SHORT PAPER

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DETERMINANTS OF ADOPTION OF VIRUS MANAGEMENT TECHNOLOGY IN PAPAYA CULTIVATION

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Abstract

Viral diseases are recognized as a major problem in successful cultivation of fruit crops by imposing cost on producers. Adoption of virus management technology (VMT) in fruit crops cultivation is highly beneficial; still its adoption is not widespread. This paper has made attempt to identify the factors influencing its adoption in papaya cultivation. The study using Tobit model reveals that the important factors which determines the successful adoption included age and experience of the farmers, family size, education and contact with extension personnel.

Keywords: papaya cultivation, virus management technology, adoption study

JEL Classifications: Q10, Q12, Q16

1. Introduction

The Indian agriculture, engaging about 56% of the workers and contributing about 18% to national income, is on the cross roads. The agricultural growth has decelerated from 3.2 per cent during the period 1980-81 to 1995-96 to 1.9 per cent during 1996-97 to 2005-06. Therefore, accelerating the agricultural growth is a major challenge. It is well recognized that diversification of agriculture towards horticulture, has potential of raising agricultural production, farm income and employment (Birthal et al, 2008). The horticulture led growth even can make substantial contribution towards improving livelihood of the small farmers. In 2005-06, contribution of horticultural crops' in agricultural gross domestic product was around 28 per cent with only 13 per cent share of national area under these crops. However, horticultural growth may come under pressure if not supported by adequate markets, infrastructure and policies.

Various pest and diseases pose problem towards quality and productivity improvement. Viral diseases are recognized as a major problem in successful cultivation of fruit crops by imposing cost on producers through reduction in yield, fruit quality and marketability. Therefore, disease management in fruit crops especially that of viral diseases, becomes crucial. The studies have shown that adoption of virus management technology (VMT) in fruit crops cultivation is

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highly beneficial (Sharma, et al, 2009). Despite being beneficial**,** the adoption of VMT is not widespread.

Keeping these conditions in mind, this study analyzes the factors responsible for adoption of virus management technology (VMT) in papaya cultivation. VMT comprises of adjustment of horticultural practices towards minimizing yield losses caused by virus infestation. Therefore, VMT is incorporation of various farming activities, such as selecting a season for papaya transplantation, raising border crops, regular application of insecticides and rouging of infected plants, use of virus free seedlings, selection of appropriate cultivar and regular weeding, etc.

India is one of the largest producers of papaya, contributed about 38% to total world production in 2004. Other major producers are Brazil and Mexico. Papaya is cultivated under all sub-tropical and tropical parts of India. Its area, production and productivity are showing an increasing trend since 1991 in India. Among different papaya producing states, Maharashtra ranked second in production (0.552 m MT) after Andhra Pradesh in 2004 (Govt. of India, Min. of Agriculture, 2009). Viral diseases, like *Papaya Ringspot Virus* (PRSV) and Papaya Leaf Curl Virus are serious threat to papaya cultivation in India. The PRSV is transmitted mainly by the aphid vectors, and it is possible to minimize yield losses by following VMT in cultivation of papaya.

2. Methodology

A farm level survey was conducted in four Talukas covering Ahmadnagar and Solapur districts of Maharashtra. A total of 103 papaya growers were selected purposively. Socio-economic, demographic and farming activity data were collected from these selected farmers. Since VMT is incorporation of different management practices, based on the extent of adoption farmers were categorized into low (< 33% adoption), medium (33-67% adoption), and high (>67% adoption) groups. Further, adoption pattern of different components of VMT were classified on the basis of intensity of adoption. An average technology adoption index was calculated. The average technology adoption index for low level of adopters was used as the threshold level for categorizing the farmers as adopter or non-adopter.

Analytical approach

The Tobit model was used to study various factors influencing adoption of VMT in papaya, which estimated likelihood and the extent (*i.e.,* intensity) of adoption. The functional form of Tobit model is as follows

$$Yi = Xi\beta \quad \text{if } i^* = Xi\beta + u_i > T$$

$$\text{or} \quad Yi = 0 \quad \text{if } i^* = Xi\beta + u_i < T$$

where Yi is the probability of adoption and intensity of use of VMT; i* is non-observable latent variable; β is k x 1 vector of parameters to be estimated; u_i is an independently normally distributed error term with zero mean and constant variance σ2 and T is a non-observable threshold level. The above equation is a simultaneous and stochastic decision model. If non-observed latent variable i* is greater than T, the observed qualitative variable Yi that indexes the adoption becomes a continuous function of explanatory variables and zero otherwise (i.e. non-adoption of VMT). The maximum likelihood approach is used to estimate the coefficients in the equation.

Variables in the model

The model assumes that the dependent variable which is defined as technology adoption index based on the extent of adoption. The adoption index is assumed to depend on the following explanatory variables age, farming experience, family size, education status of the farmer, operational holding, area under papaya, and contact with the extension officer. One of the main problems encountered in cross sectional analysis is heteroscedasticity. Both heteroscedasticity and autocorrelations were checked in this model and data were found free form these problems.

Dependent Variable: Technology adoption Index

Based on the extent of adoption, farmers were categorized into low (< 33% adoption), medium (33-66% adoption), and high (>66% adoption) groups. A mean technology adoption index was calculated. While considering VMT in totality, most of the farmers (about 61%) had medium level (33-66%) of VMT adoption. While about 22% of them were categorized under low adopter (adopting VMT in <33% area) and only 17% under high adopter groups (adopting VMT in >66% area). Average technology adoption index was 47. The data revealed that most of the farmers adopted the technology only at partial level. Main reason of majority of farmers classified into low and medium adopters was limited availability of seeds of preferred cultivars and virus-free seedlings, however, they were adopting other aspects of VMT.

On the relationship between age (AGE) and adoption of VMT we expect to have negative impact, since the younger farmers are usually more risk taker (Ekboir (2003) and have greater willingness to adopt the new technology. The older farmers, on the other hand, are more rigid in farming practices and it is difficult to induce them to change their mindset from existing agricultural practices. Farming experience is a measure of human capital invested in farming. Its effect on adoption is hypothesized to be positive as considered by Laxmi & Mishra (2007) and Shiyani et al. (2000).

The family members also work as unpaid labourers on their own farm. Hence we expect larger family size to have negative impact on the technology adoption. This is contrary to what Kiresur et al. (1999) observed with respect to number of on-farm workers in the family. The level of education (EDUC) of the farmer is hypothesized to have a positive impact on the VMT adoption decision. Many studies have shown positive relationship between education and the adoption of new technology (Shiyani et al. 2000; Adesina and Baidu-Forson, 1995).

There are two schools of thought with respect to operational holding and adoption of technologies. One argues that the variable has a positive influence on adoption, as large farm size farmers generate more income, which enhances their risk bearing capacity (Sarap and Vashist, 1994). Another argument advocates that small holding farmers utilize their limited resources more efficiently and adopt new technology faster (Shiyani et al. 2000). In this study, we go with the first argument.

The level of social awareness among farmers has been captured by incorporating dummy variables that control for the exposure of farmers to extension officer. This has being hypothesized to have positive impact on adoption of VMT.

3. Results and Discussions

Characteristics of the sample farmers show that more than 80% farmers were educated. Average family size was 10.22. Large family size can be attributed to joint families and higher

number of children. Asset status of farmers revealed that they were capable of bearing risk in farming. Availability of family labour shows that on an average, about four man-days are available per family on full time basis, and similar labour is available on part time basis.

In the sample average land holding was 3.98 Ha, while size of operational holding of sample farmers was 2.38 Ha. Average area under irrigation was 2.38 Ha. About one-third of the irrigated land was covered under papaya cultivation. Average plant population was 2,300 per hectare. Well, boring and tube well were major sources of irrigation, while drip, channel and flooding were common methods of irrigation. Drip irrigation is catching up fast as a popular method of irrigation in papaya cultivation.

Farm machinery ownership pattern by sample farmers shows that most of the farmers owned sprayers, which is essentially required for fruit cultivation. Other common farm equipment was tractor with trolley. Some farm families owned cultivators and harrows. About one tenth of the surveyed farmers in Solapur also owned harrow.

Factors influencing VMT adoption

An attempt was made to understand the factors influencing adoption of VMT in papaya cultivation. Maximum likelihood estimates of coefficient of Tobit model is given in Table 1. The results indicated that age and experience of the farmers were significant at 1% level and their sign were as expected. Experience in papaya cultivation played a positive role in the adoption of VMT. Training through contact with extension personnel had a positive and significant influence empowering farmers by providing necessary skills for adoption of VMT. Therefore, policies to improve human capital through training and awareness programme are beneficial for adoption of VMT. Thus there is a need to have resource allocation to improve the human capital through extension programmes,

Table 1. Maximum Likelihood Estimates (MLE) of Coefficients of the Tobit Model for VMT Adoption

Variable	*MLE*	*Standard Error (SE)*	*Asymptotic t Ratio*	*P-value*
Intercept	17.707	11.429	1.55	0.125
AGE	-0.726	0.178	-4.08*	0.000
EXP	3.865	0.382	10.13*	0.000
EDUC	2.679	1.754	1.53***	0.130
PAPAREA	0.238	1.726	0.14	0.891
FSIZE	-0.674	0.392	-1.72**	0.089
OPLNHOLD	0.317	1.241	0.26	0.799
EXTN	5.906	2.638	2.24*	0.027
Disturbance standard deviation				
Sigma (σ)	12.091	0.927	10.25	13.930
Log likelihood function = -349.97				

Note: * significant at 1%; **Significant at 10%; *** significant at 15%

Level of education also had a positive and significant impact on probability of adoption of VMT. Therefore, education programmes, especially adult education, should be given more emphasis. Further, the results showed that the size of family had a significant and negative correlation with the adoption of VMT. Other variables, namely, area under papaya and operational holdings were not significant, but retained their expected sign in the model. Disturbance standard deviation from the model was 12.09.

The empirical model can be used to draw economic implications for virus management strategies for papaya cultivation in the state. Following a Tobit decomposition framework suggested by McDonald and Moffit (1980), effects of changes in the farm and farmer specific traits on adoption probabilities, and use intensities were obtained. The value of Z was 2.38. The predicted probability of VMT adoption above the limit for a farmer with the vector of explanatory variables was 0.991, which is the cumulative standard normal distribution function F(Z). This result indicated that there was 99.1% chance that a farmer would adopt VMT measures. This looks like a high value, but the adoption of VMT involves many components and the adoption of a single practice might make the farmer an adopter. The expected value of VMT adoption is defined in the model as E(Y) and the value obtained was 28.85. This indicated that new adopters could be expected to raise Technology Adoption Index on an average by 29 points.

4. Conclusions

Viral diseases are recognized as a major problem in successful cultivation of fruit crops by imposing cost on producers. Therefore, disease management in fruit crops especially that of viral diseases, becomes crucial. Adoption of virus management technology (VMT) in fruit crops cultivation is highly beneficial still its adoption is not widespread. The paper has made attempt to identify the factors influencing its adoption in the cultivation of papaya in Ahmadnagar and Sholapur districts of Maharashtra.

The study reveals that the important factors which determines the successful adoption of VMT for papaya cultivation included age and experience of the farmers, family size, education and contact with extension personnel. Therefore, programme for improving the adoption of VMT in papaya should first target to the younger farmers and particularly those who have more experience of farming. Policies to improve human capital through training and awareness programme are beneficial. Thus there is a need to have resource allocation to improve the human capital through extension programmes and qualified extension personnel. Further, Government flagship programme on birth control need to be carried forward with more dynamism. It is expected that the adoption rate of VMT would be much faster if such factors are institutionalized.

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