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KNOWLEDGE ASSESSMENT OF KINNOW CULTIVATORS ON DRIP IRRIGATION SYSTEM

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ABSTRACT

Agriculture is the backbone of Indian economy. Efficient water use, particularly through drip irrigation systems, is critical for increasing agricultural productivity. Although, India ranks eighth in the world for drip irrigation coverage, the method is underutilized, particularly in fruit production, such as Kinnow farming. The purpose of this study was to analyze the understanding of drip irrigation systems (DIS) and cultivation practices among Kinnow producers in Rajasthan, particularly in the high-production district of Sri Ganganagar. An ex-post facto research design was used, with 80 Kinnow growers selected randomly from two talukas. Data were collected through structured interviews to assess knowledge of six components of drip irrigation and eleven categories of Kinnow agriculture methods. The findings found that 31.25% of producers had a high degree of understanding on approved Kinnow procedures, while 41.25% had medium knowledge. Farmers had good knowledge of soil preparation (51.25%), seed treatment (55%), and fertilizer management (60%). Regarding DIS, 66.25% had medium understanding, particularly in areas such as water conservation (75%), and system efficiency (75%). Age, education, and landholding size all had a significant correlation with knowledge levels, with education having the highest influence ($t=3.651$, $p<0.01$).

Keywords: *agriculture, drip irrigation, kinnow*

INTRODUCTION

Agriculture is the foundation of the Indian economy. Agriculture provides a living for around two-thirds of the people (Mallappa et al., 2023). The Indian agriculture industry provides 21.1% of the Indian GDP (**source: The World Bank)**. Agriculture has been exceedingly effective in acquiring the bulk of the world's accessible natural resources, the most essential being land and water, both of which play a vital and critical part in raising overall agricultural productivity. One of the most significant prospects for expanding agricultural productivity is the effective use of irrigation water, which is a valuable commodity everywhere, particularly in India. However, water shortage is currently the most pressing global issue for a variety of reasons. Thus, efficient utilization of existing water is critical. In this regard, drip irrigation systems play an important role and are the best option when water is scarce. India ranks seventh internationally in drip irrigation coverage, with 6,66,257 hectares under the system by 2021-22 (Bhuriya et al., 2015. Orchard crops account for roughly 54% of drip irrigation worldwide, with citrus being a major benefactor. However, drip irrigation covers just 2.8 lakh hectares of India's potential 11 million hectares, indicating underutilization (Bhagat and Yadav, 2019). India's diversified agro-climatic zones give a competitive edge in fruit production (Singh, 2013), with total horticulture production of 1,07,242 MMT across 70.49 lakh hectares (Department of Agriculture & Farmers Welfare, 2021-22). Rajasthan has turned its attention to horticulture in order to diversify its agriculture and increase farmer earnings, realizing the constraints of groundwater availability. Citrus ranks third in fruit production in India, after mango and banana, with Kinnow emerging as the most popular citrus fruit. Kinnow, a high-yield hybrid of King (Citrus nobilis) and Willow leaf (Citrus deliciosa), is a multipurpose crop high in bioactive compounds, vitamins, and minerals (Purewal and Sandhu, 2020). The northern regions of Rajasthan, notably Sri Ganganagar and Hanumangarh, are ideal for Kinnow cultivation, with 12,079 hectares and 3,20,000 metric tonnes produced in Sri Ganganagar alone in 2019-20. Water pollution and salinity, mostly caused by over-exploitation of canal water, pose substantial risks to the region's citrus producing industry. Drip irrigation technique promotes the effective use of water, changing horticulture (Bhagat and Yadav, 2019). Many farmers are still ignorant of this approach, despite its advantages. Citrus growers are using drip irrigation more frequently now because to recent initiatives backed by government programs that provide a 75% subsidy (Kaushal

et al., 2011). Therefore, research into the variables impacting farmers' awareness of and use of drip irrigation is desperately needed, particularly as the agricultural landscape changes (Kaushal et al., 2011).

OBJECTIVES

(1) To determine the knowledge level of Drip irrigation system of Kinnow cultivators.

(2) To quantify the Association between Socio-personal characteristics and knowledge level of respondents regarding drip irrigation system.

METHODOLOGY

An ex-post facto research design was used to examine the knowledge of drip irrigation systems among Kinnow cultivators in Rajasthan and Sri Ganganagar District have been chosen purposefully as it is referred to as **"Hub of Kinnow Production".** The two talukas with the highest Kinnow coverage, Sri Ganganagar and Padampur, were selected out of the ten taluka, further Mirzewala and Hindumalkot (HMK) in Sri Ganganagar and 33 L.N.P. and 34 L.N.P. in Padampur were the two randomly chosen villages from each taluka which comprises of total 80 respondents i.e. 20 Kinnow growers were chosen at random from these villages. Primary information on farmers' knowledge of drip irrigation systems and Kinnow cultivation techniques was gathered using a well-organized interview schedule. To comprehend the elements impacting the growers' knowledge, the study considered a variety of independent and dependent variables. This was done after consulting experts and reviewing relevant literature. Six different regions were used to group the farmers' knowledge of drip irrigation systems, whereas eleven major categories were used to assess their knowledge of Kinnow agriculture practices. Based on the respondents' familiarity with suggested Kinnow cultivation techniques and drip irrigation systems, they were subsequently divided into three groups: high, medium, and low. The degree of correlation between the respondents' knowledge and independent variables like age, education, and landholding size was ascertained by analyzing the link between these variables and the farmers' knowledge levels using regression and logistic models. For the data analysis part MS-Excel and SPSS have been used.

RESULTS AND DISCUSSION

Table 1 presented the assessment of respondents' knowledge of Kinnow cultivation practice. All knowledge components were separated into eleven categories. The study found that Kinnow farmers had a good degree of knowledge about various farming practices. Nearly half (46.25%) had extensive experience in land preparation, while 51.25% were familiar with the best soil types. Over half were familiar with suggested varieties (57.25%) and hybrid breeds (55%). The majority of farmers (62.5%) understood the proper seedling raising time, and 55% were aware of seed treatment methods. More than half also had a strong understanding of sowing time (53.75%) and spacing (60%). harvesting times, and 62.5% excelled in grading, packaging, and storage practices. Farmers were well-versed in training and pruning (55%), intercropping (53.75%), and weed control (50%). In fertilizer management, 60% knew the right timing and 58.75% the correct amounts. Disease and insect pest management saw 61.25% and 55% knowledgeable, though fewer (50% and 60%, respectively) knew control measures. Lastly, 60% were familiar with fruit maturity signs.

Table 1: Distribution of respondents based on the level of knowledge regarding recommend cultivation practices of Kinnow. (n=80)

Sr. No.	Recommended cultivation practice of Kinnow	Level of Knowledge				
		High (3)	Med (2)	Low (1)	Mean	Rank
A	**Land preparation**					
	a) Preparation of land for Kinnow plantation	37 (46.25%)	33 (41.25%)	10 (12.5%)	2.35	XX
	b) Which soil is best for Kinnow cultivation? I)sandy II) clay III) sandy loam	41 (51.25%)	23 (28.75%)	16 (20%)	2.3	XXII
B	**Recommended varieties**					
	a) Do you take seedlings from agricultural stations?	46 (57.5%)	25 (31.25%)	09 (11.25%)	2.4625	IX
	b) knowledge about Hybrid varieties	44 (55%)	23 (28.75%)	13 (16.25%)	2.3875	XVI
C	**Seedling raising time and seed treatment**					
	a) knowledge about right time of raising seedling of Kinnow	50 (62.5%)	24 (30%)	06 (7.5%)	2.55	I

Sr. No.	Recommended cultivation practice of Kinnow	Level of Knowledge				
		High (3)	Med (2)	Low (1)	Mean	Rank
C	b) knowledge about treatment of seedling	44 (55%)	21 (26.25%)	15 (18.75%)	2.35	XX
D	**Sowing time & Spacing**					
	a) knowledge about Right time of sowing of Kinnow	43 (53.75%)	27 (33.75%)	10 (12.5%)	2.425	XII
	b) knowledge about Suitable spacing between plants	48 (60%)	24 (30%)	08 (10%)	2.4875	VI
E	**Training & Pruning Operation**					
	a) knowledge about effect of training & pruning on plants	44 (55%)	24 (30%)	12 (15%)	2.4	XIV
	b) knowledge about right time of training & Pruning in Kinnow	42 (52.5%)	29 (36.25%)	9 (11.25%)	2.4125	XIII
F	**Intercultural operation**					
	a) knowledge about grow crops between plants	43 (53.75%)	25 (31.25%)	12 (15%)	2.4	XIV
	b) knowledge about control of weeds	40 (50%)	31 (38.75%)	09 (11.25%)	2.3875	XVI
G	**Fertilizer management**					
	a) knowledge about right amount of fertilizer to Kinnow plant	48 (60%)	23 (28.75%)	09 (11.25%)	2.475	VII
	b) knowledge about right time of fertiliser application	47 (58.75%)	21 (26.25%)	12 (15%)	**2**.45	XI
H	**Disease management**					
	a) knowledge about major diseases of Kinnow	49 (61.25%)	26 (32.5%)	05 (6.25%)	2.55	I
	b) knowledge about control measure of these diseases	40 (50%)	32 (40%)	08 (10%)	2.375	XIX
I	**Insect management**					
	a) knowledge about major insect-pest of Kinnow	44 (55%)	27 (33.75%)	09 (11.25%)	2.4625	IX
	b) knowledge about control measures of Insect-pests	48 (60%)	25 (31.25%)	07 (8.75%)	2.5125	IV
J	**Maturity & fruit harvesting stage**					
	a) knowledge about signs and symptoms of maturity of Kinnow fruit	48 (60%)	17 (21.25%)	15 (18.75%)	2.3875	XVI
	b) knowledge about right time of harvesting of kinnow fruit	45 (56.25%)	29 (36.25%)	06 (7.5%)	2.5	V
K	**Grading Packaging & Storage**					
	a) knowledge about grading and packaging of Kinnow fruits	50 (62.5%)	24 (30%)	06 (7.5%)	2.55	I
	b) knowledge about effective & efficient method of storage of Kinnow	48 (60%)	23 (28.75%)	09 (11.25%)	2.475	VII

The fig.1 indicated that 31.25% kinnow growers had high level of knowledge of recommended kinnow practices, while 41.25% and 27.5% had medium and low level of knowledge, respectively. Brar (2008), Tiwari *et. al.,* (2024) & Chaudhary *et. al.,* (2024) found that the majority of farmers fell into the category of medium knowledge.

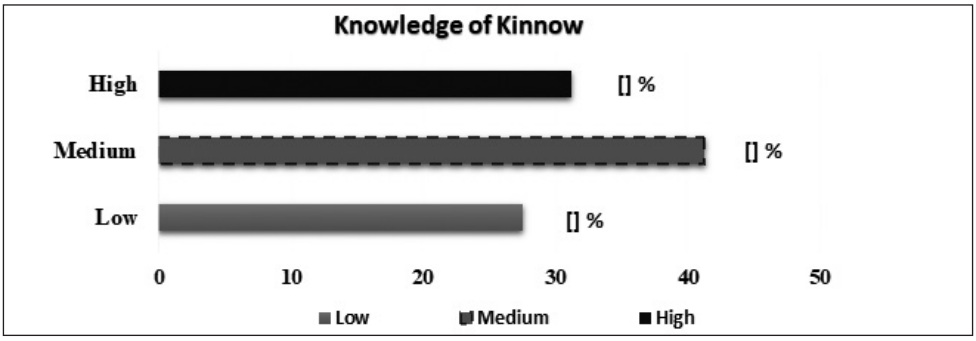

Fig. 1: Graphical representation of their overall knowledge level about kinnow cultivation

Table 2 : Distribution of respondents according to their item wise knowledge about drip irrigation system in kinnow cultivation (n=80)

Sr. No.	Aspects	Frequency (%)	Overall Rank
A	**General aspects of DIS**		
	In India, the drip irrigation technology covers the most area.	55 (68.75%)	XIV
	Irrigation technology in which disease occurrence is extremely not feasible.	54 (67.5%)	XV
	Per drop more crop' is the tag line for which of the following irrigation systems under PMKSY,2015.	50 (62.5%)	XVII
	Method of irrigation in which the amount of water can be easily measured.	60 (75%)	IV
	Irrigation system with great water efficiency if properly maintained.	60 (75%)	IV
B	**Kinnow quality and yield**		
	The Long-Term Effect of a Drip Irrigation System on Kinnow Plant Quality.	56 (70%)	XI
	The impacts of drip irrigation on the root growth and development of the kinnow plant.	63 (78.75%)	II
C	**Technical aspects**		
	Relevant water source for drip irrigation system.	48 (60%)	XIX
	Water conservation in kinnow orchards utilising a drip irrigation system.	49 (61.25%)	XVIII
	Depth of mains and sub-mains beneath the soil surface to prevent inter-culture damage and degradation due to UV rays.	59 (73.75%)	VII
	Appropriate time to use the DIS.	56 (70%)	XI
	Optimal time to establish a drip irrigation system in kinnow orchards.	63 (78.75%)	II
D	**Preventative strategies for drip irrigation systems**		
	Drip irrigation system quality component mark.	58 (72.5%)	IX
	Acid is used to algae and germs out from growing in drip pipes.	58 (72.5%)	IX
	Filter used for filtering algal/living harmful substances from water.	56 (70%)	XI
E	**Managing natural resources**		
	The effect of a drip irrigation system on the kinnow crop's fertiliser requirements.	70 (87.5%)	I
	The impact of drip irrigation on soil nutrients.	52 (65%)	XVI
F	**financial aspects**		
	Average cost of Drip Irrigation System installation per hectare (If a water tank is available).	60 (75%)	IV
	The Rajasthan government provides a subsidy for drip irrigation systems through the Soil Conservation Department.	59 (73.75%)	VII

A critical look at Table-2 represents that Knowledge was assessing responders' understanding of a variety of characteristics of drip irrigation systems in kinnow production which have been grouped into six distinct groups. It was found that 68.75% of respondents knew India had the largest area under drip irrigation, and 62.5% were aware that it reduces disease incidence. Sixty percent recognized the "Per drop more crop" tagline under PMKSY, while 75% could measure water use effectively and knew the system's high efficiency. Seventy-five percent understood the benefits of drip irrigation on Kinnow quality, and 65% knew its impact on root growth. Technically, 87.5% were aware of proper irrigation sources, 75% understood water savings, and 70% knew the correct depth for mains and sub-mains. Preventative strategies were also well-known, with 73.75% aware of quality components, 72.5% knowledgeable about acid use, and 78.75% familiar with filtration methods. Additionally, 70% knew how DIS affected fertilizer needs, and 72.5% were aware of installation costs, while 78.75% understood government subsidies. The study highlighted strong awareness in technical, operational, and financial aspects of drip irrigation.

The Fig 2 revealed that nearly **2/3rd** (66.25%) kinnow Gowers, which used DIS had medium level of knowledge followed by 18.75 % and 15% high and low level of knowledge in using DIS, respectively. These outcomes concurred with Jitarwal (2007), Natwadia et al., (2022), Abhishek *et. al.,* (2023), Natwadia et al., (2023), Fazely et al., (2024) conclusions most of the medium level of knowledge using DIS.

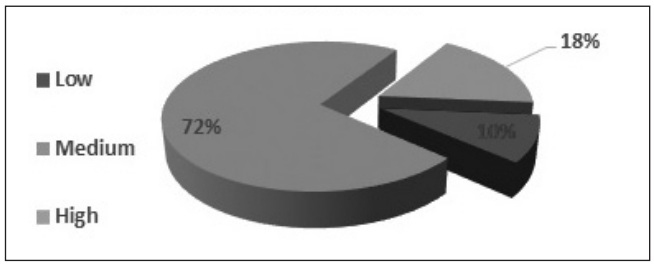

Fig. 2: Graphical representation of their knowledge level about DIS in kinnow cultivation.

The perusal of Table 3 reveals socio-personal characteristics such as age, farming experience, annual income, extension contacts, risk orientation, market orientation, while education, land, age of orchard, innovative proneness, economic motivation, were positively and significantly correlated with the knowledge level of kinnow growers at the 5 percent and 1 percent level of significance, respectively.

The study further reveals that 54.5% of the variance in Kinnow growers' knowledge about the Drip Irrigation System (DIS) was explained by the study's dependent variables, with the remaining 45.5% due to external factors which were not included in the study.

Table 3 : Relationship of Socio-personal characteristics of respondents with knowledge level regarding drip irrigation system in kinnow cultivation

(n=80)

Sr. No.	Characteristic	'r' Value	Sig. (2-tailed)
X_1	**Age**	0.246*	0.028
X_2	**Education**	0.409**	0.000
X_3	**Land**	0.436**	0.000
X_4	**Age of orchard**	0.313**	0.005
X_5	**Farming Experience**	0.245*	0.028
X_6	**Annual income**	0.234*	0.037
X_7	**Innovative Proneness**	0.364**	0.001
X_8	**Extension contacts**	0.248*	0.026
X_9	**Economic motivation**	0.318**	0.004
X_{10}	**Risk orientation**	0.240*	0.032
X_{11}	**Market orientation**	0.237*	0.035
X_{12}	**Caste**	-0.016	0.891
X_{13}	**Marital Status**	0.054	0.634
X_{14}	**Family Size**	0.033	0.768
X_{15}	**Source of Irrigation**	0.137	0.247

** Significant at 1 percent level & * Significant at 5 percent level

Table 4 revealed that Among the 16 factors education had a significant impact at the 0.01 level, with a 't' value of 3.651, increasing DIS knowledge by 0.370 per unit increase in education. Age, land, and orchard age were significant at the 0.05 level, with 't' values of 0.275, 0.258, and 0.682, respectively, all positively affecting DIS knowledge. Farming experience negatively influenced DIS knowledge, decreasing it by 0.598 per unit increase, while risk orientation increased it by 0.183 per unit, as farmers with higher risk tolerance were more knowledgeable about DIS. The modal summary concludes that the R-value was 0.738, with an R-squared of 0.545, indicating that 54.5% of the variance in farmers' knowledge about DIS. The ANOVA analysis confirmed the model's significance, with an F-value of 4.360 and a regression sum of squares of 160.936, showing the strong influence of these predictors at a 0.01 significance level.

Table 4 : Regression analysis between independent variable and knowledge of kinnow growers about use of DIS

Sr. No.	Constant	Unstandardized Coefficients		Standardized Coefficients		Sig.
		B	SE	Beta	t	
		3.054	**3.845**		**.794**	**.430**
X_1	**Age**	.059	.025	.275	2.408	**.019****
X_2	**Caste**	-.211	.288	-.077	-.733	.466
X_3	**Education**	.777	.213	.370	3.651	**.001*****
X_4	**Marital Status**	-.202	.674	-.035	-.299	.766
X_5	**Family size**	-.036	.401	-.013	-.089	.929
X_6	**Family type**	-.111	.522	-.029	-.213	.832
X_7	**Land**	.130	.052	.258	2.511	**.015****
X_8	**Source of Irrigation**	-.444	.923	-.056	-.481	.632
X_9	**Age of orchard**	.398	.177	.682	2.251	**.028****
X_{10}	**Farming Experience**	-.339	.174	-.598	-1.952	**.055***
X_{11}	**Annual income**	5.603E6	.000	.158	1.254	.214
X_{12}	**Innovative proneness**	.032	.029	.115	1.095	.278
X_{13}	**Extension contacts**	.059	.082	.075	.718	.476
X_{14}	**Economic Motivation**	-.002	.023	-.009	-.072	.943
X_{15}	**Risk orientation**	.136	.079	.183	1.736	**.088***
Dependent Variable: Knowledge of DIS, **SE: Standard Error**						

CONCLUSION

Agriculture is a vital part of the Indian economy. As we all know that Kinnow is a very crucial horticultural crop from the economic point of view. So, there is an immense need to enhance the knowledge and understanding level of the farmers regarding kinnow cultivation. To improve Kinnow growers' understanding of acceptable cultivation procedures, the horticulture department should give appropriate guidelines, conduct awareness programs, training, workshops, and knowledge exchange sessions. To improve farmers' understanding of drip irrigation technology to increase productivity and water use efficiency, the extension department should organize field visits by KVK specialists, run awareness programs, demonstrations, mobile apps, online courses, and share success stories, while maintaining regular contact with agricultural experts.

IMPLICATIONS

(1) The findings of the study can help in efficient application of Drip Irrigation System (DIS) for the Kinnow cultivators.

(2) The study can be further utilized for the formulation of various policies regarding DIS.

(3) This study can be done with larger sample size for the wider coverage and more generalize findings.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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