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Perception of effectiveness of SAWAJ *Trichoderma* in controlling the diseases among its end users

KP Baraiya, AK Baraiya, VC Gadhiya, SH Lakhani and JN Thaker

Abstract

Trichoderma have long been recognized as bio-control agents for the control of plant diseases and for their ability to enhance root growth and development, crop productivity, resistance to abiotic stresses, and uptake and use of nutrients. It is a very effective biological mean for plant disease management especially the soil born. For the management of soil borne diseases especially stem and pod rot of groundnut, *Trichoderma harzianum* is very effective. Junagadh Agricultural University (JAU) has started the commercial production and selling of bio-agent *Trichoderma harzianum* culture under the brand name of SAWAJ *Trichoderma*. The survey of 100 farmers were carried out by interview schedule and analyzed. The study revealed that respondents were middle age, educated up to secondary level, occupation of agriculture and animal husbandry with medium size land holding. Television, agriculture fair, Krishi Mela and farmers seminar are the main extension participation of the respondent. They are adaptability after knowing other experience farmers only and they believed use farming is very risky business. The perception of respondent were first rank to *Trichoderma* can mix with FYM (4.35 mean score), followed by mix with sand (4.34), use in any type of soil (4.33), pre application is more beneficial (4.32) means scores, for second, third and fourth rank, respectively. The minimum mean score of 1.74 found for benefit of *Trichoderma* is not found, and it was followed by 1.97 mean score in Necessary to seed treatment with *Trichoderma* on groundnut seed kernels for protection of infestation of pest & diseases. They have main constraints that *Trichoderma* cannot mix with chemical fertilizer, and another is SAWAJ *Trichoderma* is not available at block level. Respondents have been given suggestions to overcome the constraints are it should be available at block level with more than six months validity. Thus, overall respondents says that SAWAJ *Trichoderma* is very use full for soil borne disease management and cost reduction.

Keywords: Constraint, *Trichoderma*, adoption, technology, organic cultivation

Introduction

Since beginning of agriculture plant diseases have been anxious with mankind and found to play a crucial role in the destruction of natural resources, contributing 20-30% losses in crop production worldwide (Anon., 1993) [2]. Although chemical control of plant diseases can be effective, it is comparatively a short term measure with the additional concern for the accumulation of harmful pesticide residues that may pose serious ecological problems along with environmental and public health hazards. Use of such chemical pesticides entails a convincing cost to the nation and developing country like India. Biological control of plant diseases is risk-free when it results in improvement of resident antagonists. Moreover, an integrated pest management (IPM) approach promotes a degree of disease management similar to that achieved with full fungicidal treatment. Persoon (1794) [15] first proposed *Trichoderma* as a genus over 200 years ago in Germany. Four species as proposed by him were *Trichoderma viride*, *T. nigroscens*, *T. aureum* and *T. roseum*. In India, *Trichoderma* was isolated for the first time by Thakur and Norris in 1928 from Madras. The potential significance of the genus *Trichoderma* as bio-control agent was first reported by Weindling in 1932 (Pandya *et al.*, 2011) [21, 12].

Trichoderma is a very effective biological mean for plant disease management especially the soil born. It is a free-living fungus which is common in soil and root ecosystems. It is highly interactive in root, soil and foliar environments. It reduces growth, survival or infections caused by pathogens by different mechanisms like competition, antibiosis, mycoparasitism, hyphae interactions, and enzyme secretion (Harman *et al*, 2004) [5].

Trichoderma is found in all types of temperate and tropical soils, and commonly in different variety of soil types such as forest soil, agricultural soil, prairie, salt marsh and desert soils.

It is also found in colonizing roots, litter, decaying wood, decaying bark and various plant materials. For about 70 years, *Trichoderma* spp. are known to parasitize on other fungi to produce different antimicrobial products that affect other microbes, and to act as bio-control microbes (Weindling, 1934) [21]. Antagonists of plant pathogenic fungi have been used to manage plant diseases and 90% of such applications have been carried out with different strains of *Trichoderma* (Monte, 2001) [11]. The success of *Trichoderma* as bio-control agents is due to their ability to survive under different unfavorable conditions, high reproductive capacity, efficiency in the utilization of nutrients, capacity to modify the rhizosphere, strong aggressiveness against plant pathogenic fungi and efficiency in promoting plant growth and defense mechanisms. These properties of *Trichoderma* have made a ubiquitous genus present in any habitat and at high population density (Misra and Prasad, 2003) [10].

Based on its potentiality to control plant pathogens, a large number of commercial products have been developed in India with different *Trichoderma* species.

T. harzianum and *T. viride* are the two most commonly used species and have been found effective when applied on about 87 different crops in India (Sharma *et al.*, 2014) [18]. Available literature reveals that researchers have attempted for use of varied substrates and techniques for multiplication and introduction of *Trichoderma* into the soil (Sabalpara, 2014) [17]. Farmers are used in huge quantity for soil borne diseases management. They are aware by different way about use and potentiality of *Trichoderma* for the management of soil borne diseases. But it is very important as per extension and research view point what's farmer's perception about effectiveness of SAWAJ *Trichoderma*. Keeping this in view the present study was conducted entitled "perception of effectiveness of SAWAJ *Trichoderma* in controlling the diseases among its end users" was undertaken with following objectives:

Objective

1. To study the profile of respondents
2. To find out the impact of SAWAJ *Trichoderma* in management of diseases

3. To determine the level of adoption of SAWAJ *Trichoderma*
4. To know the problems and suggestions from respondents for increasing adoption

Methodology

The study was undertaken by Krushi Vigyan Kendra, Junagadh Agricultural University, Jamnagar in Jamnagar and Devbhumi Dwarka districts of Gujarat state. For distribution of overall area the survey were carried out from all talukas Jamnagar, Lalpur, Kalavad, Dhrol, Jodia, Jamjodhpur of Jamnagar District and Bhanvad, Dwarka, Jamkhambhalia and Jam Kalyanpur from Devbhumi Dwarka. Purposively five villages were selected from each taluka, two farmers from each villages. Total 100 respondents were selected by proportionate random sample method from different villages of Jamnagar and Devbhumi Dwarka Districts. *Trichoderma* have purchased, supply as front line demonstration, on farm trial etc from Krishi Vigyan Kendra, Junagadh Agricultural University as well as directly from Junagadh Agricultural University, Junagadh by respondents. The interview schedule was developed according to the objectives.

The data were collected by personal interview of the SAWAJ *Trichoderma* users with developed questionnaires. The collected data was tabulated analyzed in the light of objectives to reach at meaningful results and conclusion. To determine perception of effectiveness of "SAWAJ" *Trichoderma*, twenty-two item statements were made and assessment based on a five quantum strongly agree, coded 5, agree coded 4, undecided coded 3, disagree coded 2 and strongly disagree coded 1, mean scores was calculated.

Results and Discussion

The present study was conducted on 120 farmers of Jamnagar districts to evaluate for knowledge about eco-friendly organic farming practices and use of *Trichoderma* in their cultivation practices. The data to statistical analysis and results are presented as per the objectives of study as below.

1. Distribution of respondents according to their personal characteristics

Table 1: Socio-demographic characters of Farmers

(n=100)			
S. no.	Land holding	Frequency	Rank
1	Age group		
1	Young (up to 35 years)	24	2
2	Middle (36 to 50 years)	59	1
3	Old (above 50 years)	17	3
2	Level of education		
1	Illiterate	4	5
2	Up to primary school level (std. 1 to 8)	21	2
3	Up to middle school level (std. 9 to 10)	47	1
4	Up to high school level (std. 11 to 12)	17	3
5	College and above	11	4
3	Social participation		
1	Participated	46	2
2	Not participated	54	1
4	Extension participation		
1	Not participated	0	
2	Participated in one activity	0	
3	Participated in more than one activity	100	1
5	Annual income		
1	Up to Rs. 50000/-	6	5
2	Rs. 50001 to 100000/-	23	2

3	Rs. 100001 to 150000/-	15	4
4	Rs. 150001 to 200000/-	21	3
5	Above Rs. 200000/-	35	1
6	Occupation		
1	Farming	61	1
2	Farming + Animal Husbandry	36	2
3	Farming + Service	1	4
4	Farming + Business	2	3
5	Others	0	5
7	Land holding		
1	Marginal (up to 1.0 ha)	8	4
2	Small (1.01 to 2.0 ha)	25	3
3	Medium (2.01 to 4.0 ha)	39	1
4	Large (more than 4.0 ha)	28	2

The results disclosed in Table 1 indicate that more than half (59%) of farmers were from middle age group, followed by 24 percent from young age and remaining 17 percent of them were in old age group. The data indicated that 47 percent of the farmers were educated up to secondary level, whereas 21, 17 and 11 percent of the farmers were educate up to primary, higher secondary and graduate level. However, very few were illiterate (4%).

According to social participation, 54 percent having not interested in social participation however only 46 percent having participated. But, all the respondents were participated in the extension activities.

With the view of income of farmers, very few farmers (6%) having their annual income below Rs. 50000, on other hand highest (35%) farmers having annual income above Rs.200000. 23 percent farmers of them were in annual income between Rs.50000 to 100000, followed by 15 percent (Rs. 100001 to 150000), 21 percent (Rs. 150001 to 200000).

According to occupation along with 61 percent farmers having only agriculture, 36 percent farmers have both agriculture along with animal husbandry business.

According to land holding of the farmers 39 percent farmers were Medium (2.01 to 4.0 ha), 29 percent Large (more than 4.0 ha) and 25 percent Small (1.01 to 2.0 ha) size of land holding. However very few (8%) having Marginal (up to 1.0 ha) land holding. The findings of the study are in accordance with the findings of Matto *et al.*, 2018; R. C Prajapati *et al.*, 2018; Latha, 2002; Meena, 2010; Agunga and Igodan, 2007; Patel, 2007 [8, 16, 7, 9, 1, 14].

2. Participation in extension programs by government

Farmers aware by different programs on different mass media and extension works carried out by Agriculture department and Agricultural University. Some participants were take a part in the extension programs and some are not participated.

Table 2: Extension participation by farmers

(n=100)			
S. no.	Extension programs by government	Frequency	Rank
1	Arrangement of demonstration on own farm	59	8
2	Discussion with extension functionaries	93	4
3	Participation in field day celebration	76	7
4	Attended farmers meeting	94	3
5	Visit of demonstration on neighbor farmers and discussion with him	85	6
6	Participation in Krushi Mela	94	3
7	Visit of Agriculture fair	96	2
8	Reading of extension literature	87	5
9	Attend radio program broadcasted among agriculture	46	9
10	Attend Television program broadcasted among agriculture	98	1

Results presented in Table 2, revealed that television program broadcasted among agriculture is the most important participant in extension programs which rank first (98%). The next best are visit of agriculture fair (96%) with second rank. Krushi mela & Farmers meeting, discussion with extension functionaries, extension literature, visit of demonstration of neighbor farmers, participation in field day, were

chronologically stand on third, fourth, fifth, sixth and seventh rank with 94, 93, 87, 85 and 76 percent farmers, respectively. However, radio program and demonstration on own farm are last rank. The present finding is very near to finding of Ansari and Paswan, 2018 [3].

3. Innovativeness in adoption of agricultural technology

Table 3: Innovativeness in adoption of agricultural technology

(n=100)			
S. no.	Adoption of agricultural technology at	Frequency	Rank
1	Immediate adaptive as came in my knowledge	39	2
2	Adapt after visit of other successful farmers experience	46	1
3	Adapt as per my amenity	15	3

According to Table 3. It can be concluded that majority of are adopt the agricultural technology on *Trichoderma* application only after visit of other successful farmers experience with 46 percent. Which proved that “seeing is believing”. Whereas immediate adaptive are very less (39%). The adoption as per their amenity rank third with 15 percent. The findings of the study are in closely with the findings of Matto *et al.*, 2018 [8].

4. Risk orientation factors

There are many risk in the farming business. Farmers having many constraints and having very huge risk orientation factors in adoption of the *Trichoderma* usages, because of they have feared about the production losses and failure of the crops.

Table 4: Risk orientation factors in *Trichoderma* usages

(n=100)								
S. no	Particulars	Strongly agree	Agree	Un Decided	Dis-Agree	Strongly Dis agree	Mean Score	Rank
1	I have faith in the challenge of risk about farming	45	53	1	0	1	4.41	1
2	I don't like the methods of any risks related to farming and related fields	10	26	14	39	11	2.85	10
3	I'm ready to take high risk related to farming and related fields	40	54	2	4	0	4.3	3
4	I choose to adopt costly methods in farming and related fields	22	32	5	35	6	3.29	8
5	I like to choose that technology Successfully accepted by others is successful	23	58	2	14	3	3.84	7
6	I believe that who taking risk are always come to top.	53	37	7	3	0	4.4	2
7	I have fear that some technological adoption can hurt the plan	10	36	17	31	6	3.13	9
8	With proper planning can reduce the risk of the consequences of risk in farming and related fields	30	52	12	6	0	4.06	5
9	I can reduce the effects of any type risk by proper implementing in farming and related fields.	26	63	6	3	2	4.08	4
10	Accepting a real risk in farming is not always dangerous	28	52	7	12	1	3.94	6

It can be concluded from Table 4, that I have faith in the challenge of risk about farming ranked 1st (4.41%); I believe that who taking risk are always come to top ranked 2nd (4.4%); I'm ready to take high risk related to farming and related fields ranked 3rd (4.3%); I can reduce the effects of any type risk by proper implementing in farming and related fields ranked 4th (4.08%); With proper planning can reduce the risk of the consequences of risk in farming and related fields ranked 5th (4.06%) ;Accepting a real risk in farming is not always dangerous ranked 6th (3.94%); I like to choose that technology Successfully accepted by others is successful ranked 7th (3.84%); I choose to adopt costly methods in farming and related fields ranked 8th (3.29%);

I have fear that some technological adoption can hurt the plan ranked 9th (3.13%) and I don't like the methods of any risks related to farming and related fields ranked 10th (2.85%).

5. Perception of use of SAWAJ *Trichoderma* in controlling the plant diseases

Trichoderma have long been recognized as bio-control agents for the control of plant diseases and for their ability to enhance root growth and development, crop productivity, resistance to abiotic stresses, and uptake and use of nutrients. Many farmers have their own perception about working and usage of *Trichoderma*

Table 5: Perception of use of SAWAJ *Trichoderma* in controlling the plant diseases

(n=100)								
S. no	Particulars	Strongly agree	Agree	Un Decided	Dis-Agree	Strongly Dis agree	Mean Score	Rank
1	Benefit of <i>Trichoderma</i> is not found	3	6	1	42	48	1.74	22
2	Good germination found with seed treated with <i>Trichoderma</i>	18	66	8	7	1	3.93	17
3	Necessary to seed treatment with <i>Trichoderma</i> on groundnut seed kernels for protection of infestation of pest & diseases	2	11	10	36	41	1.97	21
4	If regular fungus attack in soil, pre application of <i>Trichoderma</i>	39	58	0	2	1	4.32	4
5	Regular application of <i>Trichoderma</i> for 2 to 3 years reduced the fungal diseases	31	64	1	4	0	4.22	13
6	<i>Trichoderma</i> can apply in furrow (Chas)	37	59	1	3	0	4.3	8
7	<i>Trichoderma</i> can apply in standing crop with other amendments	37	57	3	2	1	4.27	10
8	<i>Trichoderma</i> can mix with sand for application	37	61	1	1	0	4.34	2
9	<i>Trichoderma</i> can mix with FYM for application	36	63	1	0	0	4.35	1
10	<i>Trichoderma</i> is effective against cumin wilt	37	59	1	3	0	4.3	9
11	<i>Trichoderma</i> is very cheap as compare to convectional fungicide	40	56	1	2	1	4.32	5
12	<i>Trichoderma</i> can be used with other chemical fertilizers & pesticides	6	21	11	47	15	2.56	19
13	SAWAJ <i>Trichoderma</i> is timely available at required quantity.	13	78	2	6	1	3.96	16
14	SAWAJ <i>Trichoderma</i> is eco-friendly	41	53	3	2	1	4.31	7
15	Sufficient moisture should be present at the time of <i>Trichoderma</i> application	34	62	0	3	1	4.25	12
16	Excess use of <i>Trichoderma</i> is dangerous to crop	3	10	5	58	24	2.1	20
17	SAWAJ <i>Trichoderma</i> stored under cool and sad condition.	35	59	1	3	2	4.22	14
18	SAWAJ <i>Trichoderma</i> induced vegetative growth of plant	20	65	14	1	0	4.04	15
19	SAWAJ <i>Trichoderma</i> can use any type of soil	36	62	1	1	0	4.33	3
20	Use of SAWAJ <i>Trichoderma</i> increase in production	30	68	1	1	0	4.27	11
21	SAWAJ <i>Trichoderma</i> is safer for mammals.	37	59	3	1	0	4.32	6

22	Sedimentation of SAWAJ <i>Trichoderma</i> induce decomposition of organic matter.	9	37	37	16	1	3.37	18
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It can be concluded from Table 5 that general perception for effectiveness and usage of SAWAJ *Trichoderma* in management of the soil borne diseases among respondents. Twenty-two different statements presented and means score work out according to mean score ranked them. General perception of farmers were *Trichoderma* can mix with FYM for application ranked 1st with (4.35) mean score; *Trichoderma* can mix with sand for application ranked 2nd with (4.34) mean score; SAWAJ *Trichoderma* can use any type of soil ranked 3rd with (4.33) mean score; If regular fungus attack in soil, pre application of *Trichoderma* ranked 4th with (4.32) mean score; *Trichoderma* is very cheap as compare to convectional fungicide ranked 5th with (4.32) mean score; SAWAJ *Trichoderma* is safer for mammals ranked 6th with (4.32) mean score; SAWAJ *Trichoderma* is eco-friendly ranked 7th with (4.31) mean score; *Trichoderma* can apply in furrow (Chas) ranked 8th with (4.3) mean score; *Trichoderma* is effective against cumin wilt ranked 9th with (4.3) mean score; *Trichoderma* can apply in standing crop with other amendments ranked 10th with (4.27) mean score; Use of SAWAJ *Trichoderma* increase in production ranked 11th with (4.27) mean score; Sufficient moisture should be present at the time of *Trichoderma* application ranked 12th with (4.25) mean score; Regular application of *Trichoderma* for 2 to 3 years reduced the fungal diseases ranked 13th With (4.22) mean score; SAWAJ *Trichoderma* stored under cool

and sad condition ranked 14th with (4.22) mean score; SAWAJ *Trichoderma* induced vegetative growth of plant ranked 15th with (4.04) mean score; SAWAJ *Trichoderma* is timely available at required quantity ranked 16th with (3.96) mean score; Good germination found with seed treated with *Trichoderma* ranked 17th with (3.93) mean score; Sedimentation of SAWAJ *Trichoderma* induce decomposition of organic matter ranked 18th with (3.37) mean score; *Trichoderma* can be use with other chemical fertilizers & pesticides ranked 19th with (2.56) mean score; Excess use of *Trichoderma* is dangerous to crop ranked 20th with (2.1) mean score; Necessary to seed treatment with *Trichoderma* on groundnut seed kernels for protection of infestation of pest & diseases ranked 21st with (1.97) mean score; Benefit of *Trichoderma* is not found ranked 22nd with (1.74) mean score. The present findings are very consonance with the works by Patel *et al.*, 2019; Herath and Wijekoon, 2013; Camellia *et al.*, 2017; and Sharma *et al.*, 2012^[13, 6, 4, 18].

6. Ranks over the major problems faced by the respondents for use of SAWAJ *Trichoderma*

The respondents were asked to show the problem or constraints for use of SAWAJ *Trichoderma*. On the basis of frequency and percentage were ranked and assign as for interpretation.

Table 6: Major problems faced by the respondents for use of SAWAJ *Trichoderma*

(n=100)				
S. no	Problem	Frequency	Percentage	Rank
1	SAWAJ <i>Trichoderma</i> not available at required time period	12	12	9
2	Application of SAWAJ <i>Trichoderma</i> is difficult at the time of sowing	6	6	10
3	At the time of SAWAJ <i>Trichoderma</i> application, sufficient moisture is not present	36	36	6
4	Castor cake used as carrier of <i>Trichoderma</i> is very costly	41	41	4
5	SAWAJ <i>Trichoderma</i> not available at required time period	15	15	7
6	<i>Trichoderma</i> can't mix with chemical fertilizers, though increase cost of application	75	75	1
7	SAWAJ <i>Trichoderma</i> is not available at block level	58	58	2
8	Packing of SAWAJ <i>Trichoderma</i> is not attractive as well as durable	3	3	11
9	SAWAJ <i>Trichoderma</i> can't apply through drip irrigation system	15	15	8
10	No major benefit of SAWAJ <i>Trichoderma</i> after initiation of <i>Sclerotium</i> rot in groundnut.	40	40	5
11	No special benefit of SAWAJ <i>Trichoderma</i> after initiation of wilt in cumin.	50	50	3

The respondents mentioned some problem in use of SAWAJ *Trichoderma*. The problems suggested by majority of farmers : *Trichoderma* can't mix with chemical fertilizers, though increase cost of application 75 percent (rank-1st); SAWAJ *Trichoderma* is not available at block level 58 percent (rank-2nd); No special benefit of SAWAJ *Trichoderma* after initiation of wilt in cumin 50 percent (rank-3rd); Castor cake used as carrier of *Trichoderma* is very costly 41 percent (rank-4th); No major benefit of SAWAJ *Trichoderma* after initiation of *Sclerotium* rot in groundnut 40 percent (rank-5th); At the time of SAWAJ *Trichoderma* application, sufficient moisture is not present 36 percent (rank-6th); SAWAJ *Trichoderma* not available at required time period 15 percent

(rank-7th); SAWAJ *Trichoderma* can't apply through drip irrigation system 15 percent (rank-8th); SAWAJ *Trichoderma* not available at required time period 12 percent (rank-9th); Application of SAWAJ *Trichoderma* is difficult at the time of sowing 6 percent (rank-10th); Packing of SAWAJ *Trichoderma* is not attractive as well as durable 3 percent (rank-11th).

7. Suggestions to overcome the constraints

The respondents were asked to give suggestion to overcome the constraints and minimize the problem for use of SAWAJ *Trichoderma*.

Table 7: Suggestions to overcome the constraints

(n=100)				
	Suggestions	Frequency	Percentage	Rank
1	<i>Trichoderma</i> should be available at block level	76	76	1
2	Packing should be in small quantity	5	5	4
3	Viability of <i>Trichoderma</i> should be more than six month	58	58	2
4	Information should be given well in advance to farmers before its use	35	35	3

Suggestions from organic growers to overcome the constraints faced by them in adoption of SAWAJ *Trichoderma* different suggestion were given by different farmers and it were ranked as per :- *Trichoderma* should be available at block level ranked first with 76 percent respondent. The second rank with 58 farmers suggested viability of *Trichoderma* should be more than six month. However, Information should be given well in advance to farmers before its use ranked third with (35%). And least farmers having suggested for packing should be in small quantity (4th rank with 5% respondent).

Conclusion

Trichoderma have long been recognized as bio-control agents for the soil born plant disease management. Middle age farmers educated up to secondary level participated in television program and farmers fail for gaining knowledge. They adopt technology of *Trichoderma* after visit of successful farmers. Farmers have faith in risk for farming and believe only risk can gave satisfactory results. They have already knowledge about use of *Trichoderma* at pre application by mixing with FYM or sand and apply by broadcasting method. They have main constraints that *Trichoderma* cannot mix with chemical fertilizer. Thus, overall respondents says that SAWAJ *Trichoderma* is very use full for soil borne disease management and cost reduction.

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