) sessions conducted before starting the demonstrations, it was observed that several traditional ITK practices had been discontinued by the local farming community. The primary reasons identified for this discontinuation include the introduction of green revolution technologies, emphasizing high-yielding varieties and monoculture

cropping systems led to a decline in the cultivation of diverse indigenous technologies. This shift resulted in the marginalization of traditional agricultural practices that had been sustained over generations. To accomplish this Front Line Demonstrations (FLDs) were conducted to assess the impact of drought mitigation techniques on groundnut production and to promote the adoption of ITK among farmers.

## Materials and Methods

### Study area

Krishi Vigyan Kendra (KVK), Banavasi conducted ten frontline demonstrations each year in the farmers' fields located at Bodabanda and Venkatapuram villages in Yemmiganur Mandal of Kurnool District, Andhra Pradesh during kharif season from 2018 to 2020 to demonstrate selected indigenous techniques in Groundnut crop. Kurnool District consists three Revenue Divisions and 54 Revenue Mandals. This district falls under Scarce Rainfall Zone with an average annual rainfall of 670.6 mm (normal). The majority of this rainfall is contributed by the South-West monsoon (455.1 mm), and followed by the North-East monsoon (149.6 mm), winter (4.7 mm) and summer (61.2 mm). Over a 20-year period (2001-02 to 2020-21), the district experienced above-normal rainfall in only eight years (Fig. 1.)

Deficit rain fall of -56.8% and -17.1% received in the years 2018 and 2019, respectively and in the 2020+73.8% excess rain fall was received (Source: CPO, JDA, Kurnool). In Kurnool district the groundnut crop is cultivated in an area of 85514 ha, which accounts for 21.49% of cropping area<sup>3</sup>. The necessary steps for selection of site and layout of demonstrations were followed<sup>4</sup>.

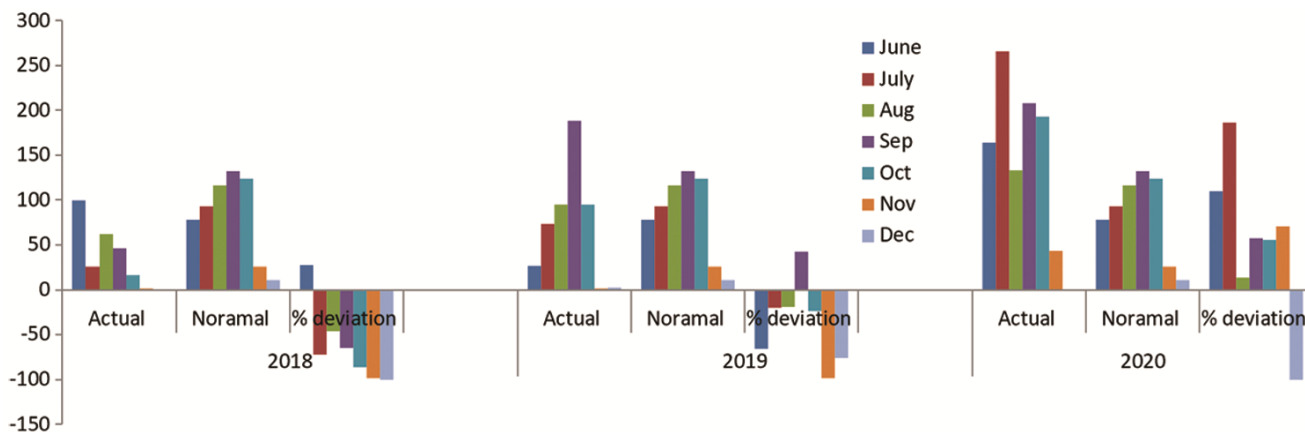


Fig. 1 — Rainfall during 2018-2020 in KVK operational area

**Methodology**

Groundnut variety Dharani was sown in 2<sup>nd</sup> to 3<sup>rd</sup> week during July and harvested during 1<sup>st</sup> to 2<sup>nd</sup> week of December during 2018-2020. Demonstrations were conducted in two treatments *i.e.*, T<sub>1</sub> demonstration plots includes five popular ITKs in groundnut *viz.*, (i) summer deep ploughing, (ii) sub soiling with chisel plough after summer showers, (iii) application of farm yard manure (FYM), (iv) sowing across the slope, (v) forming of dead furrows at every 2 meters with 30 cm depth (Fig. 2 to Fig. 5) and T<sub>2</sub> check plot (Farmer’s practice) which means not following any drought mitigation techniques. In this study, the ITK-based demonstration plots compared with adjacent farmers’ fields practicing conventional methods without following any ITK based drought mitigation techniques. The indigenous practices used for demonstration in this study have been part of the community’s agricultural traditions for generations inherited from their ancestors and have been adapted over time to suit local conditions. Practicing farmers known for preserving these ITKs were engaged as lead demonstrators. These farmers not only showcased the practices but also shared insights on contextual adjustments.

The data were collected from both the demonstration plots (T<sub>1</sub>) and the check plots (T<sub>2</sub>), along with a feedback survey conducted to assess the impact of ITK on drought mitigation practices in groundnut cultivation. The study aimed to evaluate not only the effects on yield and economic returns but also farmers’ perceptions regarding the adoption of these traditional practices. A total of 120 farmers from Venkatapuram and Bodabanda villages were included in the sample, representing marginal, small, and medium farm categories. The demonstrations were carried out under the close supervision of scientists from Krishi Vigyan Kendras (KVKs), State Agricultural Universities (SAUs), and their Regional Research Stations. Input and output prices prevailing during the study period were used to compute net returns and the benefit-cost (B:C) ratio. Additionally, key extension parameters such as the extension gap, technology gap, and technology index were calculated using standard formulas<sup>5</sup>.

Technology gap = Potential yield – demonstration yield

Extension gap = Demonstration yield - farmers practice yield

Technology index (%) = (Technology gap/ Potential yield) X 100

Impact on yield = (Yield of Demonstration plot – Yield of control plot/ Yield of control plot) X 100



Fig. 2 — Sub soiling with chisel plough



Fig. 4 — Sowing across the slope



Fig. 3 — Forming of dead furrows at every 2 meters with 30 cm depth



Fig. 5 — Summer deep ploughing

Impact on adoption = (No of adopters after demonstration – No of adopters before demonstration / No of adopters before demonstration) X 100

## Result and Discussion

### Yield attributes

During 2018, the average number of pods per plant (22.1) and test weight (29.7 g) were recorded highest in demonstration plots. The average lowest pods per plant (19.5) and test weight (21.4 g) recorded in farmers practice. Similar trend was followed in the year 2019 and 2020. During 2018, an average yield of 1498 kg ha<sup>-1</sup> was recorded in demonstration plots and it was 8.94% higher than farmers practice (1375 kg ha<sup>-1</sup>). During the year 2019, 19.35% higher average yield recorded in demonstration plots (1511 kg ha<sup>-1</sup>) than farmer practice (1266 kg ha<sup>-1</sup>). During the year 2020 an average yield of 1496 kg ha<sup>-1</sup> was recorded in demonstration plots and it was 18.54% higher than farmers practice (1262 kg ha<sup>-1</sup>).

The pooled results over three consecutive years (2018 to 2020) revealed that the demonstration plots recorded a significantly higher number of pods per plant (20.8), test weight (30 g), and seed yield (1,501 kg/ha) compared to the farmers' practice, since the p-value was less than 0.05 across individual years as well as in the pooled analysis (Table 1). Hence, it clearly indicated that there is significant difference among the demonstration and farmers practice with regard to yield in which following drought mitigation techniques significantly produced more yield than that of farmers' practice. Therefore, it was concluded that the demonstrated drought mitigation practices had a positive and significant impact on groundnut yields.

ITK on drought mitigation techniques had demonstrated their better performance over farmers practice under demonstrations organised at farmer's field. The possible reason for higher yields in demonstration is due to moisture conservation during

drought situations by following indigenous drought mitigation techniques. The implementation of ITK practices has led to significant improvements in groundnut yield and drought resilience. These practices enhance soil structure, fertility, and water management, which are crucial for sustainable agriculture. Summer deep ploughing, conducted during the pre-monsoon period, increases soil moisture retention, reduces weed growth, and enhances soil aeration, thereby improving seedbed conditions for subsequent crops. Subsoiling with a chisel plough after summer showers alleviates soil compaction, facilitates deeper root penetration, and enhances water infiltration, leading to improved crop yield potential. The application of FYM enriches soil organic matter, improves nutrient availability, and enhances microbial activity, contributing to better soil fertility and structure. Formation of dead furrows at 2-meter intervals with a 30 cm depth aids in water conservation by capturing runoff, reducing soil erosion, and improving water availability for crops. Sowing across the slope, as opposed to along it, reduces water runoff, minimizes soil erosion, and enhances water retention, leading to improved crop growth. These results are in accordance with the results achieved in rainfed crop by implanting climate resilient drought mitigation techniques<sup>6</sup>.

### Cost economics

In demonstration fields, costs include land preparation, other crucial inputs *viz.*, seeds, fertilizers, insecticides and cost of drought mitigation techniques, cost of harvesting, threshing etc., and prevailing seed selling prices in the year were considered for computing the cost of cultivation, gross revenue, net income and benefit cost ratio for demonstration and farmers practices and presented in Table 2. The highest net returns and benefit-cost ratio were significantly higher in the demonstration plots compared to the farmers' practice, across all three years of the study

Table 1 — Effect of ITKS on yield and yield attributes of groundnut in 2018, 2019, 2020 and pooled

Particulars	No of pods/plant				Test weight (g)				Seed yield kg ha <sup>-1</sup>							
	2018		2019		2020		pooled		2018		2019		2020		Pooled	
Demonstration plots (T1)	22.0	18.1	22.3	20.8	29.7	30.0	30.3	30	1498	1511	1496	1501				
Check plots (T2)	19.5	20.6	19.3	19.8	21.4	21.2	21.4	21.3	1265	1266	1262	1264				
SD	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
	0.9	1.3	0.8	1.2	0.9	1.4	1.1	1.2	1.4	1.7	1.3	1.8	1.5	1.8	1.3	1.7
t-value	2.10	2.11	2.10	2.10	2.46	2.39	2.40	2.35	2.42	2.50	2.53	2.60				
p-value	0.004*	0.001*	0.002*	0.002*	0.004*	0.000*	0.001*	0.001*	0.002*	0.002*	0.003*	0.002*				

(2018 to 2020). The average higher net income (Rs. 49216/- *per ha*) and benefit cost ratio (2.47) was realized in demonstration plots. The average lower net income (Rs. 31,333/- *per ha*) and benefit cost ratio (2.00) was recorded in farmers' practice.

The highest net returns and benefit cost ratio in demonstration plots is due to following of drought mitigation techniques in adverse situations which leads to highest yields. The positive outcomes observed in demonstration fields are promising, potentially encouraging wider adoption of the indigenous technical knowledge for mitigating drought and promoting enhanced agricultural sustainability and productivity. The best management strategies resulted in increased production and profitability when compared to traditional farming approaches. These results are consistent with results reported in small and marginal farmers' fields in Ananathapur and Adilabad districts underrainfed farming systems<sup>7</sup>.

#### Gap analysis and adoption of indigenous drought mitigation techniques by the farmers

Demonstration on drought mitigation techniques, additional measures such as the technology gap, extension gap, and technology index were computed in addition to cost economics, shown significant advantages over farmer's practice (Table 3). The technology gap of demonstrated field was 177 kg ha<sup>-1</sup>,

156 kg ha<sup>-1</sup> and 166 kg ha<sup>-1</sup> during 2018, 2019 and 2020, respectively. This technology gap may be due to different management practices followed and different level of soil fertility present in the demonstrated fields. The extension gap of 581 kg ha<sup>-1</sup>, 603 kg ha<sup>-1</sup> and 592 kg ha<sup>-1</sup> was recorded during 2018, 2019 and 2020, respectively. The extension gaps in groundnut demonstrations highlight the need for farmers to enhance their knowledge of indigenous technical knowledge on drought mitigation techniques during adverse drought situations. This might be accomplished through field days, capacity building, and exposure visits among farmers having similar farming situations. The technology index assesses the feasibility of better technology at the farmer level under existing local conditions. In this study, an average technology index of 8.32% was observed with demonstration fields during three consecutive years, indicates the feasibility of improved technology. In the rainfed semi-arid area of Andhra Pradesh, yield data from consecutive years showed that FLDs had a positive impact on farmer practices for enhancing the productivity of groundnut by adopting drought mitigation techniques in dry spells. Similarly comparable results were found in cluster FLDs in Bengalgram<sup>8,9</sup>.

From Table 4 it could be inferred that 79.17% change in adoption of summer deep ploughing,

Table 2 — Effect of ITKS on cost economics of groundnut in 2018, 2019, 2020 and pooled

Particulars	Demonstration plots (T1)				Check plots (T2)			
	2018	2019	2020	pooled	2018	2019	2020	pooled
Gross returns	73962	75125	74962	74683	63425	61750	63825	63000
Net returns	48512	49625	49512	49216	31925	30250	31825	31333
BC ratio	2.5	2.4	2.5	2.47	2.0	2.1	1.9	2.0

Table 3 — Gap analysis of ITKS in groundnut in 2018, 2019 and 2020

Gap analysis	Technology gap kg ha <sup>-1</sup>	Extension gap kg ha <sup>-1</sup>	Technology index
Years			
2018	177	581	8.85
2019	156	603	7.80
2020	166	592	8.32

Dharani variety potential yield 2000 kg ha<sup>-1</sup>

Table 4 — Impact of frontline demonstrations on adoption of ITKs for drought mitigation in groundnut

S. No	Technology	No of Adopters N=120		Change in no of adopters	Impact change (% Change)
		Before demonstration	After demonstration		
1	ITKS for drought mitigation in groundnut				
1	Summer deep ploughing	20 (16.67)	85 (70.83)	+95	79.17
2	Sub soiling with chisel plough after summer shower	02 (0)	78 (65.00)	+106	88.33
3	Application of farm yard manure,	30 (25.00)	105 (87.50)	+86	71.67
4	Forming of dead furrows at every 2 meters with 30 cm depth	28 (23.33)	85 (70.83)	+82	68.33
5	Sowing across the slope	15 (12.50)	70 (58.33)	+93	77.50
		Overall Impact 92.83			

Table 5 — Degree of the effectiveness of Traditional Knowledge (ITK) practices for drought mitigation in groundnut used by the farmer N=120

S. No	Technology	Response categories			Mean score	Rank
		Most effective	Effective	Not effective		
1	ITKS for drought mitigation in groundnut Summer deep ploughing	90 (75.00)	20 (16.67)	10 (8.33)	2.29	i
2	Sub soiling with chisel plough after summer shower	85 (70.83)	17 (14.17)	18 (15.00)	2.13	iii
3	Application of farm yard manure	75 (62.5)	30 (25.00)	15 (12.5)	2.19	ii
4	Forming of dead furrows at every 2 meters with 30 cm depth	60 (50.00)	30 (25.00)	30 (25.00)	1.88	iv
5	Sowing across the slope	83 (69.17)	12 (10.00)	25 (20.83)	1.98	v

percent change in adoption of Sub soiling with chisel plough after summer shower 88.3% change in FYM application 71.67, 68.33% change in forming dead furrows at intervals of every 2 meters, each with a depth of 30 cm, 77.5% change in sowing across the slope. The highest per cent change (88.33%) was recorded in adoption of sub soiling practice which is a prominent water conservative technique. When calculated, the degree of effectiveness of ITK practices for drought mitigation in groundnut used by the farmer among all five drought mitigation techniques, summer deep ploughing ranks first with 2.29 mean score followed by application of farm yard manure, sub soiling with chisel plough after summer shower, sowing in across the slope and forming dead furrows at intervals of every 2 meters, each with a depth of 30 cm with mean scores of 2.19, 2.13, 1.98 and 1.88 respectively (Table 5). These insights reveal that while many farmers appreciated the cost-effectiveness and sustainability of ITK practices. Similar findings were also reported previously<sup>10</sup>.

### Conclusion

In semi-arid zone of Andhra Pradesh, drought is the major obstacle for ground nut productivity. Smallholders encounter different constraints which restrict enhancing agronomic productivity of groundnut crop. ITK carried over from generations provides suitable solutions towards enhancing productivity levels and overcoming threats of climate-induced hazards. The adoption of ITK could be regarded as a promising step towards enhancing production levels, maintaining sustainability and enhancing livelihood security. ITKs for increasing productivity, profitability and forecasting of climatic vagaries like drought and floods is important for self-reliance of the smallholders.

### Acknowledgements

Authors are thankful to the Indian Council of Agricultural Research (ICAR), ATARI Zone X for funding support. Authors are also thankful to ICAR-

Krishi Vigyan Kendra, Banavasi, 518360, Acharya N.G Ranga Agricultural University, Guntur 522 034, Andhra Pradesh, India.

### Conflict of Interest

Authors declare that they do not have any conflict of interest.

### Declaration

Authors conducted frontline demonstrations in the selected farmers' fields and collected the field data and analyzed.

### Author Contributions

All authors equally contributed, MJ: Conceptualization, data collection and write original document. BHC: and KRC Data tabulation, analysis and editing. GPB: Supervision, editing and review.

### Ethical Approval

Human/animal experimental models have not been studied in this paper. Therefore, ethical approval from any agency is not applicable.

### Informed Consent

We have not used photographs/figures from other published sources. Information taken from other sources has been properly cited in reference section.

### Data Availability

Specific data has not been used and interpreted in this paper. This is an attempt to contextualize Indian traditional water knowledge with contemporary water challenges in India. Data supporting the findings of this study will be made available by the corresponding author upon reasonable request.

### References

- Mishra P K, Indigeneous technical knowledge on Soil and Water Conservation in semi-arid India (Eds: P.K. Mishra, G. Sastry, M. Osman, G.R. MaruthiSankar and N. BabjeeRao), NATP, CRIDA, Hyderabad, (2002) 151.

- 2 Srinivasarao C, Lakshmi C S, Kundu S, Kumar G R, Somashekar, *et al.*, Indigenous technical knowledge for enhanced agronomic productivity and soil health of small holder farmers in Tropical India, *Climate Change Environ Sustain* (CCES), 9 (1) (2021) 1-13.
- 3 Rao, Y H P M M P, Madhu T & Appanna B, Cropping pattern in Handri river basin of Kurnool district Andhra Pradesh, *Int J Geogr Geol Environ*, 6 (1) (2024) 269-278.
- 4 Choudhary B N, Krishivigyan Kendra- A guide for KVK managers, division of agricultural extension, ICAR, (1999) 73-78.
- 5 Samui S K, Mitra S, Roy D K, Mandal A K & Saha D, Evaluation of frontline demonstration on groundnut, *Journal of the Indian Soc Coast Agric Res*, 18 (2) (2000) 180-183.
- 6 Rao C S & Gopinath K A, Resilient rainfed technologies for drought mitigation and sustainable food security, *Mausam*, 67 (1) (2016) 169-182.
- 7 Gopinath K A, Dixit S, Ravindra Chary G, Srinivasarao C, Osman M, *et al.*, Improving the rainfed farming systems of small and marginal farmers in Anantapur and Adilabad Districts of Andhra Pradesh, *Central Research Institute for Dryland Agriculture* (CRIDA), *Hyderabad, Andhra Pradesh*, (2013) 46.
- 8 Jayalakshmi V, Chaithanya B H, Manjunath J, Ahammad S K, Kamakshi N, *et al.*, Impact of tribal sub plan (TSP) intervention on yield and economics of chickpea cultivation in Kurnool District of Andhra Pradesh, *Indian J Ext Educ*, 58 (2) (2022) 217-220.
- 9 Singh N K, Kumar S, Singh B K & Wajidhasan, Impact of cluster frontline demonstration on yield of chickpea in Nalanda, Bihar, *J Agrisearch*, 7 (1) (2020) 44-46.
- 10 Meena D C, Rao C R, Dhyani B L, Dogra P, Samuel J, *et al.*, Socio-economic and environment benefits of soil and water conservation technologies in India: A critical review, *Int J Curr Microbiol Appl Sci*, 9 (4) (2020) 2867-2881.