Mysore J. Agric. Sci., 59 (1) : 341-348 (2025)

Improved Dryland Technologies for Sustainable Crop Productivity in Rainfed Situation in Anantapuramu District

Sahaja Deva[1], G. Sri Manjula Reddy[2], B. Sahadeva Reddy[3] and C. H. Apparao[4]
[1]RARS, Tirupati, [3]ARS, Aanthapuramu, [4]RARS, Maruteru, Acharya NG Ranga Agricultural University, Andhra Pradesh
[2]College of Veterinary Science, Proddutur, Sri Venkateswara Veterinary University, Andhra Pradesh
e-Mail : sahajadeva@angrau.ac.in

Authors Contribution

Sahaja Deva :
Conceptualization and conducting of experiments

G. Sri Manjula Reddy & C. H. Apparao :
Accompanied in conducting experiments

B. Sahadeva Reddy :
Supervision and guidance

Corresponding Author :
Sahaja Deva

Received : September 2024
Accepted : September 2024

Abstract

On-farm demonstrations were conducted under AICRP Dryland Agriculture- On-Farm Research during 2023-24 in Niluvurai village, Narpala mandal, Anantapuramu district in order to evaluate and disseminate the improved dryland technologies under rainfed conditions on improving productivity and profitability of marginal and small farmers. Demonstrations were conducted in farmers fields under different themes like varietal performance, rain water management and nutrient management through foliar spray. Demonstrations clearly showed the advantage of improved dryland technologies over farmers practice even under severe drought conditions. Among different technologies, the per cent increase in yield with improved dryland technologies ranged from 4.4-24.7 per cent. Highest per cent yield increase was observed in varietal performance in groundnut (24.7%) followed by supplemental irrigation through farm pond in redgram (12.2 %), varietal performance of redgram (7.6%), foliar spray of KNO_3 (6.8%), conservation furrows in castor (6.5%) and subsoiling (4.4%). Additional net returns through improved dryland technologies ranged from Rs.580-14490 /ha. Higher net returns were obtained in varietal performance of groundnut (Rs.14490/ha) followed by conservation furrows in castor (Rs.5390/ha), supplemental irrigation through farm ponds in redgram (Rs.4200/ha), varietal performance of redgram (Rs.3610/ha), foliar spray of KNO_3 (Rs.2562/ha) and subsoiling (Rs.580/ha). Rain water use efficiency is higher in demonstrated plots compared to farmers practice which clearly indicate that improved dryland technologies are beneficial in rainfed areas.

Keywords : Dryland, Economics, On farm demonstrations, Productivity in rainfed

Anantapuramu is a dryland area where rainfall is the major constraint. Delayed onset of monsoon, low and erratic rainfall, uneven distribution of rainfall, early cessation of rainfall, mid season drought are the major challenges being faced by farmers of Anantapuramu district which leads to low productivity of the crops. As 75 per cent of the area comes under rainfed situations there is need to conserve water by following certain management practices. Groundnut is the major crop accounting for about 75 per cent of rainfed area and redgram + groundnut is the commonly followed intercropping system in Anantapuramu district. Water conservation technologies like farm ponds, subsoiling, formation of conservation furrows; foliar sprays to mitigate water stress during crop growth period; use of improved and high yielding varieties not only improve water use efficiency but also increases productivity of crops. Efforts are being made to conserve water and utilize during critical stages through farm ponds, formation of sub soiling and conservation furrows to improve infiltration and increase availability of water at root zone for longer period, introduction of improved varieties which are drought tolerant and high yielders. Farmers are not

following any water conservation technologies due to lack of awareness. In order to create awareness to farmers on improved dryland technologies, AICRPDA has started On-Farm Research during 2018-19 to evaluate and disseminate the technologies to farmers.

Material and Methods

On-farm demonstrations were conducted under AICRP Dryland Agriculture- On-Farm Research during 2023-24 in Niluvurai village in farmers fields under different themes like varietal performance, rain water management and nutrient management through foliar spray (Table 2).

Niluvurai village is located in Narpala mandal, Anantapuramu district of Andhra Pradesh. It is situated in Latitude of 14.736394° N, Longitude of 77.797108° E. Mean elevation of this village is 372 m. It is located at 25 km from Anantapuramu and 17 km from Agricultural Research Station, Rekulakunta, Anantapuramu. 65 per cent of the families depends on agriculture a one and 69 per cent of area is under rainfed situation with major crops being cultivated are groundnut followed by redgram and castor during *kharif* season.

Soils of this village are shallow red sandy loams which are slightly acidic with pH of 6.63, low in electrical

Table 1

Details of technologies interventions

Details of intervention/ technology	Time of implementation	No. of farmers
Subsoiling at 1 m interval	After receipt of summer rains/before onset of monsoon (May)	10
Formation of conservation furrows at both sides of the row	30 DAS	10
Spraying of potassium nitrate @ 5 ml/lit of water twice at 1 week interval	Crop-Wilting stage (Pod development stage in groundnut and vegetative to flowering stage in redgram)	10
Supplemental/Protective irrigation through farm ponds	Crop-Wilting stage (Pod development stage in groundnut and vegetative to flowering stage in redgram)	2

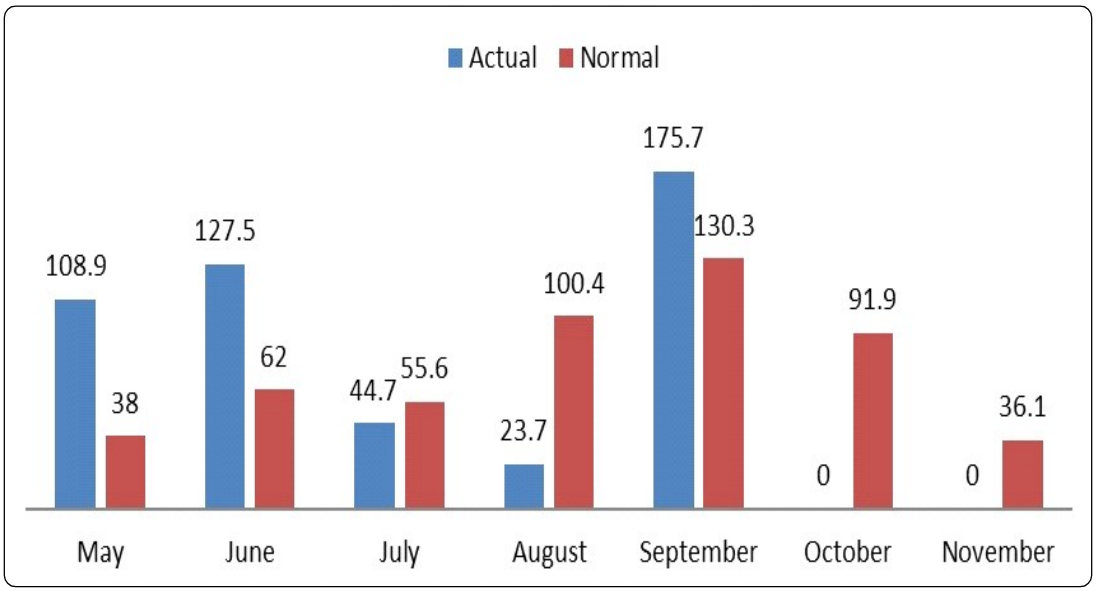

Fig. 1 : Rainfall data during crop growth period

conductivity (0.02 dS m^{-1}), organic carbon (0.29%), available nitrogen (167 kg/ha); medium in available phosphorus (48 kg/ha) and potassium (294 kg/ha); deficient in micronutrients like copper (0.13 ppm), manganese (1.90 ppm), iron (0.70 ppm) and zinc (0.05 ppm).

Actual and Normal rainfall during crop growth period is depicted in Fig. 1 which clearly indicates that actual rainfall is less compared to normal during all months except during July and August. Subsoiling was done during May and sowings were started during June and harvestings were done from September (groundnut) to January (redgram). Total rainfall of 480.5 mm was received from May to September against normal annual rainfall of 554.1 mm in 26 rainy days. No rainfall was received from October. Normal mean crop seasonal rainfall during *kharif* and *rabi* are 383.2 and 117.1 mm and actual mean crop seasonal rainfall during *kharif* and *rabi* are 371.6 and 0.0 mm, respectively.

Dryspells during Crop Growth Period

Dryspell is the major problem in rainfed crops leading to poor productivity. Crops were subjected to dry spells from vegetative stage to harvesting stage and details are presented in Table 2 and Fig. 2.

Table 2

Dry spells during crop growth period

Period of dryspell	No. of days
10.06.23 - 20.06.23	11
27.06.23 - 16.07.23	20
28.07.23 - 09.08.23	13
12.08.23 - 01.09.23	21
07.09.23 - 21.09.23	15
After 30.09.23	No rainfall

Results and Discussion

***In-situ* Moisture Conservation**

Farmers usually plough the 15-30 cm of soil which lead to formation of sub soil hard pan. Which makes rain water difficult to infiltrate into deeper layers. Due to poor infiltration, crops starts wilting in the absence of rains. Subsoiling and conservation furrows improve the infiltration of rain water. Subsoiling breaks the hard pan and allows water to infiltrate to deeper layers which will be available to crop during stress conditions. Conservation furrows increase the time of water availability at root zone.

Subsoiling : Subsoiling gave higher yield, net returns and B:C ratio compared to farmers practice (Table 3

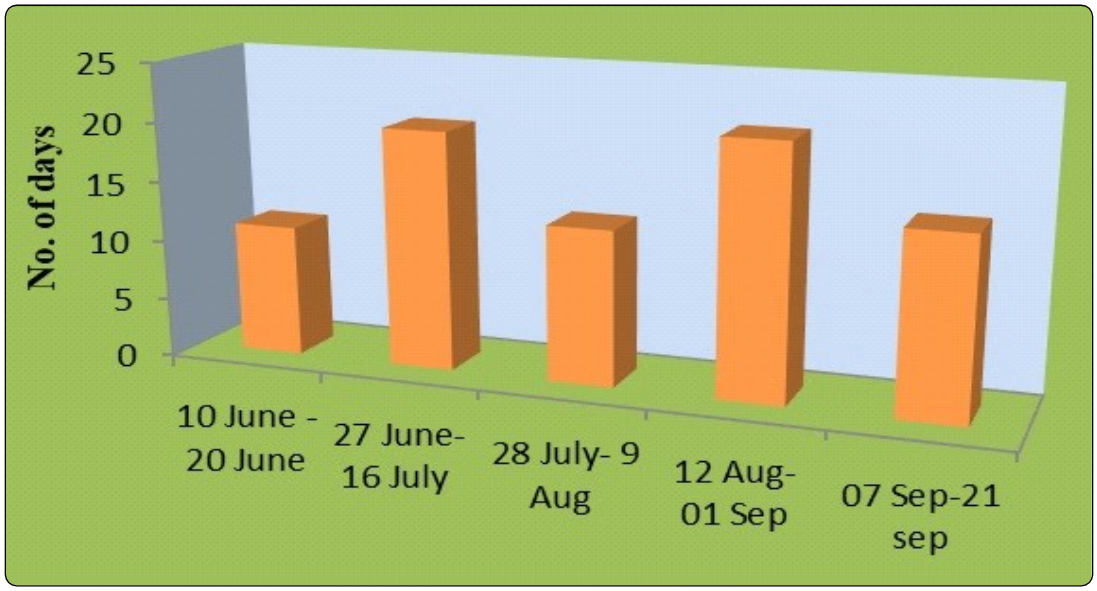

Fig. 2 : Dryspells during crop period

TABLE 3

Productivity and economics of groundnut + redgram intercropping system under *in-situ* moisture conservation (Subsoiling)

Parameter	Improved practice (With subsoiling)	Farmers practice (Without subsoiling)
Groundnut yield (kg/ha)	560	537
Redgram yield (kg/ha)	180	172
GEY (kg/ha)	831	796
per ecnt yield increase over farmers practice	4.4	
Haulm yield (kg/ha)	982	956
Cost of cultivation (Rs./ha)	36625	35000
Gross returns (Rs/ha)	52353	50148
Net returns (Rs/ha)	15728	15148
B:C ratio	1.43	1.40
Additional Net Returns (Rs/ha)	580	
Rain water use efficiency (kg/ha mm)	2.2	2.1

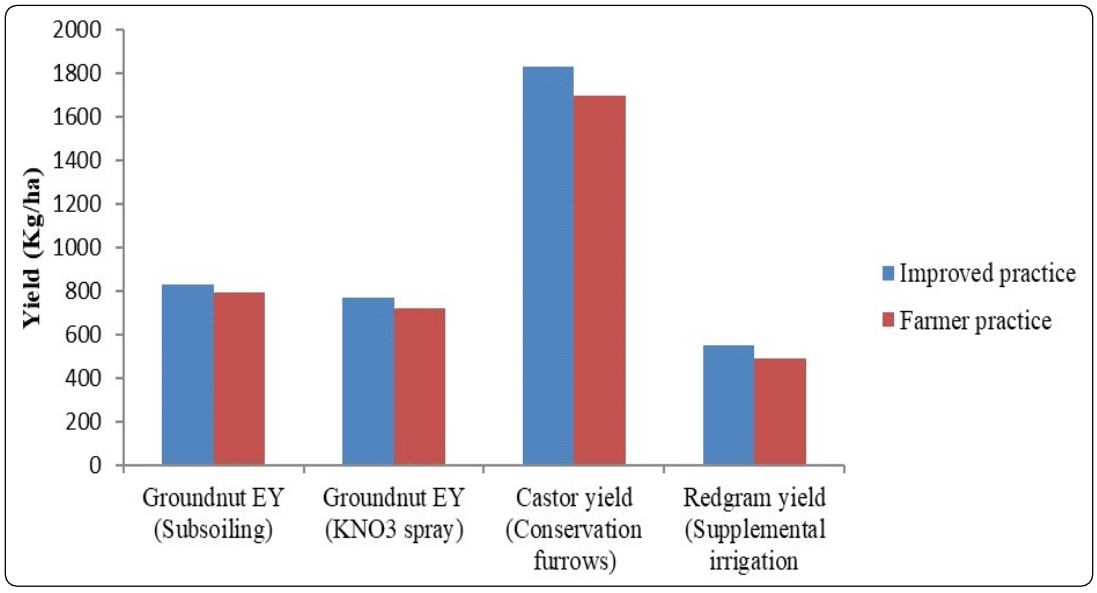

Fig. 3 : Yield comparison in different improved dryland technologies with farmers practice

and Fig.3). Groundnut equivalent yield of 831 kg/ha was obtained in improved practice which was 4.4 per cent higher than farmers practice (796 kg/ha). Additional net returns of Rs.580/ha was obtained in improved practice with net returns and B:C ratio of Rs.15728/ha and 1.43, respectively. Net returns of 15148 Rs/ha and B: C ratio of 1.40 was obtained in farmers practice. Results are in conformity with findings of Ghosh *et al*. (2006). Rajitha *et al*. (2018) reported that Vertical tillage with subsoiler and deep ploughing effective in conserving the soil moisture content by providing better environment for rainfed groundnut. Srinivasa Reddy *et al*. (2023) reported that groundnut + pigeonpea intercropping system recorded higher yield compared to groundnut or Redgram as sole crop.

TABLE 4

Productivity and economics of castor under *in-situ* moisture conservation (Conservation furrows)

Parameter	Improved practice (With subsoiling)	Farmers practice (Without subsoiling)
Yield (kg/ha)	1830	1700
Prer cent yield increase over farmers practice	6.5	
Cost of cultivation (Rs./ha)	30500	29000
Additional cost (Rs/ha)	1500	
Gross returns (Rs/ha)	96990	90100
Net returns (Rs/ha)	66490	61100
B:C ratio	3.2	3.1
Additional Net Returns (Rs/ha)	5390	
Rain water use efficiency (kg/ha mm)	4.9	4.6

Conservation Furrows : Conservation furrows at 30 DAS in castor recorded higher yield and economics compared to farmers practice (Table 4 and Fig. 3). 6.5 per cent yield increase was observed in improved practice (1830 kg/ha) over farmers practice (1700 kg/ha). Net returns of Rs.66490 and 61100/ha were obtained in improved practice and farmers practice, respectively with B:C ratio of 3.2 and 3.1. Additional net returns of Rs.5390/ha was obtained with additional cost of Rs.1500/ha. Similar trend was observed by Rajendra Reddy *et al.* (2015) who reported that conservation furrows in castor gave higher bean yields of 159 kg/ha and net income (Rs.3232/ha) than non-conservation furrow.

Higher yield with *in-situ* moisture conservation furrow might be associated with the increased infiltration and availability of water near root zone.

Varietal Demonstration

Most of the farmers' in the domain are using old traditional varieties which are susceptible to pests & diseases, drought and also low yielders. New improved varieties in redgram and groundnut are available which are tolerant to drought, pest and diseases.

Groundnut : Insect pests are the major responsible for low productivity in groundnut among the several factors (Rudramani and Thippaiah, 2023). Improved varieties of groundnut proved best compared to local variety in terms of pest incidence, yield and economics (Table 5 and Fig.3). Yield increase of 24.7 per cent was observed in Kadiri Lepakshi (1060 kg/ha) and 11.2 per cent in Visishta (945 kg/ha) compared to local variety (850 kg/ha). Additional net returns of Rs.14490/ha was obtained in Visishta (33040 Rs/ha)

TABLE 5

Productivity and economics of improved varieties of groundnut under rainfed condition

Parameter	Kadiri Lepakshi	Visishta	Local variety (K-6)
Yield (kg/ha)	1060	945	850
Per cent yield increase over farmers practice	24.7	11.2	
Haulm yield (kg/ha)	1256	1175	1000
Cost of cultivation (Rs./ha)	35000	35000	35000
Gross returns (Rs/ha)	57240	68040	53550
Net returns (Rs/ha)	22240	33040	18550
B:C ratio	1.6	1.9	1.8
Additional net returns (Rs/ha)	3690	14490	
Rain water use efficiency (kg/ha mm)	2.9	2.5	2.3

TABLE 6

Productivity and economics of of improved varieties of redgram under rainfed condition

Parameter	PRG 176	LRG 105	Local variety (Arjun)
Yield (kg/ha)	535	510	497
Per cent yield increase over farmers practice	7.6	2.6	-
Cost of cultivation (Rs./ha)	21500	21500	21500
Gross returns (Rs/ha)	50825	48450	47215
Net returns (Rs/ha)	29325	26950	25715
B:C ratio	2.36	2.25	2.19
Additional net returns (Rs/ha)	3610	1235	
Rain water use efficiency (kg/ha mm)	1.4	1.4	1.3

with B:C ratio of 1.9 and Rs.3690/ha in Kadiri Lepakshi. Rain Water Use efficiency is higher in Kadiri Lepakshi (2.9) followed by Visishta (2.5) and K-6 (2.3). Mamatha *et al*. (2022) and Siva Jyothi *et al.* (2003) also reported similar findings.

Redgram : Improved varieties of redgram gave higher yield, net returns and B:C ratio compared to local variety Arjun (Table 6 and Fig.3). Yield increase of 7.6 per cent was observed in PRG 176 (535 kg/ha) and 2.6 per cent in LRG 105 (510 kg/ha) compared to local variety (497 kg/ha). Additional net returns of Rs.3610/ha were obtained in PRG 176 (29325 Rs/ha) with B:C ratio of 2.36 and Rs.1235/ha were obtained in LRG 105 (26950 Rs/ha) with B:C ratio of 2.25. Local variety recorded net returns and B:C ratio of Rs.25715/ha and 2.19, respectively. Higher yields in improved varieties were due to drought tolerance and pests and disease resistance. Similar findings were reported by Venkanna *et al*. (2022).

Foliar Spray in Groundnut + Redgram Intercropping System

Under rainfed condition when crops subject to moisture stress express the symptoms of wilting and crop removal is the option left to farmers if unable to provide protective irrigation at critical stages. Spraying of potassium nitrate @ 0.5 per cent during moisture stress conditions twice at weekly interval will protect crop from wilting for a period of 7-10 days.

Groundnut equivalent yield (Table 7 and Fig. 3) of 772 kg/ha was obtained in improved practice which was 6.8 per cent higher than farmers practice (723 kg/ha). Additional net returns of Rs.2562/ha was obtained with additional cost of Rs.525/ha in improved practice with net returns of Rs.13111/ha and B:C ratio of 1.4. Farmers practice realized a net returns of Rs.10549/ha and B:C ratio of 1.3. Suresh e*t al*. (2021) reported higher yields in redgram fields

TABLE 7

Productivity and economics of groundnut + redgram intercropping system under foliar spray with 0.5% KNO_3

Parameter	Improved practice (KNO_3 spray)	Farmers practice (without spray)
Groundnut Yield (kg/ha)	540	524
Redgram yield (kg/ha)	154	132
GEY (kg/ha)	772	723
Per cent yield increase over farmers practice	6.8	

Continued...

Table 7 Continued...

Parameter	Improved practice (KNO_3 spray)	Farmers practice (without spray)
Haulm yield (kg/ha)	954	903
Cost of cultivation (Rs./ha)	35525	35000
Additional cost (Rs/ha)	525	
Gross returns (Rs/ha)	48636	45549
Net returns (Rs/ha)	13111	10549
B:C ratio	1.37	1.30
Additional net returns (Rs/ha)	2562	
Rain water use efficiency (kg/ha mm)	2.1	1.9

sprayed with 1.0 per cent potassium nitrate. Rajitha *et al*. (2015) reported higher yield in groundnut fields sprayed with 0.5 per cent potassium nitrate.

Supplemental Irrigation/Protective Irrigation in Redgram

Under rainfed conditions, due to uneven distribution of rainfall sometimes excess rains may be received. Excavation of farm ponds and storing the excess runoff water through rain water harvesting will be beneficial for supplemental irrigation or protective/ life saving irrigation at critical stages to realize good yields. Venkata Rao *et al*. (2015) also reported the similar findings.

Improved practice recorded 12.2 per cent higher yield and Rs.4200/ha additional net returns compared to farmers practice (Table 8 and Fig. 3). Yield of 550 kg/ha, net returns of Rs.29250/ha and B:C ratio of 2.27 were recorded in improved practice. Whereas, in farmers practice yield of 490 kg/ha, net returns of Rs.25050/ha ad B:C ratio of 2.16 was obtained.

Demonstrations clearly showed the advantage of improved dryland technologies over farmers practice even under severe drought conditions. Per cent increase in yield in improved dryland technologies ranged from 4.4-24.7 per cent in different technologies. Additional net returns through improved dryland technologies ranged from Rs.580-14490/ha. Rain water use efficiency is higher in demonstrated plots compared to farmers practice which clearly indicate that improved dryland technologies are beneficial in rainfed areas.

Table 8

Productivity and economics of redgram under supplemental/protective irrigation

Parameter	With supplemental irrigation	Without supplemental irrigation
Yield (kg/ha)	550	490
Per cent yield increase over farmers practice	12.2	-
Cost of cultivation (Rs./ha)	23000	21500
Additional cost (Rs/ha)	1500	
Gross returns (Rs/ha)	52250	46550
Net returns (Rs/ha)	29250	25050
B:C ratio	2.27	2.16
Additional net returns (Rs/ha)	4200	

REFERENCES

GHOSH, P. K., MOHANTY, M., BANDYOPADHYAY, K. K., PAINULI, D. K. AND MISRA, A. K., 2006, Growth, competition, yield advantage and economics in soybean/ pigeonpea intercropping system in semi-arid tropics of India I. Effect of subsoiling. *Field Crops Res.*, **96** : 80 - 89.

MAMATHA, A., SRIDHAR, K., AVIL KUMAR, K. AND VIJAYA LAKSHMI, D., 2022, Yield performance of groundnut (*Arachis hypogaea* L.) varieties under varied soil moisture regimes of micro sprinkler irrigation. *Bio. Forum – An Int. J.*, **14** (3) : 189 - 193.

RAJENDRA REDDY, G., PRASAD, Y. G. AND HIMABINDU, T., 2015, Assessment of *in-situ* moisture conservation technologies on productivity and profitability in rainfed crops. *Indian J. Dryland Agric. Res. & Dev*., **30 (**2) : 125 - 127.

RAJITHA, G., PRABHAKARA REDDY, G., MUNEENDRA BABU A. AND SUDHAKAR P., 2018, Effect of *in-situ* moisture conservation practices on soil moisture content of rainfed groundnut (*Arachis hypogaea). Int. J. Curr. Microbiol. App. Sci*., **6** : 309 - 315.

RAJITHA, B., LATHA, P., UMAMAHESH, V., CHANDRIKA, V. AND SUJATHA, K., 2015, Effect of foliar nutrition in ameliorating drought tolerance and yield in groundnut. *Andhra Pradesh J. Agril. Sci*., **1** (4) : 7 - 12.

RUDRAMUNI, T. AND THIPPAIAH, M., 2023, Studies on the host plant interaction and management of insect pests in groundnut. *Mysore J. Agric. Sci*., **57** (1) : 441.

SIVA JYOTHI, V., TRIKALA MADHAVI AND SASHIKALA, G., 2003, Performance of Kadiri Lepakshi (K-1812) groundnut in Anantapuram district of Andhra Pradesh, India. *Eco. Env. & Cons*., **29** (3) : 1157 - 1163.

SRINIVASA REDDY, D. V., SAVITHA, M. S., RAMESH, P. R., BHANDI, N. H., RAJU G. TEGGELLI, VISHWANATH AND RAVI, S., 2023., Climate - resilient technology to adapt to climate change for sustainable livelihood and production. *Mysore J. Agric. Sci*., **57** (2) : 294 - 300.

SURESH, G., NAGAVANI, A. V., SUMATHI , V., GIRIDHARA KRISHNA, T. AND SUDHAKAR, P., 2021, Tillage practices, nutrient levels and foliar sprays effect on nutrient content of redgram [*Cajanus cajan* L.] at different growth stages. *Bio. Forum - An Int. J.*, **13** (4) : 1201 - 1208.

VENKANNA, Y., BHASKAR RAO, B., SRINIVAS, A. VINAYAK, R. AND NARESH, B., 2022, Performance of cluster front line demonstrations on integrated crop management in red gram (*Cajanus cajan*) using variety PRG-176 in Peddapalli district under North Agroclimatic Zone of Telangana State in India. *Asian J. Agric. Ext. Econ & Soc.,* **40** (8) : 96 - 103.

VENKATA RAO, P., SUBBARAMI REDDY, A., SATEESH BABU, J. AND RAMANA, M. V., 2015, Effect of sowing time and supplemental irrigation on yield and economics of *rabi* pigeonpea [*Cajanus cajan* (L.) Millsp.]. *Int. J. Res. Agric. Sci.,* **3** (6) : 2348 - 3997.