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Influential Factors Shaping Farmers Knowledge Levels Regarding Critical Interventions in Dryland Farming in Drought Prone Region of Andhra Pradesh

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Authors' contributions

This work was carried out in collaboration among all authors. Authors PLRJ and TL conceptualized the study, performed the methodology, reviewed and edited the manuscript. Author MCM did the formal analysis and investigation and wrote original draft of the manuscript. Author PMR searched for resources. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted to investigate the profile, knowledge, and adoption of critical interventions among dryland farmers in the Prakasam district of Andhra Pradesh. Ex post facto research design was followed for the study and a sample of 120 dryland farmers were drawn. The research focused on the association between 16 independent variables and dryland farmers' knowledge and adoption of critical interventions in redgram and cotton. The findings revealed that variables such as education, land holding, yield, annual income, extension contact, mass media exposure, information seeking behavior, social participation, credit orientation, risk preference, irrigation status, economic orientation, decision making ability, and cropping pattern were positively and significantly related to knowledge and adoption of critical interventions in both crops. Conversely, age and experience in dryland farming were negatively and significantly related to knowledge and adoption. The independent variables explained 85.20% of the variation in knowledge on critical interventions in redgram, 76.80% in cotton, and 74.70% and 72.80% in the extent of adoption of critical interventions in redgram and cotton, respectively. These findings suggest that addressing these factors can enhance dryland farmers' knowledge and adoption of critical interventions, ultimately improving productivity and sustainability. Specifically, increasing education, land holding, yield, and annual income, and promoting extension contact, mass media exposure, and social participation can positively impact knowledge and adoption. Additionally, improving credit orientation, risk preference, irrigation status, economic orientation, and decision-making ability can also enhance adoption. Conversely, addressing the negative impact of age and experience is crucial. Overall, this study highlights the importance of a comprehensive approach to enhancing dryland farmers' knowledge and adoption of critical interventions.

Keywords: Dryland farming; critical interventions; knowledge adoption; redgram and cotton; sustainability.

1. INTRODUCTION

The FAO defines drylands as those areas with a length of growing period (LGP) of 1-179 days [1]; this includes regions classified climatically as arid, semi-arid and dry sub-humid. Based on the FAO Global Agro-Ecological Zones (GAEZ) modelling system (FAO, 2020), drylands represent 43.20 % of total global area in 2020, and are predicted to be 44.20 % in 2050. In India, rain fed agro-ecosystems occupy a significant portion of agricultural land, spanning 80 million hectares across arid, semi-arid and sub-humid climatic zones; constituting nearly 57 **%** of the net cultivated area. Rainfed agriculture supports 40 **%** of human population and 60 **%** livestock population. About 70 **%** of rural population lives in rainfed areas where their livelihoods are directly tied to the success or failure of crops (Rao *et al*., 2016). Climate change can act as a conflict threat multiplier, whereby already fragile ecosystems and local communities are pushed beyond coping capacity, resulting in increasing tensions related to natural resource access and use [2,3-6]. Productivity of rainfed agriculture continues to remain low due to multiple risks and constraints relating to biophysical and socio-economic issues (Rao *et al*, 2016). Advancement and adoption of moisture conservation technologies by the farmers may improve dryland crop productivity, farm income along with upliftment in their livelihood. Furthermore, harnessing every inch of rainfed lands by following highly efficient technologies is also need of the hour to feed the ever-increasing population [7].

The report by the Commission on Inclusive and Sustainable Agricultural Development of Andhra Pradesh [8], out of the 645 non-urban mandals (blocks) in the state, 129 have been identified as extremely resource-deprived. These mandals are predominantly located in Anantapuramu (51), Kurnool (30), Kadapa (24), and Prakasam (18). Notably, 64.30 percent of the 129 severely resource-deprived mandals are in the Rayalaseema and Prakasam districts. Prakasam has been considered highly vulnerable under Climate Change vulnerability on account of increased frequency of occurrence of drought /erratic monsoon. With over 60 % area under rainfed farming, sustaining the livelihood is a key challenge in the district [9,10,11]. Moreover, Prakasam district has the highest area under dryland among coastal districts of Andhra Pradesh. In general, there has been an increase

in productivity of dryland crops during a period of 50 years mainly due to the adoption of improved crop husbandry and farming technologies [12]. Therefore, it is crucial to assess the knowledge levels of farmers to enhance their understanding, particularly for those in dryland areas. This will, in turn, contribute to greater adoption of improved practices [13,14]. This study aimed to gain insights into their understanding and knowledge of improved rainfed practices, which are vital for their livelihoods. Based on the findings, recommendations will be made to enhance their knowledge and increase the adoption of these practices.

2. METHODOLOGY

The study employed a descriptive survey research design to assess the knowledge and adoption of critical interventions among dryland farmers in redgram cultivation. This design was chosen to gather information on the current state of knowledge and adoption of critical interventions among dryland farmers.

The study was conducted in the Prakasam district of Andhra Pradesh, India. This region is characterized by dryland farming, making it an ideal location for the study. A sample size of 120 dryland farmers was selected for the study using a simple random sampling technique. A structured questionnaire was designed to collect data from the respondents.

The questionnaire consisted of two sections: Knowledge and adoption. Knowledge test was developed for the study by using item difficulty index and discrimination index. Knowledge section evaluated farmers' knowledge of 28 critical interventions (as given in the appendix) in redgram cultivation, including: Soil conservation techniques, Water harvesting and management, Crop management practices, Pest and disease management, Nutrient management. Respondents were asked to indicate their level of knowledge for each intervention using mcq's, true or false and fill in the blanks. The primary data collected were analyzed using statistical methods such as Pearson's Correlation Coefficient and Multiple Linear Regression, with the analyses being conducted through SPSS software. These statistical tools were employed to determine the relationships between the variables under study and to provide insights into the factors influencing the knowledge and adoption of critical interventions among the participating farmers.

3. RESULTS AND DISCUSSION

3.1 Relationship between the Profile and Level of Knowledge of Dryland Farmers on Critical Interventions in Redgram and Cotton

An attempt has been made to find out if there exists any relationship of the profile viz., age, education, land holding, experience in dryland farming, yield, annual income, extension contact, mass media exposure, information seeking behaviour, social participation, credit orientation, risk preference, irrigation status, economic orientation, decision making ability and cropping pattern with their level of knowledge on critical interventions in redgram and cotton. Correlation co-efficient (r) values were computed and the values were presented in Table 1.

It was evident from the Table 1 that computed 'r' values (critical interventions of redgram) with regards education, land holding, yield, annual income, extension contact, mass media exposure, information seeking behaviour, social participation, credit orientation, risk preference, irrigation status, economic orientation and decision-making ability were significant at 0.01 level of probability. Age and experience in dryland farming were found negative and significant at 0.01 level of probability. Variable of cropping pattern was found significant at 0.05 level of probability with level of knowledge level on critical interventions in redgram.

It was also evident from the Table 1 that computed 'r' values (critical interventions of cotton) of education, yield, annual income, mass media exposure, information seeking behaviour, social participation, credit orientation, risk preference, irrigation status, economic orientation and decision making ability were positive and significant at 0.01 level of probability. Land holding, extension contact and cropping pattern was found positive and significant at 0.05 level of probability. Age was found negative and significant at 0.01 level of probability. Experience in dryland farming was found negative and significant at 0.05 level of probability with level of knowledge on critical interventions in cotton.

Table 1. Relationship between the profile of dryland farmers with their level of knowledge on critical interventions in redgram and cotton(n=120)

S.No.	Profile	'r' value (redgram)	'r' value (Cotton)
X3.1	Age	-0.408**	-0.331**
X_2	Education	0.577**	0.556**
X_3	Land holding	0.426**	0.291*
X_4	Experience in dryland farming	-0.427**	-0.302*
X_5	Yield	0.558**	0.449**
X_6	Annual income	0.559**	0.480**
X_7	Extension contact	0.436**	0.256*
X_8	Mass media exposure	0.478**	0.456**
X_9	Information seeking behavior	0.611**	0.514**
X_{10}	Social participation	0.611**	0.528**
X_{11}	Credit orientation	0.552**	0.464**
X_{12}	Risk preference	0.597**	0.450**
X_{13}	Irrigation Status	0.345**	0.221**
X_{14}	Economic orientation	0.680**	0.611**
X_{15}	Decision making ability	0.767**	0.688**
X_{16}	Cropping pattern	0.271*	0.273*

** : *Significant at 0.01 level of probability*
* : *Significant at 0.05 level of probability*
NS : Non-significant

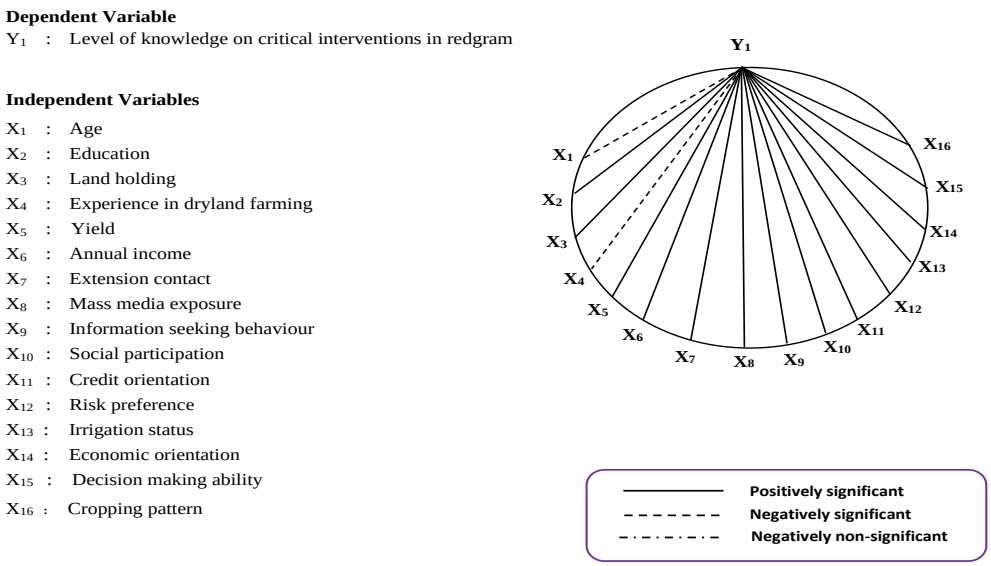

Fig. 1. Relationship between profile of dryland farmers and level of knowledge on critical interventions in redgram

The findings suggest that as age increases, the knowledge on critical interventions decreases. It is quite natural that as age increases, the recalling ability decreases and moreover, the middle and old age farmers have many other responsibilities besides farming compared to young farmers hindering their interest in acquiring knowledge. Education, on the other hand, enhances intellectual and cognitive skills, thereby facilitating the acquisition of knowledge. It also improves analytical abilities and problem-solving skills. Furthermore, education aids decision-makers by enabling them to think critically and efficiently utilize information sources. Educated farmers are generally more aware of various information sources and are better equipped to evaluate and interpret information regarding new interventions. In contrast, illiterate farmers may struggle to effectively utilize information sources to gain

knowledge about crop-related technologies, which may explain the positive and significant relationship observed.

Large landholders were found to possess a higher level of knowledge, likely due to their greater income levels, which naturally drives their interest in acquiring information from various sources and expanding their knowledge about the crops they cultivate. Thus, a positive and significant relationship was observed between landholding and knowledge of critical interventions in redgram. Importantly, the study found that knowledge of critical interventions is not dependent on a farmer's experience in dryland farming, indicating that acquiring knowledge is more closely tied to personal interest rather than experience. Farmers who are keen to stay informed about the latest developments in cultivation are more likely to actively seek out information, which may account for the negative significant relationship between experience and knowledge.

The findings indicate that farmers with good knowledge get high yields compared to farmers with low knowledge. Dry spells and crop losses are a regular phenomenon in dryland area. Therefore, the farmers in the study area might have acquired knowledge by contacting extension personnel, utilized mass media to gain knowledge on critical interventions in redgram and cotton. Farmers with high level of annual income have high knowledge of critical interventions of redgram and cotton. The probable reason might be due to the fact that the farmers with high level of income can afford to contact different sources of information, travel to research stations, KVKs and contact the scientists to acquire and enhance their knowledge level on crop related technologies. This might be the reason for the variable having positive and significant relationship with the knowledge on critical interventions.

The KVK Scientists and Department of Agriculture conduct on farm demonstrations and training programmes to create awareness on critical interventions in dryland crops. As drought is a regular phenomenon in the study area, the farmers frequently contact the Department of Agriculture, Scientists of KVK to mitigate the crop losses. Farmers who contact the extension personnel naturally gain knowledge on critical interventions. Thus, positive and significant relation could be observed between level of knowledge and extension contact. Farmers who are have high exposure to mass media have high knowledge on critical interventions of redgram and cotton. Apart from print and electronic media, the NGOs and KVK also conduct training programmes for improving the knowledge and skills in dryland farming. In addition to these, some of the private organizations are also offering farm advisory services through toll free numbers. Farmers who utilize these services automatically gain knowledge on critical interventions. Hence, a positive and significant relationship was observed between knowledge and mass media exposure.

The farmers having high information seeking behavior possess high level of knowledge. Most of the farmers in the study area are less educated, hence they depend on different information sources like department of agriculture staff, progressive farmers, input dealers, scientists and KVK staff to gain more knowledge and skills in dryland farming. It is a known fact that when farmers seek farm related information, they acquire knowledge and become conversant of practices to be adopted on field. This might be the reason for the variable showing positive and significant relationship. Farmers having higher social participation will have high level of knowledge. In the study area, most of the farmers were members of self-help groups and had vast scope to interact and exchange information on crop related aspects and gain knowledge. Thus, the variable showed positive and significant relationship with knowledge on critical interventions.

Farmers with high credit orientation possess high level of knowledge. Capital is the one of the most important initiating factors to a farmer for cultivation. A farmer with high level of credit orientation is ready to face the risk in cultivation and approaches different sources for gaining information and improves his knowledge level. On the other hand, farmers with low credit orientation concentrate on ways and means of obtaining capital which is of prime importance for initiating the farming activities rather on acquiring knowledge and skills. This might be the reason for the variable showing positive and significant relationship with knowledge on critical interventions.

Dryland farming is itself a risky activity and the farmers who are willing to take risk show interest in acquiring knowledge on improved cultivation practices and also on interventions which will save the crop at times of crisis. The same trend

was depicted through the above findings. Thus, the variable exhibited positive and significant relationship with critical interventions in redgram and cotton. Farmers having good irrigation facilities and able to provide irrigation at critical stages of crop growth will have a positive outlook towards farming. The positive attitude will motivate the farmers to acquire knowledge on improved technologies and crop related interventions. Thus, positive and significant relationship was observed between irrigation status and knowledge on critical interventions of redgram and cotton. Farmers with high level of economic orientation will always try to maximize their net returns by allocating the available resources in a premeditated manner. More so, they explore ways which increase their farm yields by gathering information on new and remunerative approaches in dryland farming. By gathering information, they acquire knowledge on crop related interventions and improved technologies. Farmers with good decision-making abilities will have high level of knowledge on critical interventions.

The farmers who take rational decisions try to seek information from different sources, contact various extension agencies and acquire knowledge. Thus, with the knowledge acquired, the farmers implement appropriate decisions in their own field. On the contrary, farmers with low knowledge lack confidence in taking decisions and implement them on their farm. Most of the farmers in the study area had marginal and small land holdings and mostly practiced agricultural operations out of experience or imitating their fellow farmers and less interested in acquiring knowledge. In case of farmers with large land holdings, they cultivated the crops both in kharif and rabi depending upon the availability of irrigation water. These large landholders, who maintain diverse cropping patterns, tend to rely on multiple sources of information to acquire knowledge on crop-related interventions, aiming to maximize their benefits. This might be the reason for the variable showing positive relationship with knowledge on critical interventions.

The study's findings are consistent with previous research [15-21]. The results suggest that improving education, landholding, yield, annual income, extension contact, mass media exposure, information-seeking behavior, social participation, credit orientation, risk preference, irrigation status, economic orientation, and decision-making ability can enhance farmers' knowledge on critical interventions in redgram and cotton.

3.2 Multiple Linear Regression Analysis of Profile of Dryland Farmers with their Level of Knowledge on Critical Interventions in Redgram and Cotton

Table 2. Model summary of profile of dryland farmers with their level of knowledge on critical interventions in redgram

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.906[a]	.821	.754	2.947

Table 3. Multiple linear regression analysis of profile of dryland farmers with their level of knowledge on critical interventions in redgram (n=120)

S. No.	Profile	Regression coefficient 'b' values	Standard error	|t| values	p-values
	Constant	3.589	4.036	0.889	0.379
X_1	Age	-0.065	0.786	0.720	0.476
X_2	Education	0.179	0.447	1.201	0.236
X_3	Land holding	-0.071	0.599	0.777	0.442
X_4	Experience in dryland farming	-0.082	0.037	0.905	0.370
X_5	Yield	0.174	0.807	1.370	0.178
X_6	Annual income	0.289	0.933	2.788**	0.008
X_7	Extension contact	-0.154	0.209	1.122	0.268

S. No.	Profile	Regression coefficient 'b' values	Standard error	|t| values	p-values
X_8	Mass media exposure	0.039	0.375	0.221	0.826
X_9	Information seeking behavior	-0.128	0.382	0.674	0.504
X_{10}	Social participation	0.283	0.774	2.025*	0.049
X_{11}	Credit orientation	0.071	0.543	0.749	0.458
X_{12}	Risk preference	-0.042	0.182	0.334	0.740
X_{13}	Irrigation status	-0.065	0.255	0.866	0.391
X_{14}	Economic orientation	0.150	0.157	1.250	0.218
X_{15}	Decision making ability	0.276	0.130	1.979	0.054
X_{16}	Cropping pattern	0.056	0.479	0.764	0.449
	R^2	0.821			
	F	12.31**			

** : *Significant at 0.01 level of probability*
* : *Significant at 0.05 level of probability*
NS : Non significant

$Y= 3.589 – 0.065X_1+ 0.179X_2 – 0.071X_3 – 0.082X_4 + 0.174X_5 + 0.289X_6 – 0.154X_7 – 0.039 X_8 – 0.128X_9 + 0.283X_{10} + 0.071X_{11} – 0.042X_{12} – 0.065 X_{13} + 0.150X_{14} + 0.276X_{15} + 0.056X_{16}$

Table 3 revealed that the coefficient of determination "R^2" value was significant. The "R^2" value of 0.821 indicated that all the selected 16 independent variables put together, explained about 82.10 **%** variation in the level of knowledge of dryland farmers on critical interventions in redgram, whereas the remaining 17.90 **%** was due to extraneous effects of unidentified profile characteristics away from the present study. Hence it could be stated that the profile of the dryland farmers to a large extent explained the variation in the level of knowledge on critical interventions in redgram.

The regression coefficient (b) values given in the Table 2 further revealed that the profile characteristics namely annual income and social participation contributed significantly to predict the variation in the level of knowledge on critical interventions in redgram.

Chart 1. Model summary of profile of dryland farmers with their level of knowledge on critical interventions in cotton

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	0.928[a]	0.860	0.809	3.055

Table 4. Multiple linear regression analysis of profile of dryland farmers with their level of knowledge on critical interventions in cotton (n=120)

S. No.	Profile	Regression coefficient 'b' values	Standard error	|t| values	p-values
	Constant	-2.734	4.247	0.644	0.523
X_1	Age	0.091	0.818	1.139	0.261
X_2	Education	0.295	0.458	2.280*	0.028
X_3	Land holding	-0.049	0.589	0.643	0.524
X_4	Experience in dryland farming	-0.020	0.038	0.264	0.793
X_5	Yield	0.219	0.455	2.663*	0.011
X_6	Annual income	0.222	0.974	0.455	0.652
X_7	Extension contact	-0.051	0.203	0.092	0.927
X_8	Mass media exposure	-0.014	0.373	1.539	0.131
X_9	Information seeking behaviour	-0.256	0.395	3.124**	0.003
X_{10}	Social participation	0.379	0.789	0.179	0.859
X_{11}	Credit orientation	-0.015	0.580	0.410	0.684

S. No.	Profile	Regression coefficient 'b' values	Standard error	|t| values	p-values
X_{12}	Risk preference	-0.043	0.176	1.158	0.253
X_{13}	Irrigation status	-0.079	0.276	2.019*	0.050
X_{14}	Economic orientation	0.205	0.156	2.495*	0.017
X_{15}	Decision making ability	0.297	0.131	1.501	0.141
X_{16}	Cropping pattern	0.096	0.492	0.455	0.652
	R^2	0.860			
	F	16.65**			

** : *Significant at 0.01 level of probability*
* : *Significant at 0.05 level of probability*
NS : Non-significant

$Y = -2.734 + 0.091X_1 + 0.295X_2 - 0.049X_3 - 0.020X_4 - 0.219X_5 + 0.222\ X_6 - 0.051X_7 - 0.014X_8 - 0.256X_9 + 0.379\ X_{10} - 0.015X_{11} - 0.043X_{12} - 0.079X_{13} + 0.205X_{14} + 0.297X_{15} + 0.096X_{16}$

Table 4 revealed that the coefficient of determination "R^2" value was significant. The "R^2" value of 0.86 indicated that all the selected 16 independent variables put together, explained about 86.00 **%** variation in the level of knowledge on critical interventions in cotton by the dryland farmers, whereas the remaining 14.00 **%** was due to extraneous effects of unidentified profile characteristic away from the present study. Hence it could be stated that the profile characteristics of the dryland farmers to a large extent explained the variation in the level of knowledge on critical interventions in cotton.

The regression coefficient (b) values given in the Table 3 further revealed that the profile characteristics namely education, yield, information seeking behaviour, irrigation status and economic orientation contributed significantly to predict the variation in the level of knowledge on critical interventions in cotton.

4. CONCLUSION

This study underscores the significance of socio-economic characteristics in determining the level of knowledge regarding critical interventions in dryland crops such as redgram and cotton. The findings reveal that factors such as education, landholding size, yield, information-seeking behavior, irrigation status, and economic orientation play substantial roles in enhancing agricultural knowledge, which, in turn, can lead to increased productivity and improved livelihoods. However, the unexplained variation of 17.90% and 14.00% in farmers' knowledge levels regarding redgram and cotton, respectively, suggests the presence of additional external factors or profile characteristics that also influence knowledge and adoption of agricultural interventions.

Given the relevance of these findings, future research should explore additional factors that may impact knowledge and adoption of agricultural practices in dryland regions. Comparative studies across different geographic and cultural contexts could provide a more comprehensive understanding of the variables influencing technology adoption. Such research is crucial for developing more targeted and effective strategies for farmer training and for formulating public policies that promote the adoption of sustainable agricultural practices. Ultimately, expanding the knowledge base on the determinants of knowledge and adoption of critical interventions can significantly contribute to food security and agricultural sustainability in arid and semi-arid regions.

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 manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX

I. Knowledge level of dryland farmers on critical interventions in redgram

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. Short duration varieties like LRG-52, PRG-158 are recommended under delayed monsoon (True/False)
4. The appropriate time of sowing for *kharif* redgram is June-August (True/False)
5. Intercropping will suppresses the weed growth (True/False)
6. 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)
7. Field must be kept weed free up to 30-50 days after sowing (True/False)
8. Inter cultivation with gorru after 20-25 days is of no help in weed management (Yes/No)
9. Minimum two weedings are required in the crop season (True/False)
10. 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)
11. Irrigation at flower bud initiation and pod filling stages helps in securing more yields (True/False)

B. Select correct answer from the given alternatives

12. Soil which is not suitable for redgram cultivation is
    a) Saline soils b) Alkaline soils
    c) Water logged soils d) All of these
13. Short duration variety of Redgram
    a) PRG-158 b) PRG-17
    c) LRG-52 d) All of these
14. The redgram variety suitable for *kharif* season in Prakasam district
    a) PRG-158 b) PRG-176
    c) LRG-52 d) All of these
15. 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
16. Recommended seed rate for *Kharif* redgram is
    a. 2-3 Kg/Acre b. 4-5 Kg/Acre
    c. 6-8 Kg/Acre d. 8-9 Kg/Acre
17. Recommended spacing for Rabi redgram
    a. 45-90 cm × 10 cm b. 45-90 cm × 20 cm
    c. 150 cm × 20 cm d. 180 cm × 20 cm
18. Water retention in the soil can be improved by following one of these practices
    a. Mulching b. Deep ploughing
    c. Frequent intercultivation d. All of these
19. Name the important pest of redgram crop
    a. Pod borer b. Weevils
    c. Leaf roller d. Aphids and Jassids

C. Fill in the blanks

20. Primary tillage for *Kharif* redgram is done during _____
21. Redgram variety LRG-30 resistant to _____
22. Variety that is tolerant to terminal moisture stress _____
23. Seed treatment in Redgram with _____ culture helps in increasing yield.
24. Normal sowing window of rainfed redgram during *Kharif* _____
25. Intercropping of redgram with ground nut in _____ ratio
26. Critical growth stages in redgram _____
27. Can you name any one of the trade name of anti-transpirants _____
28. Under rainfed conditions, redgram crop is mostly affected with _____ disease.

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