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DEVELOPMENT OF KNOWLEDGE TEST TO MEASURE THE KNOWLEDGE LEVEL OF MARIGOLD FARMERS ON MARIGOLD CULTIVATION PRACTICES

Mohammad Monis Ansari[1], Jasbir Singh Manhas[2] and Poonam Parihar[3]

1 Ph.D. Scholar, Division of Agricultural Extension Education, FoA, SKUAST Jammu - 180009
2 Professor, Directorate of Extension, SKUAST Jammu - 180009
3 Professor, Agricultural Extension Education, FoA, SKUAST Jammu - 180009
Email : monis.rj26@gmail.com

ABSTRACT

Marigold is a prominent and popular flower in India, ranking third in popularity behind roses and chrysanthemums. Respondents' knowledge played an important role in marigold cultivation. Due to the lack of a suitable test to measure the knowledge level of marigold farmers regarding the scientific practices of marigold cultivation, it was necessary to construct a knowledge test. The relevant areas that covered the major aspects of marigold cultivation practices were included and discussed with scientists. This study was conducted in the Jammu region in Jammu and Kashmir. Item analysis provided the item discrimination and an item difficulty index. The respondents were given one mark for each correct and zero for incorrect answer. Reliability was measured using the split-half method and found 0.77. The reliability coefficient of the full test was computed by using Spearman-Brown prophecy and was found 0.87, which indicates the test is highly reliable. The evaluation content validity was in two stages. Initially the CVR was calculated, with a threshold of 0.59 or higher considered acceptable. Subsequently, CVI was computed in second phase. The Kappa statistics were also computed. The I-CVI value ranges from 0.45-1.00 and S-CVI was 0.85. The final test includes twenty-six items.

Keywords: *Content validity, Item analysis, Kappa, Knowledge test, Reliability, Split-half.*

INTRODUCTION

The flower brings happiness and smile to billions worldwide, making it the most pleasing creation on Earth. From genesis to death, flowers must be present throughout the human life cycle. Flowers are symbols of emotions such as passion, love, beauty, and purity. Floriculture is becoming increasingly important as a farming technique for financial gain (Sarkar, 2023). However, advanced production technologies have not been widely adopted by farmers: because of a lack of knowledge and experiments conducted on this crop. Various factors are important for the high production of marigold including; variety, planting time, manures and fertilizers, plant spacing, and cultural practices such as pinching, irrigation, and most importantly a good quality of soil. Marigold production has been reduced owing to a lack of expertise and awareness of modern management procedures among farmers (Yadav *et al.,* 2023). High technical understanding (knowledge) leads to higher adoption rates. In India, marigolds are primarily cultivated as loose flower and are widely used in ceremonies and religious gatherings (Dutta and Gupta, 2022). Marigold production has been reduced owing to a lack of expertise and awareness of modern management procedures among farmers (Yadav *et al.,* 2023).

Worldwide, floriculture covers an area of 702.38 thousand hectares. Europe accounted for 48.70 thousand hectares, North America had 21.06 thousand hectares, Asia encompasses 523.82 thousand hectares, the Middle East comprises 4.02 thousand hectares, Africa had 7.60 thousand hectares, and Central and South America spanned 97.15 thousand hectares. According to the Indian Horticulture Database, India occupies a floriculture area of 183 thousand hectares, 26% of the global area. (Misra and Ghosh, 2016). Marigold cultivation in India covers 81.54 thousand hectares, yielding 923.43 thousand tonnes of flowers, of which 897.24 thousand tonnes are loose and 26.19 thousand tonnes are cut flowers. States like Madhya Pradesh, Karnataka, Gujarat, West Bengal, Chhattisgarh, and Andhra Pradesh are the major producing states led by Madhya Pradesh, which has a maximum area (21.18 thousand ha) under marigold cultivation (DoAFW, 2023).

In the Jammu division, the total area under marigold cultivation was 0.164-thousand-hectare, production 1745.2 tonnes of Loose flower. Districts such as Doda, Jammu, Poonch, Kathua, and Samba are the majority of the area under marigold cultivation, while Doda district has the maximum area (33.64 ha), and Ramban has the minimum area (3.45 ha) under marigold cultivation. The total number of registered

growers is 831 in all ten 10 districts of the Jammu division (DoF Jammu, 2023).

The main objective was to develop a knowledge test for evaluating the knowledge level of marigold farmers regarding marigold cultivation practices.

OBJECTIVE

To development of knowledge test to measure the knowledge level of marigold farmers on marigold cultivation practices

METHODOLOGY

For the study, knowledge was defined as "includes those behaviors and test situations that emphasize the remembering either by recognition or recall of ideas, material, or phenomena" (Bloom *et.al.,* 1956). Knowledge is an important component of behavior and plays an important role in adoption of marigold cultivation. The test was administered to 24 farmers randomly from among the non-sampled farmers to construct a knowledge test. The locale of the study was the Jammu district of Jammu and Kashmir.

Collection of knowledge items

The test consisted of questions that referred as items (Thorat *et al.,* 2015). Questions were prepared by carefully going through literatures such as research papers, books, SKUAST-J package of practices for open-pollinated varieties, package of practices of Indus seeds for hybrids, and conducting discussions with experts. The questions were modified and drafted such that each item was free from ambiguity.

Editing and Correction of items

The preliminary prepared questions underwent a thorough evaluation and modification process, meticulously edited, adjusted and reorganized. Following the feedback from experts and subject matter specialists, the items were reformulated to incorporate their suggestions.

Item Analysis

Item difficulty and item discrimination are two types of information often obtained from item analysis. Initially, 46 items were prepared focusing on marigold cultivation practices. The assessment utilized dichotomous response option: correct or incorrect. A score of '1' was assigned for each correct answers, while '0' for incorrect answers. The total knowledge score for each respondent was calculated by summing the correct response across all 46 items. The scores of 24 respondents were ranked in descending order and subsequently divided into six equal groups, each containing four individuals. Labels were assigned to the groups from G1, through G6. The score ranges were as follows:

Table 1: The range of scores obtained by the respondents

(n=24)

Group no.	G_1	G_2	G_3	G_4	G_5	G_6
Score range	22-25	19-22	18-19	15-17	14-15	9-13
No. of respondents	4	4	4	4	4	4

Difficulty Index

DI indicates the degree to which an item is difficult. An item should not be too difficult or too easy. An item's DI is computed as the fraction of participants who correctly answer the particular item (Dadheech et al., 2024; Chandran et al., 2024; Abhishek et al., 2023; Dodiya et al., 2023; Rathavi et al., 2023)

DI of a particular item.

$$P_i = n_i / N_i \times 100$$

Whereas,

P_i = Difficulty index of the i^{th}, item (percentage)

n_i = Number of respondents giving correct answers to i^{th}, Item

N_i = Total number of respondents

Example of the difficulty index of the first item

16 respondents (ni) gave correct answers out of 24 to whom the test was administered. Thus, the difficulty index calculated as

Pi = ni / Ni x 100
Pi = 16 / 24 x 100
Pi = 66.66

Items Selection

Items with difficulty values from 30-80% were retained in the test.

Discrimination Index

It measures how effectively an item discriminates between individuals who are well-informed from poorly-informed. The method suggested by Mehta (1958) was used in the study.

$$E1/3 = (S_1 + S_2) - (S_5 + S_6) / N/3$$

Whereas,

S1, S2, S5, and S6 = Groups G1, G2, G5 and G6, frequencies of correct answers

N = total respondents in the sample

Example of the discrimination index of Item of the first item

The frequencies of correct responses given by the respondents in a subgroup for a test item are presented by G1, G2, G5, and G6. For the first item, four respondents in the first group (G1) gave the correct answer. Similarly, four respondents in G2 answered correctly. From G5 and G6, one and two respondents respectively, answered correctly.

Based on the information, the discrimination index was then computed:

$E1/3 = (S_1 + S_2) - (S_5 + S_6) / N/3$

$E1/3 = (4+3) - (1+2) / 24/3$

$E1/3 = 0.50$

Items Selection

The items having discrimination values from 0.25-0.75 are retained in the test.

Reliability

Extent to which the instrument produces consistent results when administered to the same individuals under varying conditions (Bellagi *et al.,* 2022). The reliability was calculated using the split-half method. The test was divided into two halves, containing odd items in one half and even items in the other half. Furthermore, the correlation coefficients between the two halves were computed. The reliability coefficient of the full test was calculated with the help of the Spearman-Brown prophecy.

Table 2: Values for the calculation of reliability

	X	X^2	**Y**	Y^2	**XY**
Total	173	1383	176	1377	1352

Reliability of half-test:

(n=11)

$$r_{half} = \frac{n\sum xy - \sum x \Sigma y}{\sqrt{[n\sum x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

$$r_{half} = \frac{24 \text{ x } 1352 - 173 \text{ x } 176}{\sqrt{[24 \text{ x } 1383 - (173)^2][24 \text{ x } 1377 - (176)^2]}}$$

$$r_{half} = \mathbf{0.77}$$

Spearman-Brown Prophecy:

$$r_{full} = \frac{2r_{half}}{1+r_{half}}$$

$$r_{full} = \mathbf{0.87}$$

The reliability coefficient of the instrument was 0.87, indicating its high reliability.

Validity

Content validity is a systematic examination of test content to assess it the test covers the representative sample of the behavioral domain intended to be measured (Anastasi, 1986). Content validity assessment was used for the knowledge test, which was performed in two steps: in step one the content validity ratio (CVR), and in step two the content validity index (CVI). The content validity index was calculated for each item I-CVI and scale S-CVI.

Content Validity Ratio (CVR)

The CVR serves as a method for evaluating the content validity of specific items within an instrument (Lawshe, 1975). CVR assesses whether each item measures the intended construct. To calculate the CVR, a panel of experts evaluates individual items, categorizing them as either "essential" or "not essential" for the assessment. The scoring assigns '1' for "essential" and "0" for "not essential" (Ansari and Khan, 2023).

Table 3: The minimum critical values for CVR were given for Lawshe

No. of Experts	**7**	**10**	**11**	**15**	**20**	**25**	**30**	**35**	**40**
Minimum value	0.99	0.78	0.59	0.49	0.42	0.37	0.33	0.31	0.29

Content validity ratio (CVR):

$$\text{CVR} = \frac{\text{ne} - \frac{\text{N}}{2}}{\frac{\text{N}}{2}}$$

ne = experts rating an item as "essential"

N = total no. of Judges.

Example of Content validity ratio (CVR) of the first item:

$$\text{CVR} = \frac{10 - \frac{11}{2}}{\frac{11}{2}}$$

$$\text{CVR} = \mathbf{0.82}$$

According to Lawshe if the number of judges involved in the validation process of the test is 11 then the

Table 4: Values of the final selected item in the knowledge test

Item	Difficulty index	Discrimination index	Reliability	CVR	I-CVI	S-CVI	Pc	Kappa
1	66.66	0.50	r_{full} = 0.77	0.82	1	**S-CVI** = 27.32/32 **S-CVI** = 0.85	0.000488	1
2	66.66	0.375		1	1		0.000488	1
3	41.66	0.625		0.64	0.81		0.02684	0.81
4	45.83	0.50		1	1		0.000488	1
5	50.00	0.50		0.64	0.81		0.02684	0.81
6	79.16	0.25		0.82	0.91		0.005368	0.91
7	37.50	0.25		0.82	0.91		0.005368	0.91
8	45.83	0.75		0.82	0.91		0.005368	0.91
9	62.50	0.25		1	1		0.000488	1
10	70.83	0.625		0.82	0.91		0.005368	0.91
11	58.83	0.25		0.64	0.81		0.02684	0.81
12	54.16	0.375		0.64	0.81		0.02684	0.81
13	45.83	0.25		0.64	0.81		0.02684	0.81
14	50.00	0.75		0.64	0.91		0.005368	0.91
15	66.66	0.625		0.82	0.91		0.005368	0.91
16	54.16	0.50		0.64	0.81		0.02684	0.81
17	50.00	0.375		0.82	0.91		0.005368	0.91
18	45.83	0.25		1	1		0.000488	1
19	70.83	0.25		0.64	0.81		0.02684	0.81
20	62.50	0.375		0.82	0.91		0.005368	0.91
21	70.83	0.50		0.82	0.91		0.005368	0.91
22	45.83	0.375		0.82	0.91		0.005368	0.91
23	45.83	0.375		1	1		0.000488	1
24	54.16	0.375		1	1		0.000488	1
25	54.16	0.25		1	1		0.000488	1
26	58.33	0.375		0.64	0.81		0.02684	0.81

minimum value of CVR 0.59 or above was selected and the items below 0.59 were discarded.

Content Validity Index (CVI)

The CVI evaluates the representativeness of items within instrument collectively. Both I-CVI (individual items) and S-CVI (overall scale) were assessed using CVI (Ansari and Khan, 2023). To determine the CVI, expert panelists rated each item on scale using four-point system, eliminating the possibility of neutral response: 1, 2, 3, 4, for not relevant, somewhat relevant, quite relevant, and highly relevant respectively. The S-CVI values ranged from 0 to 1, with higher scores indicating stronger content validity. I-CVI was calculated by dividing the no. of experts providing the rating of 3 or 4 by total number of experts.

Example of individual content validity index (I-CVI) of the first item:

I-CVI = 9/11

I-CVI = 0.81

S-CVI = Σ (I-CVI) / n

n = total no. of items

S-CVI = 27.32 / 32

S-CVI=0.85

An accepted threshold for adequate content validity is an S-CVI = 0.80 or higher (Shrotryia and Dhanda, 2019). The S-CVI value was 0.85, which was above the commonly accepted threshold and demonstrating strong content validity.

Kappa Statistics

The kappa coefficient provides a more accurate assessment of content validity by eliminating random agreement. The statistic complements the CVI by verifying that expert consensus is not due to any chance (Wynd *et al.,* 2003). For the computation of the kappa statistic, it is necessary to determine the probability of chance agreement.

$$P_C = \frac{N!}{A!\ (N-A)!} \times 0.5^N$$

Whereas,

Pc = probability of chance agreement

N = number of experts in the panel,

A = number of experts in the panel who agree that the item is relevant

Example of the probability of chance agreement of the first item:

$$P_C = \frac{11!}{11!\ (11-11)!} \times 0.5^{11}$$

$$P_C = \frac{39916800}{39916800} \times 0.000488$$

$$P_C = 0.000488$$

Example of the Kappa statistic is the calculation of the first item:

$$K = \frac{I - CVI - P_C}{1 - P_C}$$

$$K = \frac{1-0.000488}{1-0.000488}$$

$$K = \mathbf{1}$$

Kappa scores exceeding 0.74 are deemed excellent, those ranging from 0.6 and 0.74 are considered good, and values falling between 0.4 and 0.59 are classified as fair. The Kappa values of the selected knowledge test items range from 0.81 – 1. Since the value was above 0.74, it was considered excellent.

CONCLUSION

An effort was made to create a knowledge test using a standard measurement device. Item analysis, reliability, and validity calculations were used to measure the instrument's stability, and the results showed that the test items were neither too easy nor too difficult to discriminate well between well-informed and poorly informed individuals and the instrument is reliable and valid for future usage. Consequently, it can be said that the items that were ultimately chosen have a good statistical fit for assessing growers' knowledge of the technology related to marigold production. Twenty-six test items were selected.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

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