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Construction of a test to measure farmers' knowledge on ANGRAU recommended organic rice cultivation practices

J Venkata Pattabhi Ramayya , K Atchuta Raju, M Venkataramulu, B Aparna and M Rama Devy
Department of Agricultural Extension, Acharya N G Ranga Agricultural University,
Agricultural College, Bapatla-522101, Andhra Pradesh, India

ABSTRACT

In the absence of a standardized instrument to assess farmers' knowledge on organic rice cultivation practices, a knowledge test was systematically developed. Test items were initially compiled from credible and authoritative sources, including "Vyavasaya Panchangam" and "Organic cultivation practices in different crops" published by Acharya N.G. Ranga Agricultural University (ANGRAU). The preliminary pool consisted of 90 items, which were subjected to expert validation and statistical methods including difficulty index, discrimination index and Point-biserial correlation were employed to evaluate item quality. Based on these criteria, 31 items demonstrating acceptable levels of validity and reliability were retained for the final test. During administration, respondents received one point for each correct response, with no penalty for incorrect answers

Keywords: *Knowledge test, Organic rice cultivation and Point-biserial correlation*

Knowledge is defined as "those behaviours and test situations which emphasizes the remembering either by recognition or by recall of ideas and materials on some phenomenon" (Bloom, 1956). Inthe present study, knowledge was defined as the extent of information possessed by farmers regarding organic rice cultivation practices, enabling them to make informed decisions about its applicability to their agricultural practices. To assess this, a knowledge test comprising thirty one (31) items was developed. Each item was evaluated using a dichotomous scale, assigning a score of '1' for a correct response and '0' for an incorrect one. Thus, the maximum and minimum possible scores were 31 and 0, respectively.

MATERIAL AND METHODS

The detailed methodology adopted for the construction and standardization of the knowledge test is outlined below.

Collection of knowledge items

The content of the test was composed of questions called items. 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 respondents' abilities. 90 items were collected from different sources like "Vyavasaya Panchangam" and "Organic cultivation practices in different crops" of Acharya N G Ranga Agricultural University.

Judges rating

The items were given in the form of statements to the judges in relevant field for finding out the degree of relevancy of the items to include in the final schedule or not. The items were selected by adopting weighted mean score method. Extension personnel selected from DAATTCs, KVKs, Professors from Department of Agricultural Extension Education, Agronomy, Entomology and Plant Pathology of Agricultural College, Bapatla, District project Officers (APCNF), Assistant Directors of Agriculture, Agricultural officers from Department of Agriculture, A.P. state were selected as judges. The scores of each statement were summed up to find out the total score of each statement for all the 30 judges. The statements under highly relevant, relevant and irrelevant were taken with weightages of 3, 2 and 1, respectively. The possible knowledge score for each statement from a judge range from 1 to 3. The mean score assigned to each statement was calculated by using the following formula.

$$\text{Mean score} = \frac{\text{Total score of each statement}}{\text{Total number of Judges}}$$

After calculating the mean score for all the statements, overall mean score was calculated by adopting the following formula

$$\text{Over all mean score} = \frac{\text{Total score of all the statement for all the Judges}}{\text{Total No. of statements X Total number of Judges}}$$

The statements with their mean score value being equal to or higher than over all mean score, were selected for the item analysis (Table-1)

Selection of items for item analysis

The screening of items was done based on the criteria followed by Conard (1948):

1. Response to items should promote thinking rather than routine memorization.
2. They should differentiate the well-informed respondent from less informed and should have certain difficulty value.
3. The items included should cover all areas of knowledge about organic rice cultivation.

Framing of test items

The items selected for construction of knowledge test were framed into multiple choice questions, fill in the blanks, yes or no and true or false type questions.

Pre-testing

The items selected for the knowledge test were pre-tested separately by administering the items to 30 farmers. Care was taken to select the matching sample of 30 farmers from non-sampling area.

Item analysis

Item analysis was done via determining the index of 'Item difficulty' and index of 'Item discrimination'. The 'Item difficulty' indicates the extent to which an item was difficult. The function of the item discrimination index was used to find out whether an item really discriminates a well-informed farmer from poorly informed farmer.

The raw data obtained was subjected for typical item analysis. Based on judges' ratings, a total of 53 knowledge items were selected for item analysis. The 53 test items were administered to each of the 30 farmers. The scores assigned were 'one' for correct answer and 'zero' for incorrect response. After computing, the total scores were obtained for each of the 30 farmers on 53 items. After computing the individual total score of 30 certified organic rice farmers, they were arranged in descending order based on total score obtained by them. These 30 respondents were then divided into three equal groups, each having 10 respondents. These groups were named as high group (top 1/3), mid group (middle 1/3) and low group (bottom 1/3).

For item analysis, the mid group was not considered in this method. Keeping only two extreme groups with high scores i.e., R_H and low scores i.e., R_L were considered for computation of item discrimination indices.

Item difficulty index (P)

The item difficulty index was worked out as the percentage of farmers answering for items correctly. The assumption of the item difficulty index was that, the difficulty is linearly related to the level of

$$\text{Difficulty Index} = \frac{\text{No. of farmers answered correctly}}{\text{Total number of farmers}} \times 100$$

farmer's knowledge about ANGRAU recommended organic rice cultivation practices. The items with 'P' values ranging from 20 to 80 were considered for selection in the final knowledge test (Table - 2).

Discrimination index ($E^{1/3}$)

The criterion for item selection was the item discrimination index indicated by '$E^{1/3}$' which is calculated by using following formulae.

$$E^{\frac{1}{3}} = \frac{(R_H - R_L)}{N/3}$$

Where:

R_H = Number of respondents in the (**top 1/3)** group who got the item correct

R_L = Number of respondents in the **(bottom 1/3)** group who got the item correct

N = Number of respondents in the sample selected for the item analysis i.e., 30

The items with $E^{1/3}$ value ranging from 0.30 to 0.70 were considered for the final selection of items for knowledge test (Table - 2).

Table 1. Selection of items for pre-testing based on judges' ratings (Overall Mean Value = 2.43)

S. No.	Knowledge Item / Statement	Mean
1	Genetically Modified Organisms(GMO) should not be used in organic rice farming.	2.22
2	Cultivation of wild/native, high yielding and hybrid varieties are recommended in organic rice farming.	2.33
3	A clearly defined and identifiable area separating/delineating an organic site from that of a conventional production unit is known as buffer zone.	2.39
4	A Buffer zone should be maintained between organic and inorganic farming fields.	2.50*
5	Organic farming mitigates hazardous effects of chemicals.	2.44*
6	For newly acquired fields , the conversion period is 24 months (2 years) in case of annual and biennial crops.	2.44*
7	For newly acquired fields, the conversion period is 36 months (3 years) in case of perennial crops.	2.33
8	The rearing of animals such as cows, goats and poultry is an integral part of organic farming.	2.61*
9	The optimum paddy seed rate recommended is 25kg per acre.	2.56*
10	The appropriate time for transplanting paddy is June and November for *Kharif* and *Rabi* respectively.	2.28
11	Seed treatment should not be done with chemicals.	2.33
12	Recommended dosage of *Pseudomonas fluorescens* for seed treatment is 10g per kg seed.	2.56*
13	Seed treatment can be done with Beejamrutham.	2.72*
14	Seedling root dip in Phosphorus solubilizing bacteria (PSB) @10g per lit of water.	2.39
15	Sewage water should not be used in organic farming.	2.44*
16	Always use clean water for irrigation.	2.17
17	Irrigation water should not be flowed from adjacent conventional farming fields.	2.56*
18	Formation of high bunds around the boundaries of organic field to restrict the flow of water from conventional fields.	2.33
19	Puddling is the method of land preparation in rice cultivation. It is done with standing water of 5-10 cm.	2.22
20	Puddling should be done 2-3 times in the rice fields.	2.17
21	Usage of bio fertilizers are recommended in organic farming.	2.50*
22	Mixing directly into the soil at the time of land preparation is the best method of application of FYM.	2.61*
23	Recommended rate of application of FYM @3tons or compost @4tons per acre at the final ploughing .	2.44*
24	The percentages of NPK in FYM .(Nitrogen-0.5%,Phosphate-0.2%,Potassium-0.50%)	2.17
25	Sunhemp , dhaincha , pillipesara are examples of green manure crops.	2.61*
26	The recommended optimum seed rate for a green manure crop is 15 kg per acre.	2.39
27	At flowering stage green manure crop should be incorporated in field.	2.61*
28	Usage of Mineral fertilizers like rock phosphate ,lime ,plant ashes are allowed in organic farming.	2.22
29	Azotobacter, Azolla, Phosphate solubalizing bacteria, Potassium mobilising bacteria, Blue green algae, Mycorrhizee, Rhizobium are some of the examples of bio fertilizers	2.22
30	Rhizobium is a nitrogen-fixing bacteria used in leguminous crops.	2.50*
31	The recommended time of application of bio fertilizers like Azolla and PSB are at with in the 3–4 days after transplanting (DAT).	2.67*
32	Azolla ,Azotobacter and Rhizobium are nitrogenous bio fertilizers.	2.50*
33	The recommended dosage of Azolla is 100 kg per acre of paddy.	2.50*
34	Azolla is typically incorporated into the soil after 2-3 weeks of application.	2.28
35	PSB is a bio fertilizer that contains beneficial bacteria that help plants absorb phosphorus from the soil.	2.33
36	The recommended dosage of PSB is 500ml for one acre of paddy.	2.44*
37	The recommended dosage of Azospirillum is 500ml for one acre of paddy.	2.39
38	Application of micro nutrients like zinc, iron, calcium, copper etc. are allowed in organic farming.	2.50*
39	Night soil , urban waste should not be used in organic farming.	2
40	Vermicompost is made up of earthworms.	2.39
41	The recommended dosage of application of vermicompost is 1-2 tons per acre.	2.39
42	Vermiwash is the liquid that is collected after water passes through compost made by earthworms.	2.44*
43	Broadcasting evenly across the field at the time of land preparation is the proper method of application of vermicompost for paddy crop.	2.33
44	Vermicompost can be stored for upto 3 years.	2.17

45	Synthetic herbicides should not be used in organic farming.	2.61*
46	Puddling can control weeds.	2.39
47	Flooding of paddy field helpful to suppress weed growth.	2.17
48	Weeds can be controlled by performing manual weeding twice, at 25 and 50 days after transplanting (DAT).	2.44*
49	Closer planting of seedlings or higher seed rate can effectively reduce the weed population.	2.39
50	Compare to direct sowing ,transplantation is the best method to control weeds.	2.56*
51	Manual Cono weeder or power weeder used to remove weeds between rows of paddy crop efficiently.	2.28
52	Deep summer ploughing helps in pest control.	2.67*
53	Clipping the tips of paddy seedlings before transplanting can help reduce stem borer infestations.	2.61*
54	Crop debris free bed, stubbles incorporation and weed free bunds check pest population.	2.17
55	For monitoring pest incidence, set up 8 pheromone traps per acre for timely control measures.	2.56*
56	Trichoderma , Pseudomonas, BT , NPV , Beauveria spp and Metarhizium spp are some examples of bio pesticides.	2.61*
57	Set up 40 bird perches to know and control the infestation of paddy stem borer.	2.39
58	Flooding and draining water in 3-4 days removes/ control larva and pupae.	2.44*
59	Installation of Trichocards having 40000 *Trichogramma japonicum* eggs per acre for control of stem borer.	2.44*
60	Leaf folder can be controlled by spraying of Neem oil (1500ppm) @5ml per lit of water after 20 and 30 DAT .	2.56*
61	To control leaf folder, boil 5 kg of neem leaves and 2 kg of custard apple leaves in 10 litres of cow urine, then filter and use the extract.	2.50*
62	Spraying BT @2ml per lit of water after 30-40 DAT to control the leaf folder	2.33
63	Alley ways of 20cm are made for every 2m length for BPH management.	2.44*
64	BPH can be controlled by spraying Thutikada kashayam (Datura leaves+cow urine).	2.56*
65	BPH can be controlled by spraying bio pesticides like Metarhizium or Beauveria 5g per lit. twice in an interval of 10days.	2.50*
66	Brahmastra is prepared from five types of bitter leaves.	2.44*
67	Agniastra is considered to be effective against insects like stem borer and leaf folder.	2.39
68	Blast,sheath blight and stem rot can be controlled by *Pseudomonas fluorescens* .	2.61*
69	Recommended dosage of *Pseudomonas fluorescens* soil application is 2kg per acre.	2.33
70	Bael leaves extract (Maredu akulu kashayam) is used to control paddy stem rot.	2.50*
71	Paddy leaf blight can be controlled by spraying asafoetida (10%) solution along with cow urine.(Inguva in telugu)	2.67*
72	Rice blast can be controlled by spraying of solution containing fermented butter milk (1lit.),cow urine(1lit.) & water (8lit.).	2.56*
73	Yellow sticky traps are used for monitoring and controlling insect pests.	2.50*
74	Planting yellow-flowering species like marigold, sunflower, and sesamum along the bunds of rice fields enhances resources for biocontrol agents. These plants provide nectar, supporting natural enemies such as predators and parasitoids, which help control pests naturally.	2.44*
75	Harvesting of paddy to the ground level prevents pest incidence.	2.50*
76	Maintenance of moisture level below 13% for storing grains.	2.50*
77	After harvesting organic produce and non organic produce should be stored separately without mixing.	2.67*
78	Produce should be stored in clean gunny bags.	2.39
79	10kg of cow dung and 10lit. of cow urine are required to prepare 200 Lit. of Jeevamrutham.	2.28
80	Quantity of jaggery and gram flour used in preparation of Jeevamrutham is 200g each per 1Lit. of cow urine.	2.50*
81	Jeevamrutham gets ready for use in 5-7 days.	2.44*
82	For preparation of Ghana jeevamrutham , the cow dung heap is sealed with a jute bag for 48 hours and left for fermentation to take place.	2.33
83	Ghana jeevamrutham can be stored upto 6 months.	2.44*
84	Calcium sulphate (lime) is used for preparation of Beejamrutham.	2.44*
85	5kg of neem paste is added with 10 litres of cow urine for preparation of Neemastra.	2.50*
86	Dashpathri kashayam is to be kept for 45 days for fermentation.	2.50*
87	Neem seed kernel extract (NSKE) acts as bio pesticide.	2.39
88	The use of plant extracts like Rotenone (Derris sp.), nicotine (tobacco) and pyrethrins (Chrysanthemum sp.) to control pests.	2.61*
89	Ferment 5 Litres of cow urine and 5 kg of cow dung for 4 days. Then, add 150 grams of lime, mix well with 100 Litres of water and spray to control stem borer.	2.44*
90	Boil 10 Litres of cow urine, 1 kg of green chilli paste, and 5 kg of neem leaf paste for some time. After boiling, filter the extract (about 3-4 litres) and mix it with 100 Litres of water. Use this solution as a spray to control stem borers.	2.28

* : Items selected for pre tesing.

Point biserial correlation (r_{pbis})

The main agenda of calculating point biserial correlation (r_{pbis}) was to work out the internal consistency of the items i.e., the relationship of the total score to a dichotomized answer to any given item. In a way, the validity power of the item was computed by the correlation of individual item of preliminary knowledge test calculated by using following formulae.

$$r_{pbis} = \frac{M_p - M_q}{SD} X \sqrt{pq}$$

Where,

r_{pbis} = Point-biserial correlation coefficient

M_p = Mean of the total scores of the farmers who answered the item correctly

or

$$M_p = \frac{\text{Sum of total scores of X and Y}}{\text{Total Numbers of correct answers}}$$

M_q = Mean of the total scores of the farmers who answered the item incorrectly

or

$$M_q = \frac{\text{Sum of total scores of X} - \text{Sum of total scores of X and Y}}{\text{Total Number of wrong answers}}$$

p = Proportion of farmers who correctly answered to item

$$p = \frac{\text{Total number of correct answers}}{\text{Total number of farmers}}$$

q = Proportion of farmers who incorrectly answered to item

q = 1 – p

X = Total score of the farmer for all items

Y = Response of the individual for the items

XY = Total score of the farmers multiplied by the response of the individual to the item

Items having significant point biserial correlation at 1% and 5% level of Probability was selected for final knowledge test (Table - 2).

Selection of the items

1. Items with difficulty level indices ranging from 20 to 80.
2. Items with discrimination indices ranging from 0.30 to 0.70.
3. Items having significant point biserial correlation either at 1 per cent or 5 per cent level of probability.

Thus, the finally selected knowledge items comprise 4 types of questions i.e., multiple choice, fill in the blanks, yes or no and true or false.

Reliability of the test

According to Kerlinger (1973) "Reliability is the accuracy or precision of measuring instrument". Reliability of the items was tested by split half method, in which a test is divided into two halves. One half (one set) contains the odd-numbered items (1,3,5,7 etc.) and the other half (other set) the even-numbered items (2,4,6,8 etc.). The scores obtained from odd numbered items were taken as one set of values and the scores of even numbered items as the second set of values for calculating the correlation coefficient. The correlation co-efficient was positive and highly significant (r=0.94) indicates that the test for measuring knowledge of the certified organic rice farmers was reliable.

Validity of the test

The content validity of the knowledge test was derived from a long list of test items representing the whole universe on ANGRAU recommended package of practices of organic rice cultivation collected from various sources as discussed earlier and includes materials from literature, experts opinion, professors, findings of past work and discussions with extension workers of research stations. The items which belonged to 'very good' category (i.e., the items with point biserial correlation value of 0.30 – 0.70) were considered to measure the knowledge of the respondents. It was assumed that the score obtained by administering the knowledge test of this study measures what was intended to measure. Thus, the knowledge test developed in the present study measures the knowledge of ANGRAU recommended package of practices of organic rice cultivation as it showed a greater degree of reliability and validity.

Administration of the test

Each item in the knowledge test was read out to the respondents i.e., certified organic rice

Table 2. Selection of items for knowledge test by using item analysis

S. No.	Item No.	Frequencies of correct answers of the respondents divided into three equal groups after arranged in descending order			Difficulty index value (P)	Discrimination index value ($E^{1/3}$)	Point Biserial correlation (r_{pbis})	t values
		R_H	R_M	R_L				
1	4	10	8	9	0.9	0.1	0.08351	0.66087
2	5	10	10	10	1	0	0.00	0
3	6	5	0	1	0.2	0.4	.477**	0.0077
4	8	10	10	10	1	0	0.00	0
5	9	10	8	6	0.8	0.4	.453*	0.01197
6	12	9	6	5	0.67	0.4	.409*	0.0249
7	13	10	8	5	0.77	0.5	.469**	0.00889
8	15	10	10	7	**0.9**	0.3	.462*	0.01007
9	17	10	7	7	0.8	0.3	.443*	0.01416
10	21	7	2	3	0.4	0.4	0.32649	0.07826
11	22	10	10	8	**0.93**	**0.2**	.379*	0.03913
12	23	7	9	2	0.6	0.5	.444*	0.01386
13	25	10	5	5	0.67	0.5	.437*	0.01564
14	27	9	5	3	0.57	0.6	.517**	0.00342
15	30	9	5	8	0.73	0.1	0.19174	0.31009
16	31	8	4	4	0.53	0.4	.398*	0.02945
17	32	10	7	3	0.67	0.7	.486**	0.00641
18	33	8	4	4	0.53	0.4	0.25108	0.18079
19	36	9	6	5	0.67	0.4	.388*	0.03394
20	38	8	6	4	0.6	0.4	.409*	0.02478
21	42	2	2	1	0.17	0.1	0.16547	0.3822
22	45	10	10	10	1	0	0.00	0
23	48	9	9	3	0.7	0.6	.538**	0.00215
24	50	9	10	9	0.93	0	0.12361	0.5152
25	52	7	8	7	0.73	0	0.09587	0.61429
26	53	10	8	5	0.77	0.5	.510**	0.00396
27	55	9	6	5	0.67	0.4	.372*	0.04294
28	56	2	2	1	0.17	0.1	0.18098	0.33852
29	58	7	9	7	0.77	0	0.14124	0.45658
30	59	5	4	5	0.47	0	-0.0155	0.93541
31	60	9	6	7	0.73	0.2	0.12202	0.52066
32	61	8	7	4	0.63	0.4	.428*	0.01834
33	63	9	7	4	0.67	0.5	.384*	0.03603
34	64	7	4	3	0.47	0.4	.363*	0.04859
35	65	3	1	0	0.13	0.3	0.27778	0.13722
36	66	10	7	5	0.73	0.5	.405*	0.0263
37	68	8	9	4	0.7	0.4	.387*	0.03468

S. No.	Item No.	Frequencies of correct answers of the respondents divided into three equal groups after arranged in descending order			Difficulty index value (P)	Discrimination index value ($E^{1/3}$)	Point Biserial correlation (r_{pbis})	t values
		R_H	R_M	R_L				
38	70	7	5	3	0.5	0.4	.416*	0.02214
39	71	10	9	7	**0.87**	0.3	.420*	0.02102
40	72	8	5	1	0.47	0.7	.417*	0.02181
41	73	10	7	6	0.77	0.4	.460*	0.0105
42	74	9	6	3	0.6	0.6	.464**	0.00977
43	75	9	5	4	0.6	0.5	.413*	0.0233
44	76	7	4	7	0.6	0	0.06294	0.74109
45	77	8	8	4	0.67	0.4	.364*	0.04811
46	80	8	6	2	0.53	0.6	.425*	0.01926
47	81	9	7	3	0.63	0.6	.404*	0.02686
48	83	8	6	4	0.6	0.4	0.30289	0.10374
49	84	9	6	3	0.6	0.6	.563**	0.00121
50	85	5	1	3	0.3	0.2	0.25652	0.17121
51	86	8	6	2	0.53	0.6	.471**	0.00857
52	88	8	4	2	0.47	0.6	.417*	0.02181
53	89	9	6	7	0.73	0.2	0.12202	0.52066

farmers in translated version (Telugu) by the investigator and the responses in the form of correct or incorrect answers were recorded.

Scoring procedure

A score of 1 and 0 was assigned for correct and wrong answer for each item, respectively. Similar procedure was followed by Kaur *et al.* (2025). The total number of correct responses given by the farmers out of the 31 items was the knowledge score obtained by him or her. Thus, the maximum and minimum possible score was 31 and 0 respectively. The farmers were grouped into three categories based on mean and standard deviation as follows

S. No.	Categorisation	Score
1	Low knowledge	Less than (Mean - SD)
2	Medium knowledge	Between (Mean ± SD)
3	High knowledge	More than (Mean + SD)

RESULTS AND DISCUSSION

The standardized knowledge test comprises of 31items, can be readily adopted by researchers and extension professionals for assessing farmer's knowledge on ANGRAU recommended organic rice cultivation practices. To ensure comprehensiveness and cater to diverse cognitive levels, the test includes a variety of question formats, including multiple-choice, yes/no, true/false and fill-in-the-blank items. This mixed format approach enhances the test's ability to capture nuanced understanding and practical knowledge among respondents.

CONCLUSION

The test developed using standard procedures can be effectively used by researchers conducting similar studies. Its application can significantly streamline the assessment process by eliminating the need to develop a new tool from the ground up. By employing this standardized scale, researchers can efficiently evaluate farmers' knowledge on ANGRAU recommended organic rice cultivation practices, thereby facilitating informed interventions and capacity-building programmes.

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