Original Research Article

Development and Validation of a Knowledge Test for Assessing Dryland Farmers' Understanding of *Redgram(Cajanuscajan L.)* Cultivation

ABSTRACT

The study aimed to assess the knowledge levels of dryland farmers regarding critical interventions in *redgram* cultivation. Utilizing a structured and standardized knowledge test, the research sought to measure the understanding and practices among farmers in relation to key agronomic practices. The test was constructed with 45 items sourced from various agricultural recommendations and research publications, focusing on areas such as soil management, pest control, and crop rotation. Following a pre-test and item analysis, the final test comprised 28 questions in different formats (multiple choice, true/false, yes/no). The difficulty and discrimination indices were used to select items that were neither too simple nor overly challenging, ensuring that they could effectively differentiate between well-informed and less-informed respondents. The reliability of the test was confirmed with a high correlation coefficient of 0.83 using the split-half method. The content validity was also established, demonstrating that the test accurately measured the intended knowledge aspects. The results revealed that 60% of the farmers had a medium level of knowledge about *redgram* cultivation, 20.83% had high knowledge levels, while 19.17% possessed low knowledge. These findings highlight that a majority of farmers are moderately informed, likely due to their practical experience and exposure to agricultural information sources, especially in light of the frequent droughts that challenge their farming practices. Farmers with medium to high levels of knowledge are better equipped to implement effective agricultural interventions, which can help mitigate crop losses. The study underscores the need for targeted extension services and educational programs to further enhance the knowledge base of dryland farmers. By focusing on critical interventions, agricultural productivity and sustainability in dryland areas can be significantly improved, leading to better crop management and increased resilience against adverse climatic conditions.

*Keywords:*difficulty Index, discrimination index, reliability test, item analysis, critical interventions

1. INTRODUCTION

Drylands are inhabited by around two billion people, with approximately 90% residing in developing countries. These regions are also home to a wide range of indigenous livestock breeds

and plant species that are crucial for ensuring food security and supporting livelihoods. According to the FAO Global Agro-Ecological Zones (GAEZ) modelling system (FAO, 2020), drylands accounted for 43.20% of the global area in 2020, a figure expected to increase to 44.20% by 2050. Challenges such as demographic growth, which leads to unsustainable pressure on natural resources— including overgrazing, continuous deforestation for fuelwood, reduction of fallow periods, and over-pumping of water—are further compounded by issues like poverty, food insecurity, biodiversity loss, frequent droughts, and environmental degradation. All of these factors are being exacerbated by the impacts of climate change.India leads in dryland area, covering 86 million hectares, and contributes 44% of the country's food grain production. This includes significant outputs of coarse cereals, pulses, oilseeds, and cotton. Dryland agriculture is marked by diverse climates, frequent droughts, fragile landscapes, poor soil, and limited water resources, challenges exacerbated by climate change. Nine states, including Andhra Pradesh, account for over 80% of India's drylands.

In Andhra Pradesh, 51.22% of cultivated land was dryland in 2019-20, primarily in Anantapuramu and Prakasam districts(Government of Andhra Pradesh, 2020). These areas suffer from frequent droughts and limited irrigation, with open wells and borewells as main water sources. The prevalence of poverty is high, with 32% of the population in these areas being chronically poor. Major crops include pulses like *redgram* and chickpea, oilseeds, cotton, and tobacco. Rainfall is low, averaging 871 mm in Prakasam and 552 mm in Anantapuramu. The proportion of land under rainfed cultivation for cotton and maize has increased over time, reducing areas for groundnut and sunflower(District Hand Book of Statistics, Prakasam.,2018).

Researchers have developed critical interventions to minimize drought impacts, and widespread adoption by farmers could reduce crop losses and enhance returns. These technological solutions are vital for the sustainable livelihoods of dryland farmers and contribute to the agrarian economy. Scientists, extension workers, and various agencies are key in promoting these interventions, but farmers need to adopt them timely. Despite efforts by researchers and specialists, the impact of these interventions on dryland farming remains limited. Given the increasing importance of dryland farming, there is a recognized need to assess the knowledge of dryland farmers regarding critical interventions in major staple crop*redgram*world-wide known as pigeon pea. The scientific name of *redgram* is *Cajanuscajan*, where *Cajanus* represents the genus and *cajan* the species. The name is derived from the Malay word 'katjang,' meaning legume, referring to the bean of the plant.

2. METHODOLOGY

The research was conducted in the dryland farming regions where *redgram* is predominantly cultivated. The study focused on a representative sample of 120 dryland farmers who were actively engaged in *redgram* cultivation. Respondents were selected using a stratified random sampling technique to ensure diverse representation from 8 villages located in prakasam district of Andhra Pradesh. The data collection for this research was conducted in March 2021 by the corresponding author of this paper.A knowledge test was created to evaluate the level of awareness among farmers regarding critical interventions in dryland *redgram* cultivation. The study is divided into two sections:

the development of the knowledge test and the assessment of farmers' knowledge levels concerning these interventions. The test consisted of multiple-choice questions, true or false statements, and fill-in-the-blank items. Statistical methods, including the difficulty index and discrimination index, were utilized to refine the items. After this screening process, 28 items were selected from an initial pool of 45. To determine the farmers' knowledge levels, the study employed statistical measures such asDifficulty Index, Discrimination Index, frequency, percentages, mean, and standard deviation. The data analysis was carried out using SPSS software.

3. RESULTS AND DISCUSSION

3.1Construction and Standardization of Knowledge Test

The main intention of the knowledge test was to identify the extent of knowledge of dryland farmers about critical interventions in *redgram*. The details of the standardization of the items were as follows.

3.2Collection and Framing of Knowledge Items

The content of the test was composed of items asked in the form of questions. The important factor considered for collecting the items for knowledge test was to determine and classify the object to be measured by taking care of the respondent's abilities. Accordingly, 45 items(*Vide*Appendix) for *redgram* were collected from different sources like ZREAC(Zonal Research and Extension Advisory Committee) recommendations of Acharya N. G. Ranga Agricultural University, VyavasayaPanchangam, Publications of CRIDA(Central Research Institute for Dryland Agriculture) like Improved Agronomic Practices for Rainfed Crops in India (AICRPDA), Websites of CRIDA and NICRA(National Innovations on Climate Resilient Agriculture) etc.

3.3Selection of Items for Item Analysis

The selection of items was done on the basis of the following criteria:

1. Response to items should promote thinking rather than rote memorization.
2. They should differentiate the well-informed respondents from the less informed and should have certain difficulty value.
3. The items included should cover all the areas of knowledge of dryland farmers about critical interventions in*redgram* cultivation.

3.4Framing of Questions

By considering above criteria, items were selected for developing knowledge test after editing carefully. The items were then framed into objective form of questions namely multiple choice, true or false and yes or no and therefore, the assessment was objective and impersonal. The particulars on the type of questions were given in the appendix.

3.5 Pre-testing

The items selected for the knowledge test were pretested separately by administering the items to 60 respondents selected randomly. Care was taken to see that 60 respondents selected for this purpose were outside the main sample of the study.

3.5Item Analysis

The item analysis was carried out to yield two kinds of information viz., indices of 'Item difficulty' and 'Item discrimination'. The item difficulty index indicates the extent to which an item was difficult. Item discrimination index provides information on how well an item measures or discriminates a well-informed respondent.

To analyze the items undertaken for item analysis, each response for multiple choice, yes or no and true or false questions were given a score of 'one' for "correct" answer and 'zero' for incorrect response. After computing the individual total score for 60 respondents, they were arranged in descending order based on total score. These 60 respondents were then divided into 6 equal groups arranged in descending order of total score obtained by them. These groups were named as G1, G2, G3, G4, G5 and G6 with 10 respondents in each group. For item analysis the middle 2 groups G3 and G4 were eliminated keeping only 4 extreme groups, with high scores namely G1 and G2 and low scores namely G5 and G6. After getting the four extreme groups for item analysis, the responses for each of the items were subjected to calculate item difficulty index as shown below:

3.6.1 Item Difficulty Index (P)

The item difficulty index was worked out as the percentage of respondents answering an item correctly. The assumption of the item statistic of difficulty index was that, the difficulty is linearly related to the level of respondent's knowledge of dryland farmers about critical interventions in *redgram*. It was computed by following formula and presented in Appendix.

$$\text{Item difficulty index (P)} = \frac{\text{No.of respondents answered correctly}}{\text{Total No.of respondents}} \times 100$$

The items with 'P' values ranging from 20 to 80 were considered for the final selection of knowledge test to avoid the extremely simple and difficult items which distort the required homogeneity and discrimination.

3.6.2Discrimination Index ($E^{1/3}$)

The item discrimination index ($E^{1/3}$), which indicates the level of discrimination between well informed and poorly informed respondents, was computed using formula given below.

$$\text{Discrimination index } (E^{1/3}) = \frac{(S1+S2)-(S5+S6)}{N/3}$$

Where,

S1, S2, S5 and S6 are the frequencies of correct answers in groups G1, G2, G5 and G6, respectively.

N is the total number of respondents in the sample selected for the item analysis *i.e.,* 60.

The items with $E^{1/3}$ values ranging from 0.20 to 0.80 were selected for the final knowledge test.

3.7Total Items Selected

Out of 45 questions selected, 28 items were finally selected for knowledge test on *redgram* crop based on the following criteria.

1. Items with difficulty level indices ranging from 20 to 80.
2. Items with discrimination indices ranging from 0.20 to 0.80.

All important components of the critical interventions have been covered. The question items were prepared in such a way that no important component has been left out.

The finally selected 28 knowledge items of *redgram* comprised of four types of questions *viz.,* multiple choice (8), fill in the blanks (9), yes or no and true or false (11) and finally selected.

Table 1: Difficulty Index and Discrimination Index for knowledge test items (*redgram*)

S. No.	Frequencies of correct answers in four extreme groups				Difficulty index	Discrimination index
1. *	10	10	8	6	68.33	0.30
2. *	8	7	4	0	41.67	0.55
3.	10	10	10	5	83.33	0.25
4.	2	1	0	0	10.00	0.15
5. *	8	3	1	4	25.00	0.30
6.	2	3	3	5	33.33	0.05
7. *	10	10	3	1	65.00	0.80
8. *	10	9	7	4	73.33	0.40
9. *	10	7	1	0	38.33	0.80

10.	10	10	7	8	90.00	0.25
11. *	10	10	7	7	68.33	0.30
12. *	10	10	5	5	73.33	0.50
13. *	10	10	5	2	65.00	0.65
14.	6	3	5	3	38.33	0.05
15. *	8	6	0	1	28.33	0.65
16.	10	10	10	9	88.33	0.05
17. *	10	10	4	3	70.00	0.65
18.	10	9	8	8	90.00	0.15
19. *	8	6	5	3	53.33	0.30
20.	10	10	9	6	88.33	0.25
21. *	4	4	2	0	20.00	0.30
22.	10	10	9	7	90.00	0.20
23. *	8	6	1	0	28.33	0.65
24. *	9	6	1	0	30.00	0.70
25. *	10	9	2	1	60.00	0.80
26. *	10	10	5	5	73.33	0.50
27.	10	10	9	9	88.33	0.10
28.	7	5	6	6	53.33	0.00
29. *	10	9	2	4	50.00	0.80
30.	6	1	0	0	15.00	0.35
31. *	8	8	0	0	45.00	0.80
32.	10	10	10	7	88.33	0.15
33. *	10	10	4	1	63.33	0.75
34. *	7	4	2	1	30.00	0.40
35. *	8	6	1	0	28.33	0.65

36. *	9	6	1	0	30.00	0.70
37.	4	1	0	1	10.00	0.20
38. *	10	10	5	1	65.00	0.70
39. *	8	8	2	2	50.00	0.60
40. *	10	9	3	0	63.33	0.80
41.	10	10	10	4	90.00	0.30
42. *	4	4	2	1	20.00	0.25
43.	10	8	10	8	90.00	0.00
44. *	10	9	1	2	63.33	0.80
45. *	8	4	2	2	30.00	0.40

3.8Reliability of the Test

Reliability of the items was tested by split half method. The scores obtained by odd number of respondents were taken on one set and the scores of even number of respondents as the second set of values for calculating the correlation coefficient. The correlation coefficient was highly significant (r = 0.83) indicating a high degree of dependability of the instrument for measuring knowledge of the respondents.

3.9Validity of the Test

Knowledge test developed on dryland critical interventions in *redgram* was subjected to content validity.

The content validity of the knowledge test was derived from a long list of test items representing the whole universe of critical interventions collected from various sources as discussed earlier and includes materials from literature, expert's opinion, findings of past work and discussion with extensionists of research stations. It was assumed that the score obtained by administering knowledge test of this study measures what was intended to measure. Thus, knowledge test developed in the present study measures the knowledge of the dryland farmers about critical interventions in *redgram* crops showed a greater degree of reliability and validity indicating that the test items were valid.

3.10Administration of the Test

Each item was read out to the respondents by the investigator and response was recorded with a score of one for correct answer and zero for wrong answer. The possible maximum and minimum scores that an individual respondent would get were 28 and 0 for knowledge test.

3.11Categorization of the Respondents

After arriving knowledge scores, the respondents were grouped into three categories based on mean and standard deviation.

List 1. Category of respondent

S. No.	Category	Score
1.	Low level of knowledge	Below mean – S.D.
2.	Medium level of knowledge	Between mean ± S.D.
3.	High level of knowledge	Above mean + S.D.

3.12 Level of Knowledge of Dryland Farmers on Critical Interventions in *Redgram*

The distribution of respondents according to their level of knowledge on critical interventions in *redgram* is depicted in Table 2. The data showed that three fifth (60.00%) of the respondents had medium level of knowledge on critical interventions in *redgram*, followed by high (20.83%) and low (19.17%) levels of knowledge.

Table 2. Distribution of dryland farmers according to their level of knowledge on critical interventions in *redgram* **(n=120)**

S. No.	Category	***Redgram***	
		f	**%**
1.	Low	23	19.17
2.	Medium	72	60.00
3.	High	25	20.83
Total		**120**	**100**
Mean		16.16	
S.D.		5.95	

Values in parentheses represent the significance level (sig.)

** Sig. at 5% level; f: Frequency; %: Percentage

It is clear from the above findings that most of the farmers had medium to high levels of knowledge on critical interventions of *redgram*. Many of the farmers in the study area were well experienced in farming and had medium level of extension contact. Moreover, the dryland farmers

were often exposed to droughts and experienced crop losses due to which they invariably depend on different information sources for gaining knowledge on critical interventions so as to minimize the crop losses. Hence, many of the farmers had medium to high level of knowledge. Similar findings were reported by Tidke*et al*. (2012), and Kumar (2019).

4. CONCLUSION

These findings highlight the importance of enhancing farmers' knowledge through targeted extension services and educational programs. By emphasizing critical interventions such as soil management, pest control, and crop rotation, these programs can equip farmers with the skills needed to enhance agricultural productivity and sustainability in dryland areas, while also addressing the socio-economic conditions of the farmerslike the size of the farms, the availability of family labour, the lack of capital, and so on.This approach will also help build resilience against adverse climatic conditions, ultimately leading to better crop management and reduced crop losses. The study's results serve as a valuable resource for policymakers, agricultural extension workers, and educators to design effective strategies for knowledge dissemination and capacity building among dryland farmers.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

REFERENCES

1. Bloom, B.S., Engelhardt, M., Frust, E., Hill, W and Rathwal, D.R. 1958. *Taxonomy of educational objectives, Vol. 1: The cognitive domain,* Orient Longmans, New York.
2. Commission on inclusive and sustainable agricultural development of Andhra Pradesh. 2016. Revitalizing rainfed agriculture of Andhra Pradesh.
3. Directorate of Economics and Statistics, Government of Andhra Pradesh, 2020. Agricultural Statistics at a glance. pp.8-16.
4. District Planning Office, Prakasam. 2018. District Hand Book of Statistics.
5. FAO, 2000. Agriculture: towards 2015/30. Technical Interim Report. Economic and Social Dept., FAO, Rome.
6. FAO, 2020. Towards a global programme on sustainable dryland agriculture. Food and Agriculture Organization of the United Nations, Rome.
7. http://www.nicra-icar.in/nicrarevised/
8. https://www.icar-crida.res.in/
9. KPR Vittal, HP Singh, G Ravindra Chary, GR Maruthi Sankar, YG Prasad, M Srinivasa Rao, JS Samra and Gurbachan Singh (2003). Improved Agronomic Practices for Dryland Crops inIndia. All India Co-ordinated Research Project for Dryland Agriculture, Central Research Institute for Dryland Agriculture, Indian Council of Agricultural Research, Hyderabad 500 059.

10. Kumar, P.P. 2019. A study on the knowledge and adoption of the recommended production technologies by the *redgram* growers of Prakasam district of Andhra Pradesh. M.Sc. (Ag.) Thesis. Acharya N.G. Ranga Agricultural University, Guntur, Andhra Pradesh.
11. Tidke, G.R., Rathod, M.K and Mandve, R.P. 2012. Knowledge and adoption of farmers about the management of pod borer complex in pigeon pea. International Journal of Extension Education. 8: 71-75.

APPENDIX

KNOWLEDGE LEVEL OF DRYLAND FARMERS ON CRITICAL INTERVENTIONS IN *REDGRAM*

The following statements are developed for conduct of pre-test for selecting the final statements for the knowledge test.

A. State True/False and Yes/No from the following statements:

1. Deep summer ploughing will help in in-situ moisture conservation (True/False)
2. Contour bunding reduces soil erosion and conserves soil (True/False)
3. *Redgram* is not grown as alternative crop in the areas affected by drought (True/False)
4. *Redgram* is a quantitative short-day plant i.e., the onset of flowering is hastened as day length shortens (True/False)
5. Short duration varieties like LRG-52, PRG-158 are recommended under delayed monsoon (True/False)
6. *Redgram* variety that is LRG-41 is resistant to *Helicoverpa* (True/False)
7. The appropriate time of sowing for *kharif redgram* is June-August (True/False)
8. intercropping will suppress the weed growth (True/False)
9. Maintaining the optimum and healthy crop stand (26,666 plants / acre) in *redgram* helps in competing with weeds at a critical growth stages of weed competition. (True/False)
10. Wider spacing of *redgram* causes weeds problem (True/False)
11. Field must be kept weed free up to 30-50 days after sowing (True/False)
12. Inter cultivation with gorru after 20-25 days is of no help in weed management (Yes/No)
13. Minimum two weedings are required in the crop season (True/False)
14. Intensity of dominant weeds can be controlled by spraying of *imazethapyr* (True/False)
15. Spraying of 20 grams of potassium nitrate or 10 grams of urea in one litre of water in case of prevailing drought is essential (True/False)
16. Sheep penning to increase nutrient status in rainfed soils (True/False)
17. Irrigation at flower bud initiation and pod filling stages helps in securing more yields (True/False)
18. *Kharif redgram* requires pre-sowing irrigation (True/False)

B. Select correct answer from the given alternatives

19. Soil which is not suitable for *redgram* cultivation is

a) Saline soils b) Alkaline soils

c) Water logged soils d) All of these

20. Duration of *kharif redgram* crop

a) 120-140 days b) 140-160 days

c) 160-180 days d) 180-200 days

21. Short duration variety of *redgram*

a) PRG-158 b) PRG-17

c) LRG-52 d) All of these

22. Selected seed of *redgram* should be

a. Free from pest and disease b. Free from any inert matter

c. Viable and genetically pure d. All of the above

23. The *redgram* variety suitable for *kharif* season in Prakasam district

a. PRG-158 b. PRG-176

c. LRG-52 d. All of these

24. Recommended chemical used for seed treatment is

a) Thiram @1.5-2g/1kg of seed b) Carbendazim@2g/1kg of seed

c) Trichoderma viride @ 4g/1kg of seed d) All of the above

25. Recommended seed rate for *kharifredgram* is

a. 2-3 Kg/Acre b. 4-5 Kg/Acre

c. 6-8 Kg/Acre d. 8-9 Kg/Acre

26. Recommended spacing for *rabiredgram*

a. 45-90 cm × 10 cm b. 45-90 cm × 20 cm

c. 150 cm × 20 cm d. 180 cm × 20 cm

27. Recommended N for rainfed *redgram* in kg/ha

a. 20 b. 50

c. 100 d. 150

28. Recommended P_2O_5 for rainfed *redgram* in kg/ha

a. 50 b. 100

c. 125 d. 150

29. Water retention in the soil can be improved by following one of these practices

a. Mulching b. Deep ploughing

c. Frequent inter-cultivation d. All of these

30. Pre emergence problem of annual grasses can be controlled by spraying of
a. Pendimethalin 30 % EC @ 1-1.5 l/acre b. Alachlor 50 % EC 1l/acre
c. a & b d. a or b

31. Name the important pest of *redgram* crop

a. Pod borer b. Weevils

c. Leaf roller d. Aphids and Jassids

32. Gram pod borer causes more damage to *redgram* crop at

a. Flower bud initiation b. Flowering

c. Pod development d. All of these

C. Fill in the blanks

33. Primary tillage for *kharif redgram* is done during _____
34. Method of sowing in *redgram*_____
35. *Redgram* variety LRG-30 resistant to _____
36. Variety that is tolerant to terminal moisture stress _____
37. *Redgram* variety that is suitable for growing on red light soils_____
38. Seed treatment in *Redgram* with _____ culture helps in increasing yield.
39. Normal sowing window of rainfed *redgram* during *kharif* _____
40. Intercropping of *redgram* with ground nut in _____ ratio
41. Any two crops grown along with *redgram* as intercrops_____
42. Critical growth stages in *redgram* _____
43. Can you name any one of micro irrigation systems _____
44. Can you name any one of the trade name of anti-transpirants _____
45. Under rainfed conditions, *redgram* crop is mostly affected with _____ disease.