

Technical adoption gap in Mung- A principal component approach

Vidya V Deshpande^{1*}, Sulbha Sarap²

Department of Mathematics, Late Laxmibai Deshmukh Mahila Mahavidyalaya, Parli Vajinath, Beed, Maharashtra, INDIA.
Email: vidyad469@gmail.com

Abstract

Introduction of sharp-edge optic intraocular lenses (IOL) and the development of the modern phacoemulsification technique have resulted in reduced rates of posterior capsule opacification (PCO). Posterior capsule opacification is the most common complication of cataract surgery and results from the proliferation and migration of residual lenticular epithelial cells. PCO decreases visual acuity and contrast sensitivity leading to disability as a result of glare. Neodymium: yttrium-aluminum-garnet (Nd: YAG) laser capsulotomy has utility in the treatment of PCO. The purpose of this study was to evaluate the influence of size and shape of Neodymium: Yttrium Aluminum Garnet (Nd: YAG) laser capsulotomy on visual acuity and refraction. No significant change in SE following capsulotomy was observed in any group. BCVA significantly improved in all groups following capsulotomy. In conclusion, our study shows that Cruciate shape capsulotomy with an opening of 3.5 mm or less provides the greatest improvement in visual function following Nd: YAG capsulotomy in patients who have had uncomplicated cataract extraction surgery.

Key Words: principal component analysis.

*Address for Correspondence:

*Address for Correspondence:

Dr. Vidya V Deshpande, Associate Professor, Department of Mathematics, Late Laxmibai Deshmukh Mahila Mahavidyalaya, Parli Vajinath, Beed, Maharashtra, INDIA.

Email: vidyad469@gmail.com

Received Date: 10/10/2016 Revised Date: 16/11/2016 Accepted Date: 11/12/2016

Access this article online	
Quick Response Code:	Website: www.statperson.com
	DOI: 20 December 2016

INTRODUCTION

The success of Agricultural and Rural Development strategy depends on planning and development. Transfer of technology from lab to land has brought transformation in the lives of farmers. Technology transfer is a very complex task which is multidisciplinary approach. The total impact of all components of the new agricultural production technologies taken together would be reflected in the level of yield obtained. The general notion is that farmers are not fully exploiting the available technologies and that is why there is large gap between the potential production and actual production. If we compare our

agricultural production with the average production of developed countries it is comparatively low. This situation can be changed with the adoption of modern technology. Modern technology plays a key role in increasing agricultural production. Use of high yielding varieties, fertilizers plant protection measures, post harvest technology can help to double the production. The strategy for increased agricultural production adopted by the State government lays major emphasis on intensive farming which necessitates use of large quantities of new inputs with sufficient technical knowhow of the modern technology with a view to achieving higher level of production. Adoption of recommended technologies for optimum level of output, farmers have to face many constraints and these constraints cease their development and affect total agricultural productivity. The use of new agricultural technology vary widely from farmer to farmer even in the same village. So under these conditions total impact of all the components of the new agricultural technology taken together would be reflected in the level of yield obtained. Pulse production programs are being taken up by Central Government to bridge the gap between availability and requirement. Considering the need and availability of pulses, short duration pulse

crops mung are selected for the study. Keeping in view the importance of mung production present study has been under taken with following objectives.

AIMS AND OBJECTIVES

1. To study technologies adopted by the farmers in mung production
 2. To develop adoption index for mung production.
 3. To measure the contribution of each components of technology in mung production.
- Background Information and Importance of the Project :
 - Project Technical profile :
 - Technical Programme :

MATERIAL AND METHODS

The present study is undertaken in Buldana district, data on 51 Mung growers for 2011-12 has been taken for the study. Recommended technologies / package of practices for mung production are presented in following table.

Table 1: Recommended technologies of mung cultivation.

Sr. No.	Item	Units	Recommendation
1	Seed rate	Kg/hect	12-15 kg/hect
2	Time of sowing	Date	Last week of June
3	Gap filling	Days	3-5 days after sowing
4	F.Y.M.	Cl/ect	10-12 Cart loads/hect
5	N	Kg/hect	200 kg/hect
6	P	Kg/hect	40 kg/hect
7	Plant protection		Di methoate Phosphumido Malathion, methyl parathion
8	Harvesting	Days	65-70 days after sowing

Practices actually adopted

Adoption of Particular practice = -----

Practices Recommended

To find out the gap in adoption level of the technologies of adoption in plant protection measure varies from farmer to farmers. If any plant protection technology is not adopted by the selected then score given is zero and if the technology is adopted the score given is one. The partial score are calculated for partial adoption of technology which were greater than zero and less than one.

Development index by Principal Component Analysis

The main objectives of the principal component analysis are to refer the dimension of a complex multiplicative problem. It is not uncommon if the variations in variables, some of which are closely correlated with one another. In this situation the multiple regression analysis often fails

to provide clear and meaningful analysis. The coefficient of independent variables become unreliable and sometimes carries wrong signs in this situation. Since these become distorted by the inclusion of other independent variable with which these show a high degree of association. The component analysis on the other hand, takes the correlation matrix into account and produces components which are uncorrelated with one another, to bypass the problem of multi-co linearity. Secondly the component analysis produces components in descending order of their importance that is the first component explains the maximum amount of variation and the last component minimum. It is further found that first 7 or 8 variables account for a sizeable amount of variation of about 75 per cent. It is therefore, possible to represent all variables in terms of Eigen components. Principal components are the linear combinations of random of statistical variable which have special properties in terms of variances. Consider a random vector X of p components covariance matrix Σ. As our interest is in variances and covariance we assume that mean vector is O. Normal distribution of X will give more meaning of principal components. The treatment was include the cases where Σ is positive semi definite (i.e. singular) and where Σ has multiple roots. A p dimensional vector U with the dispersion matrix Σ. Let λ₁ ≥ λ₂ ≥ ... ≥ λ_p be the eigen values and P₁ -- P_p be the corresponding eigen vectors of Σ then.

$$\lambda = \lambda_1 P_1 P_1' + \lambda_2 P_2 P_2' + \dots + \lambda_p P_p P_p' \quad (i)$$

$$I = P_1 P_1' + P_2 P_2' + \dots + P_p P_p'$$

$$P_1' \Sigma = \lambda_1 P_1' \Sigma P_j = 0, i=j \quad (ii)$$

Consider the transformed random vectors

$$Y_i = P' u, i=1, \dots, P$$

If Y denotes the vector of the new random vectors and P denotes the orthogonal matrix with P₁, P₂, ... P_p as its columns, then Y is obtained from U by the orthogonal transformation Y = P. u. The random vector Y_i is called ith principal component of U. From (ii) above Some of the properties of Principal components are

(i) The principal components are all uncorrelated. The variance of the ith

Principal component is λ_i

$$V(P' u) = P_i \Sigma P_i = \lambda_i, \text{CoV}(P' iU, P' jU) = P' i E P_j = 0 \quad i \neq j,$$

Thus the linear transformation Y = PU reduces correlated set of variables into an uncorrelated set by an orthogonal transformation.

(ii) Let G_i = λ_i^{-1/2} P_i' U for λ_i ≠ 0 and further let r be the rank of Σ so that only the first r eigen values of Σ are non

zero.

(iii) Let B be any vector such that 11 B11 = 1. Then V(B'U) is a maximum when. B = P₁ and the maximum

variance is λ_i .

Since $V(B^T U) = B^T \Sigma B$, we need the max $B^T \Sigma B$.

Subject to the condition $11 B11 = 1$. But the maximum is attained when $B = P1$.

(iv) The following consequence of the results.

(a) Min $V(B^T U) = \lambda_p = (P^T p \cdot U)$

$$11B11 = 1, V(B^T U) = \lambda_i = V(P^T i U)$$

(b) Max

$$11B11 = 1, B [P1 \dots Pi-1]$$

$$V(B^T U) = \lambda_i = V(P^T i U)$$

(c) Min Max

$$\lambda_{i-1} \quad 11B11 = 1, B \lambda_{Si-1}$$

Where $Si-1$ is a space of $(i-1)$ dimensions in Ep .

(d) Let $B1, B2 \dots Bk$ be a set of orthogonal vectors in Ep .

$$\text{Then } \lambda_1 + \lambda_2 + \dots + \lambda_k \text{ max } [V(B^T 1U) + \dots + V(B^T kU)] B1 \dots Bk$$

$$= V(P^T 1U) + \dots + V$$

$(P^T kU)$

(v) Let $B^T 1 U1 \dots B^T k Uk$ be K Linear functions of U and $\lambda^2 i$ be the residual variance predicting Ui , by the

linear predictor based on

$$B^T 1 U \dots B^T k U,$$

then,

$$\text{Min } \sum_{i=1}^p \lambda_i$$

$B1 \dots Bk$

Is attending when the set $B^T 1 U1 \dots B^T k Uk$ is equivalent to $P^T 1 U \dots B^T k U$, that is $B^T i U$ is a linear combination of the first K principle components. We can without loss of generality replace $B^T 1 U \dots B^T k U$ by an equivalent set of uncorrelated functions and each with variance unity. It is also clear that the functions $B^T 1 U \dots B^T k U$ should be linearly independent for the optimum solution. The residual variance in predicting Ui on the basis of $B^T 1 U \dots B^T k U$ is $\lambda^2 i = \lambda_{ii} - [CoV(Ui, B^T 1 U)]^2 \dots [CoV(Ui, B^T k U)]$

$$= \lambda_{ii} - (B^T 1 \Sigma_i)^2 \dots B^T k \Sigma_i \Sigma_i^T B^T k$$

Where Σ_i is the i th column of Σ and λ_{ii} is the variance of Ui

Now,

$$\sum_{i=1}^p \lambda_i^2 = \sum_{i=1}^p \lambda_{ii} - B^T 1 (\sum_{i=1}^p \Sigma_i \Sigma_i^T) B1 \dots B^T k (\sum_{i=1}^p \Sigma_i \Sigma_i^T) Bk$$

$$= \text{trace } \Sigma - B^T 1 \Sigma \Sigma B1 \dots B^T k \Sigma \Sigma Bk$$

To minimize $\sum \lambda^2 i$, we need maximize $B^T 1 \Sigma \Sigma B1 + \dots + B^T k \Sigma \Sigma Bk$

Subject to the conditions

$$B^T i E Bi = 1, Bi E Bj = 0 \quad i = j$$

(I.e. $B^T 1 U \dots B^T k U$ are un correlated and each has variance unity.)

The optimum choice of Bi such a case is,

$$M(B1, B2 \dots Bk) = M(P1, P2 \dots Pk)$$

Where $P1, P2 \dots Pk$ are the first K Eigen vectors of $1 E \lambda_i 1 = 0$

The result in (V) provides an interesting interpretations of the principle components to replace the p dimensional random vector U by $K < p$ linear functions without much loss of information. How is the best K linear function to be chosen? The efficiency of any choice of K linear functions depends on the extent to which the K linear functions enable us to reconstruct the p original variables. One method of reconstructing the variables. Ui is by determining its best linear predictor on the basis of K linear functions, which case the efficiency of prediction, may be measured by the residual variance $\lambda^2 i$. An overall measure of the predictive efficiency is $\sum \lambda_i^2$. The best choice of the linear functions, for which $\sum \lambda_i^2$ is minimum, is the first K principle components of U .

Development of composite index of technology

The components of technology recommended by the University for Different Crops in terms of adoption scores ($X1 \dots Xn$) was utilized for developing composite index of technology adopted. A composite index is a single numerical value representing the net adoption of all components of technologies whose values lies in between 0 and 1. The principal component analysis (PCA) approach was used for developing composite index. PCA based on correlated component was a matrix between k th components of technology computed. A set of K th components explaining 100% of total variation of all components of recommended technologies was considered correlation matrix where row represents variables and columns represents eigen vectors from which weight (w_i) coefficients of components of technology say Σ is determine as,

$$W_i = \frac{M_i}{\sum M_i}$$

Where,

W_i = Weight or coefficient of component of technology.

M_i = Maximum element in i th row.

$\sum M_i$ = Sum of maximum element in i th row. The required linear function for deriving composite index is,

$$S_i = W_1 X_1 + W_2 X_2 + \dots + W_n X_n$$

Where,

S_i = composite index score.

X_i 's = adoption scores for individual component of technology.

This provides adoption index (of all components of technologies) for each cultivator. The composite index obtained in the process lie in between 0 and 1. The composite score of farmers was classified as low level

adoption (40-60%) medium level (60-80%) and high level of adoption (above 80%).

RESULTS AND DISCUSSION

The various technologies recommended by the university in cultivation of Mung adopted by selected cultivators at their farm are presented in the tables.

Table 2: Technology adopted by mung cultivators

Sr. No.	Technology	Level of adoption		
		Small	Medium	Large
1	Seed Rate	0.91	0.93	0.95
2	Time of sowing	0.95	0.87	0.87
3	Gap filling	0.83	0.88	0.90
4	FYM	0.10	0.20	0.16
5	N	0.88	0.97	0.72
6	P	0.65	0.94	0.61
7	Plant Protection	0.59	0.81	0.25
8	Harvesting	0.62	0.59	0.49
9	Yield	4.42	5.04	3.58

The yield harvested by the selected cultivators ranges between 3.52 to 5.04 q/hect the non adoption practices at its recommended level has reduced yield below 60 percent of the recommended level. The yield received by cultivators are poor than the recommended yields. The yield harvested by selected farmers are about 60 percent of the recommended yield.

The composite Index of adoption

The composite index of adoption of recommended technologies in mung are worked out and presented in following tables. Eigen value and proportion of selected technologies in mung production.

Table 3: Eigen value and proportion of technologies

	Seed rate	Time of sowing	Gap filling	FYM	N	P	K	Harvesting
Eigen value	2.3869	2.0942	1.2451	0.858	0.731	0.354	0.1708	0.1177
Proportion	0.298	0.262	0.156	0.107	0.097	0.044	0.021	0.015
Cumulative	0.298	0.56	0.716	0.823	0.92	0.964	0.985	1.00

Table 4: Distribution of selected cultivators according to composite index

Sr. No.	Level of adoption		
	Low	Medium	High
1	0.3872	0.6063	0.8016
2	0.3930	0.6178	0.8098
3	0.3930	0.6249	0.8116
4	0.4083	0.6251	0.8762
5	0.4110	0.6272	0.9224
6	0.4117	0.6476	0.9296
7	0.4176	0.6534	0.9299

8	0.4179	0.6235
9	0.4199	0.6716
10	0.4205	0.6823
11	0.4246	0.7049
12	0.4293	0.7294
13	0.4312	0.7486
14	0.4448	0.7598
15	0.4597	0.7626
16	0.4646	0.7713
17	0.4661	0.7825
18	0.4669	0.7862
19	0.4696	0.7932
20	0.4712	
21	0.4875	
22	0.4938	
23	0.5624	
24	0.5836	
25	0.5945	

The results of Principal component analysis indicated that out of 8 technologies five technologies seed rate, time of sowing, gap filling, FYM and N have explained 92 per cent contribution in mung productivity. The total 51 cultivators have been classified according their adoption level as low, medium and high adopters.

Contribution of technologies in yield gap: The contribution of each technology in yield gap in mung production are presented in table.

Table 5: Contribution of technologies in mung production

Sr. No.	Technology	Mung	
		Coefficient	Contribution
1	Seed rate	-0.3990*	6.64
2	Time of sowing	-0.0257	0.17
3	Gap filling	-0.7798*	7.82
4	FYM	0.5282	1.22
5	N	-0.6204	12.21
6	P	-0.8271*	25.86
7	K	-0.2363	5.76
8	Plant Protection	-0.4198*	13.17
9	Harvesting	-0.7072**	27.14
10	Yield	4.35	4.65

* Significant at 5% level of significance, ** Significant at 1% level of significance

In mung production seed rate, Gap filling, N, P, K plant protection and harvesting are major contribution in yield gap of mung production to the extent of 4.50 q/ha. In udid production. Sed rate, time of sowing, N, P and Harvesting time are the major contributors of yield gap to the extent of 4.58 q/ha.

CONCLUSIONS

1. Seed rate, time of sowing, gap filling application of FYM, N, P, K plant protection measures and appropriate harvesting time are the technologies adopted by mung cultivators.

2. Seed rate, time of sowing application of N, P, Plant protection and appropriate harvesting time are the technologies adopted by udid cultivation.
3. The distribution of mung and udid cultivators indicated that out of 51 mung cultivators 25 cultivators are grouped in low level of adoption group 19 in medium and 7 high adopters. 46 udid cultivators 24 in low, 17 in medium and 5 in high adopters.
4. Seed rate, Gap filling, application of N, P Plant protection and harvesting time are the important technologies in mung production.
5. Seed rate, time of sowing, application of N, P and harvesting time are the important technologies in udid production.

REFERENCES

1. Jackson, J.E. (1991). A User's Guide to Principal Components (Wiley).
2. Jolliffe, I. T. (1986). Principal Component Analysis. Springer-Verlag. p. 487.
3. Jolliffe, I.T. (2002). Principal Component Analysis, second edition (Springer).
4. Husson François, Lê Sébastien & Pagès Jérôme (2009). Exploratory Multivariate Analysis by Example Using R. Chapman & Hall/CRC The R Series, London. 224p. ISBN 978-2-7535-0938-2
5. Pagès Jérôme (2014). Multiple Factor Analysis by Example Using R. Chapman & Hall/CRC The R Series London 272 p

Source of Support: None Declared
Conflict of Interest: None Declared