Economics of drip and micro sprinkler fertigation on turmeric and small onion under intercropping system

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ABSTRACT

In a farmer's field at Thondamuthur, Coimbatore, field studies were done in 2015–16 and 2016–17 to examine the effects of drip and micro sprinkler fertigation on the growth, yield, and economics of a turmeric + onion intercropping system. Thirteen treatments were reproduced three times in the experiment, which was designed using a randomised complete block method (RCBD). Drip and Micro sprinkler irrigation system with three irrigation levels, 80, 100, and 120%PE and 75 and 100 % levels of fertigation with water soluble fertilisers (WSF). The control consisted of soil fertiliser application at 100% RDF along with surface irrigation (5 cm depth). According to the findings, irrigating the turmeric and onion intercropping system at 120% PE with 100% RDF as WSF through drip was significantly advantageous for greater yield. The maximum gross return was achieved with drip irrigation at 120% PE and 100% RDF. The net return and B:C ratio were achieved highest under micro sprinkler irrigation at 120% PE and 100% RDF.

Keywords: Drip irrigation, Micro sprinkler fertigation, intercropping, growth, yield

INTRODUCTION

Turmeric is produced, consumed, and exported most frequently in India. The total global production of turmeric is 8.0 lakh tonnes, with India holding a portion of roughly 75–80% and using about 80% of its own output. About 6% of the entire land in the country devoted to spices and condiments is taken up by turmeric (Agriculture and Cooperation, 2011). India, which accounts for 20% of global area and 12.3% of global production, is the second-largest producer of onions after China. In India, the total area planted with onions makes up 7.41% of the total area planted with vegetable crops, and it produces 5.7% of the nation's yearly vegetable output. In India, little onions provide an average output of 12.8 t ha-1, which is used for both domestic and international trade (Pandey *et al* , 2004). With an annual cultivation across an area of 0.20 million ha and a production of 3.15 million tonnes, Maharashtra leads the states that produce onions and accounts for 18.8% and 15.53% of the nation's total onion production. However, production is very low due to a number of factors, including the agricultural community's socioeconomic status and inadequate knowledge of cultivation methods. The crop's available soil and climate conditions may not always allow for maximum yield to be achieved. Therefore, it is important to look into proper agronomic management approaches and other related methods in order to increase productivity and maximise profit in a sustainable system. In light of the aforementioned information, this experiment was conducted to investigate economics of drip and micro sprinkler fertigation under Turmeric + small onion intercropping system.

MATERIAL AND METHODS

In the years 2015–16 and 2016–17, the experiment was carried out. The study contains two degrees of fertigation (100% RDF and 75% RDF), three levels of irrigation (120% PE, 100% PE, and 80% PE), and two irrigation techniques (Drip and micro sprinkler). Three replications of the studies were set up using a randomised block design (RBD). The treatments were T_1-Drip Irrigation (DI) at 120% PE + fertigation with WSF at 100% RDF, T_2-DI at 120% PE + fertigation with WSF at 75% RDF, T_3-DI at 100% PE + fertigation with WSF at 100% RDF, T_4-DI at 100% PE + fertigation with WSF at 75% RDF, T_5-DI at 80% PE + fertigation with WSF at 100% RDF, T_6- DI at 80% PE + fertigation with WSF at 75% RDF and T_7-Micro Sprinkler Irrigation (MSI) at 120% PE + fertigation with WSF at 100% RDF, T_8-MSI at 120% PE + fertigation with WSF at 75% RDF, T_9-MSI at 100% PE + fertigation with WSF at 100% RDF, T_{10}-MSI at 100% PE + fertigation with WSF at 75% RDF, T_{11}- MSI at 80% PE + fertigation with WSF at 100% RDF, T_{12}-MSI at 80% PE + fertigation with WSF at 75% RDF, T_{13}- Surface irrigation (5 cm depth) + soil application of conventional fertilizers at 100% RDF. The recommended dose of fertilizer (RDF) is 150:60:108 kg N: P_2O_5: K_2O ha^{-1}.

RESULTS AND DISCUSSION

Turmeric and onion growth parameters

During the two experimental years, irrigation systems with various irrigation and fertigation levels had a substantial impact on all the growth indicators of turmeric and onion. According to data on turmeric growth characteristics reported in Table 1, higher plant height values (154.3 and 143.9 cm) were grown under drip irrigation at a PE ratio of 120% with fertigation at an RDF ratio of 100% (T1) during the years 2015–16 and 2016–17, respectively. But in 2015–16 and 2016–17, it was comparable to drip irrigation at 100% PE with 100% RDF fertigation (T3) and micro sprinkler irrigation at 120% PE with 100% RDF (T7). Similar to all other treatments under research, the turmeric crop grown under drip irrigation (T1) and micro sprinkler irrigation (T7) at 120% PE with fertigation at 100% RDF registered considerably more tillers plant-1. However, it was comparable to T3 and T9. The fertigation of 100% RDF with irrigation at 120% PE through drip (T1) had recorded significantly higher dry matter production as compared to all other treatments, with the exception of T7 (DMP). In small onions, significantly more leaves, plant height, and DMP were achieved in T1, which was comparable to T7, T3, and T9. Increased vegetative growth in the aforementioned treatment was caused by the presence of optimal soil moisture and the application of a sufficient amount of readily available water soluble fertilisers. Anitta et al. has already discussed a similar outcome (2011). In this field experiment, the T13 treatment, which received surface irrigation to a depth of 5 cm at a ratio of 1.0 IW/CPE and 100% RDF, had considerably lower plant height, leaf count, and DMP than the other treatments throughout the course of the two years. This was because crops went through a water stress period after every irrigation because there was less moisture and fertiliser available for plant absorption. According to Thiyagarajan et al. (2011) and Tiwari et al. (2014), this water stress hampered plant growth and resulted in lower DMP in surface-irrigated turmeric and tiny onions.

Turmeric and onion Yield

The expression of a crop's morphological, physiological, biophysical, biochemical, growth, and yield factors is called its yield. When compared to surface watering with 100% traditional fertiliser in the years 2015–16 and 2016–17, the use of drip and micro sprinkler fertigation systems considerably increased the yield of turmeric and onion. (Table 2).

In both years, drip irrigation at 120% PE with 100 RDF (T1) significantly increased fresh rhizome output above surface irrigation (T13) (20.87 t ha-1 and 19.70 t ha-1 in 2015-16 and 2016-17, respectively, by producing 28.56 t ha-1 and 27.30 t ha-1. Similar fresh rhizome yields of 28.14 t ha-1 and 27.25 t ha-1 with T1 were achieved with irrigation at 120% PE using a micro sprinkler system and 100% RDF (T7) in the years 2015–16 and 2016–17, respectively. The increased fresh rhizome production under fertigation with WSF was greater under treatments than surface irrigation in 2015–16 and 2016–17, respectively, by 36.85 and 38.58% under drip fertigation system and 34.83 and 38.32% higher under micro sprinkler fertigation at 120% PE with 100% RDF. According to the individual needs of the turmeric crop and type of soil, drip fertigation makes sure that vital nutrients are carefully delivered at the site of the most intense root activity, resulting in a larger fresh rhizome output. The outcomes are consistent with the conclusions reached by Hebbar et al (2004). In the current study, it was found that drip fertigation at 120% PE with 100% RDF increased cured rhizome production to the tune of 7.11 t ha-1 and 6.72 t ha-1, respectively, over surface irrigation with 100% RDF soil application in the years 2015–16 and 2016–17. (control). The outcomes of Pawar et al. (2007) and Veeraputhiran et al. concur with this result (2012). The current analysis also revealed that, between 2015–16 and 2016–17, drip fertigation at 120% PE with 100% RDF produced cured rhizome yields of 44.51 and 46.41 percent more than surface irrigation.

In comparison to all other treatments, treatment T1 (DI at 120% PE + Fertigation with WSF at 100% RDF) had considerably higher bulb weights of 63.82 g plant-1 and 61.60 g plant-1 in 2015-16 and 2016-17, respectively. Compared to WSF at 100% RDF, MSI at 120% PE + Fertigation, this was equivalent (T7). The soil water and nutrient concentration in the wetted area of the plant zone also remains relatively constant under drip and micro sprinkler fertigation because irrigation water and nutrients were supplied slowly and frequently once every two days as per the crop requirements at different growth stages. Micro irrigation was used to obtain the soil moisture level that was ideal for maximum yield: slightly below the field capacity (Shrivastava et al, 1994).

Following drip fertigation at 120% PE with 100% RDF, higher turmeric equivalent yield (TEY) was observed under micro sprinkler fertigation at 120% PE with 100% RDF. It is suggested that intercropping results in better biomass output and, as a result, more effective use of the available resources and land. Additionally, in the intercropping system of turmeric and onion, little onion plants emerged more quickly, which improved growth and development as well as rhizome yield. The conclusions of Islam et al. are supported by the results (2016).

Economics

One of the key criteria for determining effective and financially viable irrigation systems is economic analysis. The data shown in Table.3 showed that, among all treatments, drip irrigation at 120% PE with fertigation at 100% RDF as WSF (T1) followed by micro irrigation at 120% PE with fertigation at 100% RDF as WSF (T7) respectively, yielded the highest gross return in the years 2015–16 and 2016–17. However, the highest net return was realised with micro sprinkler irrigation at 120% PE with fertigation at 100% RDF as WSF (T7), which was followed by drip (T1). The micro sprinkler irrigation at 120% PE with fertigation at 100% RDF as WSF (T7) had the highest benefit cost ratio, followed by (T1) and micro sprinkler irrigation at 100% PE with fertigation at 100% RDF (T9). Thus, it can be said that the intercropping system of turmeric and onions responded effectively to micro irrigation systems. Due to the high investment costs, drip irrigation systems may not be feasible for small and marginal farmers with scattered land holdings.

Micro sprinkler systems would then be more affordable, resulting in a larger return on investment per rupee invested.

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Table 1. Effect of drip and micro sprinkler fertigation on growth parameters of turmeric and onion under intercropping system

Treatments	Turmeric						Onion					
	Plant height		No of tillers plant^{-1}		DMP (kg ha^{-1})		Plant height		No of leaves plant^{-1} ^{1}		DMP (kg ha^{-1})	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1	154.3	143.9	3.8	3.6	10768	10381	44.87	43.48	12.3	12.0	4790	4692
T_2	137.4	134.5	3.0	3.2	8732	8286	37.94	36.83	11.3	10.7	3993	3892
T_3	148.6	140.0	3.6	3.4	9891	9471	43.37	42.41	12.0	11.7	4756	4659
T_4	134.5	132.0	3.0	3.2	8394	7891	37.23	35.65	11.3	10.7	3915	3814
T_5	143.2	137.2	3.4	3.2	8916	8489	41.47	40.62	11.3	11.0	4367	4277
T_6	122.7	126.5	2.6	3.0	7316	6741	34.70	34.11	9.7	9.3	3525	3388
T_7	152.8	143.4	3.8	3.6	10651	10259	44.43	43.16	12.3	12.0	4779	4678
T_8	135.0	134.0	3.0	3.2	8619	8171	37.80	36.71	11.3	10.7	3960	3860
T_9	146.8	139.7	3.6	3.4	9816	9458	43.17	42.29	12.0	11.7	4745	4652
T_{10}	133.6	130.6	3.0	3.2	8311	7808	36.53	35.13	10.0	10.3	3904	3771
T_{11}	141.8	137.0	3.2	3.2	8884	8447	40.48	40.33	11.3	11.0	4362	4265
T_{12}	122.8	127.2	2.6	3.0	7304	6696	34.05	34.01	9.7	9.3	3516	3376
T_{13}	121.7	125.6	2.6	3.0	7335	6802	33.78	33.67	9.7	9.3	3509	3369
SEd	5.8	5.8	0.14	0.16	379	399	1.91	1.58	0.51	0.57	169	174
CD (P=0.05)	12.0	12.0	0.28	0.32	783	823	3.93	3.26	1.06	1.17	348	359

Table 2. Effect of drip and micro sprinkler fertigation on yield of turmeric and onion under intercropping system

Treatments	Turmeric				Onion		Turmeric Equivalent yield (TEY)	
	Fresh Rhizome (t ha^{-1})	Fresh Rhizome (t ha^{-1})	Cured Rhizome (t ha^{-1})	Cured Rhizome (t ha^{-1})	Bulb yield (t ha^{-1})	Bulb yield (t ha^{-1})		
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1	28.56	27.30	7.11	6.72	23.76	21.85	43.41	40.95
T_2	22.01	21.94	5.32	5.26	19.48	16.84	34.18	32.46
T_3	26.58	25.82	6.55	6.32	21.87	19.63	40.25	38.09
T_4	21.56	20.99	5.15	4.97	19.23	16.31	33.58	31.18
T_5	24.29	23.95	5.95	5.80	20.07	17.56	36.84	34.93
T_6	20.92	19.97	4.96	4.70	17.45	14.42	31.82	28.99
T_7	28.14	27.25	6.98	6.70	23.70	21.42	42.96	40.63
T_8	21.78	21.25	5.26	5.09	19.45	16.48	33.93	31.55
T_9	26.51	25.69	6.50	6.23	21.86	19.37	40.17	37.80
T_{10}	21.40	20.83	5.10	4.91	19.23	16.05	33.42	30.86
T_{11}	24.27	23.70	5.89	5.71	19.98	17.47	36.76	34.62
T_{12}	20.91	19.72	4.94	4.60	17.43	14.17	31.80	28.57
T_{13}	20.87	19.70	4.92	4.59	16.97	13.98	31.48	28.44
SEd	0.97	0.56	0.24	0.23	0.81	0.71	1.53	1.39
CD (P=0.05)	2.00	1.16	0.50	0.48	1.67	1.47	3.16	2.87

Table 3. Effect of drip and micro sprinkler fertigation on economics of turmeric and onion under intercropping situation

Treatments	Cost of cultivation (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio	B:C ratio
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
T_1	124494	124494	347280	327650	222786	203156	2.79	2.63
T_2	122519	122519	273480	259720	150961	137201	2.23	2.12
T_3	124494	124494	321990	304710	197496	180216	2.59	2.45
T_4	122519	122519	268630	249470	146111	126951	2.19	2.04
T_5	124494	124494	294670	279400	170176	154906	2.37	2.24
T_6	122519	122519	254610	231860	132091	109341	2.08	1.89
T_7	119315	119315	343620	325100	224305	205785	2.88	2.72
T_8	117341	117341	271490	252400	154149	135059	2.31	2.15
T_9	119315	119315	321380	302370	202065	183055	2.69	2.53
T_{10}	117341	117341	267350	246890	150009	129549	2.28	2.10
T_{11}	119315	119315	294060	276950	174745	157635	2.46	2.32
T_{12}	117341	117341	254430	228610	137089	111269	2.17	1.95
T_{13}	108622	108622	251810	227500	143188	118878	2.32	2.09