Technological Impact of *Phytopthora* Management Practices in Mandarin

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ABSTRACT

The present research study was conducted on "Technological impact of Phytopthora management practices in Mandarin" in the Narkhed tahsil of Nagpur district in Maharashtra state. To evaluate the phytopthora management practices demonstrated under TOT RKVY project, 45 beneficiaries and 45 non beneficiaries were studied and comparative analysis was done. To study the impact for calculating technological impact, mean and per cent change was found out. This per cent change was then considered for the extent of impact of each parameter. Regarding, tree canopy, gum oozing, fruiting and fruit drop, fruit quality of Mandarin 27.74, 29.82, 32.43 and 28.34 per cent improvement over non beneficiaries was recorded by the beneficiaries. This change was significantly higher than the non-beneficiaries of TOT RKVY project and z value shows high significance at0.01 level of probability. In case of overall technological impact, per cent change of beneficiaries was 29.08 per cent over non beneficiaries. The z value (5.83) was found highly significant at 0.01 level of probability.

Keywords: Rashtriya Krishi Vikas Yojana, Phytopthora, Mandarin

INTRODUCTION

Citrus is one of the most important fruit crops of the world. Brazil is at the top with more than 20 million tons production, China ranked second with 19.6 million tons and United States is third largest producer with 10 million tons. Other important citrus producing countries are Mexico, India, Spain, Iran Nigeria and Turkey Misachi (2017). Most of the citrus growing countries are suffering from *Phytopthora* disease and doing research on its management. In India Vidarbha region of Maharashtra State is leading area of Santra cultivation.

At present the cultivation of Mandarin is mostly concentrated in five districts of Vidarbha namely Nagpur, Amravati, Wardha, Yavatmal, and Akola. The Nagpur district has 31.45 per cent area under Mandarin cultivation. Total area under Mandarin cultivation in Nagpur district is 25882.84 ha. and total production is 132553.85 MT.

Phytophthoraspp. is the causal agent of several serious diseases of citrus in India. *Phytophthoraparasitica, P. citrophthora* and *P. palmivora* have been mostly involved in causing damping off, collar rot and root rot in Mandarin. However, *Phytophthora parasitica* and *P. palmivora* are the most prevalent species in Mandarin orchards of Nagpur region. It remains a threat and a persistent problem wherever Mandarin is grown that can result in substantial tree loss particularly trees on susceptible rootstock. Supply of poor quality sapling may result in foot rot, root rot or gummosis in orchard. These are the most important soil borne diseases of Mandarin causing mortality of newly planted trees and a slow decline and yield loss of mature trees. Epidemics of *Phytophthora* on heavy black cotton soils play an important role in Mandarin root stock failure. Hence, *Phytopthora* disease management is very important (Lende *et al.* 2015).

Transfer of technology (TOT) under Rashtriya Krishi Vikas Yojana (RKVY) has been implemented in Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in its jurisdiction of 11 districts through cluster approach. It is implemented in co-ordination with the State Department of Agriculture. Total package of crops along with recommended technologies are demonstrated in cluster approach. Under this scheme Extension Education Section, College of Agriculture, Nagpur has given the recommended package of practices for *Phytopthora* disease management in Mandarin. They provide overall package of practices for the control

of *Phytopthora* disease to reduce and to control its attack.

METHODOLOGY

The study was conducted in Khapri (Kene) and Rohana villages in Narkhed tahsil of Nagpur district of Maharashtra state for the demonstrations of *Phytopthora* management practices under TOT RKVY project.

Package of practices for management *Phytopthora*in Mandarin was prepared by the Scientists of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra and critical inputs were provided to the beneficiaries of project.

Management practices of *Phytopthora disease* in Mandarin crop provided under TOT-RKVY project

Sl. No.	Particulars	Per tree	Per acre	Application
1	**Fertilizers and manures**	FYM @ 50kg	4.0 t	Soil application
		Neem cake@7.5 kg	600kg	
		Ammonium sulphate @1kg	80kg	Soil application
		Single super phosphate 1kg	80kg	
		Murate of potash @500kg	40kg	
2	**Potassium permanganate**	@12.5gm	1kg	Application at infected area with proper treatment
3	**Bourdeaux mixture**	Copper sulphate @100gm Lime @100gm	8kg $CuSO_4$ + 8kg Lime	Application at trunk of tree up to 1meter from ground level
4	**Metalaxyl M-72**	@20gm	1.6kg	Drenching
5	**Fosetyl- Al**	@8gm	640gm	Spraying
6	**Trichoderma**	@100gm	8kg	Soil application

To study the impact, comparative analysis of beneficiaries of TOT RKVY project and non beneficiaries was conducted. For the study census was selected as sample in which all 45 beneficiaries (beneficiary Mandarin growers of TOT RKVY) and equal number of non beneficiaries were selected from the villages that were not demonstrated under TOT RKVY project of *Phytopthora* management practices.

An exploratory research design of social research was used for the present investigation. Survey method of data collection was used. The data were collected through personal interview of respondents at their home and farm.

Technological impact of project was measured based on parameters i.e. tree canopy, gum oozing, fruiting or fruit drop and fruit quality. By measuring all parameters finally overall technological impact was calculated. All the parameters and overall technological impact was measured in terms of per cent change.

$$\Delta T.I. = \frac{T.I._b - T.I._{nb}}{T.I._{nb}} \times 100$$

Where, $\Delta T.I.$ = Per cent change in Technological
T.I.b = Technological Impact of Beneficiaries
T.I.nb = Technological Impact of Non Beneficiaries

To test the significance of technological impact of *Phytopthora* management practices on beneficiaries and non beneficiaries mean scores of Mandarin growers calculated by "Z test".

RESULTAS AND DISCUSSION

Profile of Mandarin growers

The study of selected characteristics was made with reference to age, education, land holding, area under Mandarin crop, source of irrigation, method of irrigation, training received, extension contact, source of information, cosmopoliteness, innovativeness, economic motivation, risk orientation towards technological impact of *Phytopthora* management practices.

Table 1
Distribution of respondents according to their profile

	Particulars	Beneficiary (n=45)		Non-beneficiary (n=45)	
		Freq	%	Freq	%
Age					
1	Young	7	15.56	7	15.56
2	Middle	26	57.77	19	42.22
3	Old	12	26.67	19	42.22
Education					
1	Illiterate	0	0	0	0
2	Primary school	1	2.23	3	6.66
3	Middle school	2	4.42	6	13.33
4	Secondary school	8	17.78	10	22.23
5	Higher secondary/ Junior college	14	31.12	14	31.11
6	Diploma or technical education	1	2.23	0	0
7	Graduate	16	35.55	10	22.23
8	Post Graduate	3	6.67	2	4.44
Land holding					
1	Marginal	5	11.12	11	24.44
2	Small	21	46.66	18	40.00
3	Semi-medium	17	37.77	14	31.12
4	Medium	2	4.45	2	4.44
5	Large	0	0.00	0	0.00
Area under Mandarin crop					
1	Low (up to 0.68)	2	4.44	5	11.12
2	Medium (0.69 to 2.62)	33	73.34	34	75.55
3	High (2.63 & above)	10	22.22	6	13.33
Source of irrigation					
1	Well	45	100	45	100
2	Tube/well	28	62.23	25	55.56
3	Canal	8	17.75	7	15.56
4	River	0	0	0	0
Method of irrigation					
1	Flooding	20	44.45	25	55.56
2	Single ring	13	28.89	19	42.22
3	Double ring	15	33.33	9	20.00
4	Drip irrigation	37	82.22	30	66.66
Trainings received					
1	No training	0	00	19	42.23
2	1-2 days trainings	45	100	23	51.12
3	3-4 days trainings	20	4.45	13	28.89
4	4-7 days trainings	5	11.12	3	6.67
5	Above 7 days trainings	2	4.45	2	4.45
Extension contact					
1	Low (up to 9.47)	7	15.56	12	26.67
2	Medium (9.48 to 13.08)	29	64.44	30	66.66
Source of information					
1	Low (up to 14.34)	5	11.12	14	31.12
2	Medium (14.35 to 20.20)	29	64.44	25	55.55
3	High (20.21 & above)	11	24.44	6	13.33
Cosmopoliteness					
1	Low (up to 9.56)	4	8.88	13	28.90
2	Medium (9.57 to 13.95)	27	60.00	24	53.33
3	High (13.96 & above)	14	31.12	8	17.77

Innovativeness					
1	Low (up to 21.08)	8	17.78	13	28.89
2	Medium (21.09 to 26.28)	27	60.00	27	60.00
3	High (26.29 & above)	10	22.22	5	11.11
Economic motivation					
1	Low (up to 21.56)	6	13.33	12	26.67
2	Medium (21.57 to 26.21)	28	62.22	29	64.45
3	High (26.22 & above)	11	24.45	4	8.88
Risk orientation					
1	Low (up to 19.78)	6	13.34	11	24.44
2	Medium(19.79 to 25.87)	27	60	27	60
3	High (25.88 & above)	12	26.66	7	15.56

The data revealed (Table 1) that the majority of beneficiaries (57.77%) were found in middle age group. Whereas, in case of non-beneficiaries also observed that, majority of non-beneficiaries (42.22%) were found in middle age group. This indicates that middle aged Mandarin growers having higher cultivation of Mandarin crop. Most of the beneficiaries (35.55%) were graduates. Whereas, majority of non-beneficiaries (31.11%) educated up to higher secondary/junior college. Majority of beneficiaries (46.66%) have small (1.01 to 2.00 ha) land holding. In case of non-beneficiaries, majority of Mandarin growers (40.00%) have small (1.01 to 2.00 ha) land holding. Nearly three fourth of the beneficiaries (73.34%) and non-beneficiaries (75.55%) of TOT RKVY project have 0.69 to 2.62 hectares (medium level) of area under Mandarin crop out of their total land holding. All the beneficiaries and non-beneficiaries use "Well" as source of irrigation. It was observed that majority of beneficiaries (82.22%) use drip irrigation. In case of non-beneficiaries, 66.66 per cent respondents use drip irrigation. It was observed that majority of Mandarin growers has moderately to highly favourable attitude towards drip irrigation (Rathod *et al*. 2019). It was found that 100.00 per cent beneficiaries received 1 to 2 days training. In case of non-beneficiaries, more than half of (51.12%) Mandarin growers had received 1 to 2 days training. Majority of the beneficiaries (64.44%) have moderate extension contact. While, majority non-beneficiaries (66.66%) have medium level of extension contact. Majority of the beneficiaries i.e. 64.44 per cent beneficiaries using medium level sources of information. Whereas, in case of non-beneficiaries, majority (55.55%) of non-beneficiaries have medium sources of information. Most of the beneficiaries (60.00%) were showing medium cosmopoliteness, while 31.11 per cent beneficiaries were showing high cosmopoliteness However, regarding non-beneficiaries most (53.33%) of the respondents showed medium cosmopoliteness. Majority of beneficiaries and non-beneficiaries (60.00%) was belonged to medium category of innovativeness. 62.22 per cent beneficiaries were belonged to medium category of economic motivation. While, 64.45 per cent non-beneficiaries were belonged to medium category of economic motivation.More than half of the i.e. 60.00 per cent of the beneficiaries and non-beneficiaries were belonged to medium level of risk orientation.

Technological impact

From Table 2, it is observed that the majority of beneficiaries found improvement in the growth of stems (64.45%), branches (66.66%) and leaves (66.66%) followed by nearly one third of the beneficiary respondents perceived that stems (28.88%), branches (31.11%) and leaves (31.11%) were started to improve as an effect of *Phytopthora* management treatments. While non-beneficiaries whatever treatment conducted on their own found improvement in growth of leaves (51.12%), stem (44.45%), and branches (48.89%), while 37.77, 31.11 and 26.66 per cent non beneficiaries found started in improvement of stem (size, luster etc.), branches and leaves of Mandarin crop, respectively.

Table 2

Impact of Phytopthora management practices on technological parameters of Mandarin

Sl. No.	Particulars	Beneficiaries (n=45)			Non-beneficiaries (n=45)		
	Tree canopy	**GI**	**SI**	**NI**	**GI**	**SI**	**NI**
a	Stem (Size & luster)	29 (64.45)	13 (28.88)	3 (6.67)	20 (44.45)	17 (37.77)	8 (17.78)
b	Branches	30 (66.66)	14 (31.11)	1 (2.23)	22 (48.89)	14 (31.11)	9 (20.00)
c	Leaves	30 (66.66)	14 (31.11)	1 (2.23)	23 (51.12)	12 (26.66)	10 (22.23)
	Gum oozing	**FC**	**PC**	**NC**	**FC**	**PC**	**NC**
a	Gum oozing	31 (68.88)	12 (26.67)	2 (4.45)	21 (46.66)	15 (33.34)	9 (20.00)
	Fruitng/fruit drop						
a	Fruiting	**I**	**LBI**	**NI**	**I**	**LBI**	**NI**
		30 (66.66)	13 (28.89)	2 (4.45)	20 (44.45)	16 (35.56)	9 (20.00)
b	Fruit drop	**FC**	**PC**	**NC**	**FC**	**PC**	**NC**
		30 (66.66)	13 (28.89)	2 (4.45)	20 (44.45)	15 (33.33)	10 (22.22)
	Fruit quality						
1	Size of fruit increased	**Yes**		**No**	**Yes**		**No**
		39 (86.66)		6 (13.34)	25 (55.56)		20 (44.44)
2	Skin colour of fruit	**I**	**LBI**	**NI**	**I**	**LBI**	**NI**
		33 (73.34)	10 (22.22)	2 (4.44)	22 (48.89)	16 (35.55)	7 (15.56)
3	Keeping quality of fruit	27 (60.00)	11 (24.44)	7 (15.56)	19 (42.22)	15 (33.34)	11 (24.45)
4	Juice Quantity	29 (64.45)	12 (26.66)	4 (8.89)	21 (46.67)	17 (37.77)	7 (15.56)
5	Juice Quality	27 (60.00)	13 (28.88)	5 (11.12)	18 (40.00)	18 (40.00)	9 (20.00)

GI- Growth improved,**SI-** Started to improve, **NI-** Not improved, **FC**- Fully controlled, **PC**- Partially controlled, **NC**- Not controlled, **I-** Improved, **LBI-** Little bit improved, **NI-** Not improved

From the findings it could be surely stated that, *Phytopthora* management practices had greater influence on the tree canopy of Mandarin plant. Improvement in growth of stem, branches and leaves of Mandarin crop.

The application of FYM, NPK, micronutrients as per recommendations gives significant results to the Mandarin growers. The results as perceived by the beneficiaries of TOT RKVY, canopy volume increased significantly due to proper irrigation schedule, timely fertigation of micronutrients and fertilizer application.

Therefore, from the findings it was concluded that majority of beneficiaries acquired more growth improvement in tree canopy of Mandarin plants than non beneficiaries. Obtained results show positive impact of *Phytopthora* management demonstration on the orchards of beneficiaries as perceived by them.

It is observed (Table 2) that 68.88 per cent beneficiaries observed that their Mandarin crop got full control over the gum oozing, followed by 26.67 per cent beneficiaries get partial control over gum oozing due to *Phytopthora* management practices,

while least number of beneficiaries (4.45%) couldn't found control over gum oozing in their Mandarin orchards. In case of non-beneficiaries it was found that 46.66 per cent respondents get full control over the gum oozing, followed by 33.34 per cent Mandarin growers get partial control over the gum oozing and one fifth of the respondents (20.00%) didn't get control over the gum oozing in their Mandarin orchards. Painting and spraying the trunk with high concentrations of these fungicides (6% a.i. of fenoxam and 10% a. i. of fosetyl-Al) also help the plant to recover. In Australia there was 48 per cent improve maintain plant health when Fosetyl-A1 was used at 15 ml/m of tree canopy for two times in period of 5 months. In Florida and California result indicated that foliar sprat was better than sleeve drench. Overall results indicated that Fosety-A1 is effective in controlling Phytophthora root rot either applied by using sleeve drench, injection or foliar spray (Muhammad Asim *et al.* 2019).

Efficacy of fosetyl-Al and metalaxyl was worked more effectively with the COC, Bordeaux mixture and Bordeaux paste for management of gum oozing in Mandarin. Pasting of metalaxyl and fosetyl-Al to the stem of Mandarin could have positive effect, and gum oozing found stopped. Next effective treatment to reduce the disease attack was spraying of metalaxyl and fosetyl-Al as per the recommendations; it imparts good results to the beneficiaries of TOT RKVY project. Treatment of these recommendations was imparted significant reduction in gum oozing index of Mandarin plants, accordingly reduction in disease index. Recently, a new systemic fungicide, dimetomorph, applied as trunk paint at high concentrations proved to be as effective as fosetyl-Al and mefenoxam in suppressing canker development on citrus bark, after inoculation with P. citrophthora and P. nicotianae (Matheron and Porchas, 2002).

Under the TOT RKVY project full kit of management practices was provided to reduce attack of *Phytopthora* disease and also the information about application schedule of these practices was given by the concerned authority to the beneficiaries of project through training and other extension activities.

From the results it was concluded that the gum oozing of beneficiaries Mandarin crop was significantly controlled over non beneficiaries crop as an effect of treatments provided through the demonstration of *Phytopthora* management.

According to the data presented in Table 2, it is revealed that 66.66 per cent beneficiaries noted the improvement in fruiting and obtained control over the fruit drop in their Mandarin orchards. It was followed by 28.89 per cent beneficiaries who acquired little bit improvement in fruiting and partial control over the fruit drop, only 4.45 per cent beneficiaries didn't acquired improvement in fruiting and didn't obtained control over the fruit drop in their Mandarin orchards.

In the case of non-beneficiaries, it was found that the 44.45 per cent Mandarin growers attained improvement in fruiting and control over the fruit drop. While 35.56 per cent Mandarin growers attained little bit improvement in the fruiting and 33.33 per cent Mandarin growers obtained partial control over the fruit drop, further it is noted that one fifth of the non beneficiaries (20.00%) didn't attained any improvement in fruiting and 22.22 per cent non beneficiaries could not get control on the fruit drop in their Mandarin orchards.

To control the pre-harvest fruit drop in Mandarin, application of fungicides like benomyl is recommended to the Mandarin orchards. These fungicides have great influence on control of fruit drop. Beneficiaries of project applied these fungicides in their orchards and it was gives benefits in control of fruit drop, reducing disease attack and accordingly resulted in increasing the fruiting of Mandarin. It was concluded that majority of beneficiaries get significant increase in fruiting and control of the fruit drop in Mandarin orchards over the non beneficiaries.

Graham and Feichtenberger (2015) discussed success and challenges in managing diseases of citrus. In mature groves proper drainage and use of effective fungicide is recommended to

manage diseases. To manage brown rot of fruit use of phosphate fungicide before the appearance of early symptoms and after infection copper based fungicides are good.

Size of fruit

From the Table 2, it is revealed that the greater majority of beneficiaries (86.66 %) noted the increase in size of Mandarin fruit, however 13.34 per cent non-beneficiaries did not obtained increase in size of fruit. Whereas, 55.56 per cent non-beneficiaries obtained the increase in fruit size whatever they adopted the treatment on their own while 44.44 per cent non-beneficiaries did not obtained the increase in fruit size.

Skin colour of fruit

It is also indicated (Table 2) that near about three fourth of beneficiaries (73.34%) acquired the improvement in the skin colour of Mandarin fruits as an effect of demonstration, while in the orchards of 22.22 per cent beneficiaries skin colour of fruits was little bit improved and 4.44 per cent beneficiaries did not obtained improvement in skin colour of fruits. Nearly half of the non beneficiaries i.e. 48.89 per cent acquired the improvement in skin colour of fruits with their own efforts, while 35.55 per cent non-beneficiaries obtained little bit improvement in the skin colour of fruits and 15.56 per cent non-beneficiaries did not obtained improvement in skin colour of fruits.

Keeping quality of fruit

Table 2 also shows that 60.00 per cent beneficiary respondents could attained the improvement in keeping quality of fruits, while in the orchards of 24.44 per cent beneficiaries achieved little bit improvement of keeping quality of Mandarin fruits and remaining 15.57 per cent beneficiaries not found improvement in the keeping quality of fruit. In case of non beneficiaries 42.22 per cent respondents could improve the keeping quality of fruit on their own while, 33.34 per cent non-beneficiaries obtain little bit improvement in keeping quality of fruit and 24.45 per cent non-beneficiaries still unable to improve the keeping of affected Mandarin orchard.

Juice quantity of fruit

It was presented in Table 2, that quantity of juice was improved in orchards of 64.45 per cent beneficiaries. Juice quantity of Mandarin fruit was little bit improved in the orchards of 26.66 per cent beneficiaries. Whereas, 46.67 per cent non-beneficiaries obtained improvement in juice quantity with their own efforts followed by 37.77 per cent non beneficiary respondents found little bit improvement in the juice quantity while 15.56 per cent non beneficiaries unable to improve the juice quality.

Juice quality of fruit

In regards with the juice quality it was observed that 60.00 per cent beneficiaries able to improve the juice quality of Mandarin fruits after the treatment provided under the project and more than one fourth of the beneficiary respondents (28.88%) obtained little bit improvement in the juice quality of fruits. Least proportion of the beneficiaries (11.12%) didn't found improvement in the juice quality. Regarding non beneficiary equal percentage of respondents (40.00%) obtained expected improvement and little bit improvement in juice quality on their own efforts, respectively and 20.00 per cent non-beneficiaries did not obtained improvement in quality of juice.

Application of recommended practices in Mandarin orchards as per recommendations gives significant results in concern with fruit quality. Results showed that, *Phytopthora* management practices helps in increase in fruit size, improvement in the skin colour of fruit, improvement in keeping quality of fruit and improvement in quality and quantity of fruit juice after getting recovered from the damages of *Phytopthora*. These management practices were useful to increase fruit firmness, imparting attractive skin colour of fruit, improvement in nutritional quality of fruit, TSS of fruit, and acidity level in fruit of Mandarin. From the findings drawn as above, we can conclude that the *Phytopthora* management practices along with

application of fungicides and other treatments enhance the fruit quality. It could be helpful in imparting the improvement of internal as well as external quality of Mandarin fruit.

Gade and Koche (2012) recorded considerable reduction in population density and intensity of root rot and gummosis in Nagpur mandarin due to combination of Metalayl, Neem cake, Fosetyl Al, *Trichoderma* sp. and *P. fluorescens*.

Graham and Feichtenberger (2015) discussed success and challenges in managing diseases of citrus. In mature groves proper drainage and use of effective fungicide is recommended to manage diseases. To manage brown rot of fruit use of phosphate fungicide before the appearance of early symptoms and after infection copper based fungicides are good.

Testing the significance of the difference in the means

In order to test the variability of means of tree canopy, gum oozing, fruiting/fruit drop, fruit quality and overall technological impact of beneficiaries over the non-beneficiaries, the data were subjected to 'Z test' and the results thus obtained have been presented in Table 3.

It was observed from the Table 3 that the means of various parameters of technological impact viz. tree canopy (81.85), gum oozing (82.22), fruiting and fruit drop (81.66), fruit quality (78.27) and overall technological impact (16.86) of beneficiaries were higher than mean of tree canopy (64.07), gum oozing (63.33), fruiting/fruit drop (61.66), fruit quality (60.98) and overall technological impact (13.06) of the non-beneficiaries.

Table 3

Technological impact of Phytopthora management practices demonstrated under TOT RKVY project

Sl. No.	Impact parameters	Mean score		% change	Z value
		Beneficiaries	Non-beneficiaries		
1	Tree canopy	81.85	64.07	27.74	4.30**
2	Gum oozing	82.22	63.33	29.82	2.92**
3	Fruiting and fruit drop	81.66	61.66	32.43	3.42**
4	Fruit quality	78.27	60.98	28.34	4.98**
	Overall technological impact	**16.86**	**13.06**	**29.08**	**5.83****

*** Significant at 0.01 level of probability*

The per cent change occurred after the application of *Phytopthora* management practices in tree canopy, gum oozing, fruiting/fruit drop and fruit quality of Mandarin orchards of beneficiaries was 27.74 per cent, 29.82 per cent, 32.43 per cent and 28.34 per cent, respectively over the non-beneficiaries of the project. The per cent change in overall technological impact of *Phytopthora* management practices on the beneficiaries was 29.08 per cent over the non-beneficiaries.

A mere quantitative superiority of the mean score of the beneficiaries over the mean score of the non-beneficiaries is not conclusive proof of its superiority. Hence, the ratio between observed differences was computed as indicated by 'Z' values.

The 'z' values of tree canopy (4.30), gum oozing (2.92), fruiting and fruit drop (3.42), fruit quality (4.98) and overall technological impact (5.82) were found highly significant at 0.01 level of probability.

It could be therefore, be inferred that the beneficiaries differed highly significant over non-beneficiaries in tree canopy, gum oozing, fruiting and fruit drop, fruit quality and overall technological impact. Therefore, be explicitly stated that there was definite increase in tree canopy, definite control over the gum oozing, definite increase in fruiting and control on the fruit drop and definite increase in fruit quality of Mandarin among beneficiaries over non-beneficiaries as result of technological impact of *Phytopthora* management practices in Mandarin organized demonstrated under TOT-RKVY project.

Table 4

Coefficient of correlation of selected characteristics of beneficiaries and their technological impact

Sl. No.	Independent variables	"r" values				
		Tree canopy	Gum oozing	Fruiting and fruit drop	Fruit quality	Technological impact
1	Age	-0.2022	-0.3997**	-0.2646	0.0185	-0.2749
2	Education	0.2890*	0.2861*	0.4493**	-0.0725	0.2417
3	Land holding	0.3191*	0.2114	0.3507*	0.2135	0.3395*
4	Area under Mandarin crop	0.3201*	0.3551*	0.3919**	0.1250	0.3433*
5	Source of irrigation	0.0016	-0.0173	0.3477*	0.0894	0.1781
6	Method of irrigation	0.1438	0.1276	0.2968*	0.0754	0.2464
7	Training received	0.1823	0.2751	0.3330*	0.2933*	0.3852**
8	Extension contact	0.0023	0.0960	0.1342	-0.1307	0.0777
9	Sources of information	0.1752	0.1314	0.3383*	-0.2202	0.1614
10	Cosmopoliteness	0.1825	0.0116	0.2974*	-0.2435	0.0834
11	Innovativeness	0.3063*	0.4585**	0.3454*	-0.1686	0.2736
12	Economic motivation	0.1606	0.2717	0.4674**	0.0112	0.2982*
13	Risk orientation	0.1392	0.2610	0.1722	-0.288	0.0391

*** Significant at 0.01 level of probability * Significant at 0.05 level of probability*

It is revealed from Table 4 that the age of the beneficiaries was highly negative significant with the gum oozing at 0.01 level of probability. However, education of beneficiaries was positive significant with the tree canopy, gum oozing at 0.05 level of probability and highly positive significant with the fruiting and fruit drop i.e. at 0.01 level of probability. Land holding of the beneficiaries had positive significant correlation with tree canopy, fruiting and fruit drop and overall technological impact at 0.05 level of probability. Area under Mandarin crop had positive and significant correlation with the tree canopy, gum oozing and overall technological impact at 0.05 level of probability, and highly significant correlation with the fruiting and fruit drop at 0.01 level of probability. Source of irrigation and method of irrigation of beneficiaries had positive significant correlation with the fruiting and fruit drop at 0.05 level of probability. Training received by beneficiaries had positive significant relationship with the fruiting and fruit drop, fruit quality and overall technological impact at 0.05 level of probability.

According to findings presented in the Table 4 it was found that sources of information and cosmopoliteness of beneficiaries was positively significant with the fruiting and fruit drop at 0.05 level of probability. Innovativeness of beneficiaries was positively significant with the tree canopy and fruiting and fruit drop at 0.05 level of probability, while positive significant with the gum oozing at 0.01 level of probability. Economic motivation of beneficiaries was significantly correlated with overall technological impact at 0.05 level of probability and with the fruiting and fruit drop significant at 0.01 level of probability. Hence null hypothesis was accepted for these variables and parameters. While, other remaining variables have non significant correlation with the technological parameters and overall technological impact, hence null hypothesis was rejected for these variables and parameters.

It indicates that high educated and innovative Mandarin growers who had more area under Mandarin crop obtained significant increase in tree canopy, fruiting, control on the gum oozing and fruit drop in Mandarin orchards. The Mandarin growers who got training about *Phytopthora*

management practices obtained the significant control on fruit drop and increase in fruiting and fruit quality of Mandarin fruits. The innovative Mandarin growers who are having more land holding under Mandarin crop and got training had significant technological impact of *Phytopthora* management practices on their Mandarin orchards. These findings are in conformity with the findings of Ahire *et al.* (2015) they also found that more area under pomegranate was positive significant with the overall impact.

CONCLUSION

It could definitely be stated that the impact of *Phytopthora* management practices in Mandarin organized under the TOT RKVY project have positive and significant technological impact on the beneficiaries.

Hence, it could be stated that developmental projects have significant impact on farmers; hence in future concerned authorities should need to organize the developmental projects like TOT RKVY to increase the participation of farmers more prominently and help to increase the horizontal impact on socio-psychological and technological parameters.

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