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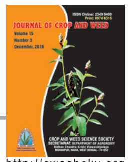

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Evaluation of yield, economics and various indices of water productivity of ginger under flexible moisture regime and nutrient management

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ABSTRACT

An experiment was conducted during 2013-14, 2014-15 and 2015-16 in lower Indo-Gangetic plains to evaluate the different levels of irrigation and nutrient on yield, economics and various water productivity of ginger. The programme was laid out in a split plot design with four irrigation levels (rainfed, 0.6, 0.9 and 1.2 of IW/CPE) and three nutrition levels (100% recommended fertilizer dose (RFD), 75% RFD + 25% RFD as vermicompost (VC) and 50% RFD + 50% RFD as VC) with three replications. Pooled analysis showed that mean maximum rhizome yield, highest monetary profits and benefit-cost ratio (BCR) was recorded with watering at IW/CPE 1.2 complemented with 75% RFD + 25% RFD as VC which was almost identical with irrigation at IW/CPE 0.9 coupled with 75% RFD + 25% RFD as VC which gave an equivalent yield, higher monetary profits, BCR, CWP, IWP, ECWP and EIWP. Under water scarce, deficit irrigation at IW/CPE 0.6 with 75% RFD + 25% RFD as VC was found as a technical alternative. Lower CWP and ECWP were obtained with rainfed condition and IWP and EIWP with irrigation at 1.2 IW/CPE, both treatments supplemented with 50% RFD as fertilizers + 50% RFD as VC. Thus, irrigation at IW/CPE 0.9 in combination with 75% RFD + 25% RFD as VC can be recommended in this zone for ginger cultivation.

***Keywords*:** Ginger, Irrigation schedule, Nutrients, Vermicompost, Rhizome, Water productivity

Ginger is one of the crucial herbaceous rhizomatous perennial spices which are generally cultivated extensively throughout the world for its flavour, pungency and aromatic values. It is also used as an important item in regular food in combination with various drinks or as one of the important items in culinary. Ginger has its own medicinal value as it is used for treating diarrhoea, nausea, asthma, cough and for resisting vomiting. The crop contains about 2-3% protein, 0.9% fat, 1.2% minerals, 2.4% fibre, 12.3% carbohydrate and rich in Cd, P, Fe and vitamins (Vadivel *et al*., 2006). It plays an important character by reducing cholesterol concentration in a cholesterol rich diet. The position in production and consumption rank of India is at top in the world.

Among the different inputs generally necessary for cultivation of ginger, water is the prime input whose efficient utilization is of paramount importance for sustenance of economic goal. Limited water supply during the critical growth stages of crop may significantly reduce the crop yield. Flood method of irrigation is the common practice in India which has several disadvantages because of water wastes in a huge quantity through runoff, deep percolation, seepage and evaporation from surface soil. Adoption of appropriate irrigation system with higher water use efficiency is mostly needed to improve the crop production and productivity. Microirrigation is the modern irrigation tool to supply water and nutrients simultaneously matching the plant water and nutrient demand which not only increases crop yield but also enhances water and nutrient use efficiencies. Irrigation scheduling with appropriate amount and proper management approach is further necessary for ensuring optimal moisture condition in the rhizosphere zone of the crop for proper growth and yield with greater water use efficiency and profitability (Himanshu *et al*., 2013, Islam *et al*., 2015). Irrigation scheduling based on environmental condition like IW/CPE ratio has been widely used world-wise because it is very simple to collect the data and has high rate of adaptability to the farmers (Singh and Mohan, 1994; Girish *et al*., 2008).

Ginger is a nutrient exhausting crop which requires huge quantity of fertilizer to replenish its nutritional requirements for obtaining better yield. Low application of fertilizer nutrients is adversely affecting the rhizome yield. On the other hand, indiscriminate use of mineral fertilizers deteriorates the soil health and causes groundwater pollution. Balanced dose and timely supply of plant nutrients is important for effective utilization of mineral nutrients by the plants for higher yield and better economic return (Shaikh *et al*., 2010; Bekeko, 2014). Organic manure is an alternative against chemical fertilizer which in addition to providing macronutrients

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substantially increases the availability of the secondary and micronutrients in the soil for boosting crop production (Taheri *et al.,* 2011). The combination of organic and inorganic plant nutrients are necessary for sustaining the soil productivity and maximize crop growth, yield and quality of crops (Yanthan *et al*., 2010; Singh *et al*., 2015). The organic source generally releases nutrients slowly while the fertilizer especially nitrogen fertilizer releases nutrient very rapidly for its utilization throughout the physiological stages of crop growth that may be reflected through better growth, development and crop yield. Actually the integrated use of organic and chemical fertilizer is acted by balancing the diet of soil-crop continuum through improving the soil health (physical, chemical and biological) through increasing input use efficiency (Shaikh *et al*., 2010).

In Indo-Gangetic plains region the farmers traditionally grow the crop under rainfed condition with injudicious or improper mineral fertilization. However, delay in pre-monsoon rain resulting in late planting and inadequate availability of irrigation water during dry season coupling with the irrational water management practices can lead to reduced yield, quality and profitability of ginger (Patra *et al*., 2022). Considering the fact, the current experiment was undertaken to find out the various water and nutrient management strategies under different irrigation and nutrient supply on rhizome yield and economic returns of ginger.

MATERIALS AND METHODS

Location details

The research was initiated with ginger plant at the CR Farm, Bidhan Chandra Krishi Viswavidyalaya, Gayeshpur, Nadia, West Bengal, India during three successive seasons in 2013-14, 2014-15 and 2015-16. The area falls under Indo-Gangetic plains of Eastern India and the location is sub-humid tropics in nature. The place is situated at 22°58'' N and 88°26' E with 9.75 m above MSL. Average annual rainfall of the location is 1450 mm and among them 75-85% is received during monsoon period (June - September). The experimental soil is sandy loam in texture having greater physical, hydro physical with good chemical properties.

Experimental treatments

The treatment comprised with four irrigation regimes (I● = rained, I, = IW/CPE 0.6, I*f* = IW/CPE 0.9 and I„ = IW/CPE 1.2) in main plots and three nutritional schedules (N● = 100% Recommended fertilizer dose (RFD), N, = 75% RFD + 25% RFD through vermicompost (VC) and N_3= 50% RFD + 50% RFD through VC) in sub-plots. The experiment was conducted in a split-plot design with twelve treatments combination which was replicated thrice.

Agronomic management

Healthy and disease-free ginger rhizome cv. Gorubathan was planted at 6-7 cm depth on the beds of having 3.5 m length, 2.5 m width and 0.15 m height at 0.60 m apart between beds with a spacing of 25 cm × 25 cm, during second week of April in each year of experiment and was harvested in the end of February next year. The adopted recommended fertilizer dose (RFD) for ginger was 75:50:50 kg of N, P_2O_5, K_2O ha^{-1} where urea was used as a source of nitrogen, SSP as a source of phosphorus and MOP was used for potassium. Half portion of N and entire P and K were used as basal at planting and the rest N was splitted into two equal parts which were applied at 45 and 90 days after planting. Nutrient content on dry weight basis of vermicompost was 2.5% N, 1.5% P_2O_5 and 1.2% K_2O which was analyzed in the laboratory by following proper protocol and the compost material was used as a source of organic nutrient which was incorporated into the soil at the time of final field preparation. The amount of P and K added through vermicompost was adjusted with SSP and MOP application to maintain the uniformity of P and K doses. The routine intercultural operation including weeding and crop protection practices were followed uniformly throughout the growing season in all the plots. The fresh rhizome after maturity was harvested plot-wise, cleaned, sun-dried for 6-7 days, weighted and the crop productivity was expressed in Kg ha^{-1}.

Irrigation scheduling

Scheduling of irrigation based on IW/CPE ratio of 0.6, 0.9 and 1.2 were given in furrow in each treatment. Every day evaporation data were collected from a USB Class A open Pan evaporimeter which was installed inside the experimental site. Number of irrigation for IW/CPE ratio of 0.6, 0.9 and 1.2 were 3, 4 and 5 at an interval of 40-45, 30-35 and 20-22 days and the depth of irrigation was 50 mm for each irrigation. For each treatment, amount of irrigation water was measured with the help of a Parshall flume and the quantity of water was applied when IW/CPE ratio reached at the desired value.

Economics

The economic analysis of different irrigation and nutrient management schedules was initiated through analysis of benefit, cost ratio. Total cost of production (CP) staring from expenditure in land preparation, inputs procurement, planting, operation on intercultural activities, manure, fertilizers and irrigation water, crop protection, harvesting and processing. The gross profit (GP) was estimated by multiplying the fresh rhizome yield with the present market price of the product. The net profit (NP) was calculated by subtracting the cost of production (CP) from the gross profit (GP). The benefit, cost ratio (BCR) was estimated by dividing the net profit with the cost of production as,

$$BCR = \frac{\left(NP\ ₹\, ha^{-1}\right)}{\left(CP\ ₹\, ha^{-1}\right)} \quad \text{......................................} \quad (1)$$

Water productivity indices

Crop water productivity (CWP) is the amount of crop yield (Y) produced for unit volume of total water used (TWU) by crop which considered irrigation, effective rainfall and soil profile water contribution (Howell, 2000):

$$CWP\left(Kg\, m^{-3}\right) = \frac{Y\left(Kg\, ha^{-1}\right)}{TWU\left(m^{-3}\, ha^{-1}\right)} \quad \text{............................} \quad (2)$$

Irrigation water productivity (IWP) was calculated as the ratio of crop yield (Y) to the amount of irrigation water (IW) applied (Stanhill, 1986):

$$IWP\left(Kg\, m^{-3}\right) = \frac{Y\left(Kg\, ha^{-1}\right)}{IW\left(m^{-3}\, ha^{-1}\right)} \quad \text{........................} \quad (3)$$

Economic crop water productivity (ECWP) is defined as the ratio of net profit of the harvested produce to total water used (TWU) by crop (Rodrigues *et al.*, 2003):

$$ECWP\left(₹\, m^{-3}\right) = \frac{\text{Net Profit}\left(₹\ ha^{-1}\right)}{TWU\left(m^{-3}\, ha^{-1}\right)} \quad \text{...............} \quad (4)$$

Economic Irrigation water productivity (EIWP) is calculated as the ratio of net profit of the harvested produce to the amount of applied irrigation water (IW) (Rodrigues and Pereira, 2009; Darouich *et al.*, 2012; Pereira *et al.*, 2012):

$$EIWP\left(₹\, m^{-3}\right) = \frac{\text{Net Profit}\left(₹\ ha^{-1}\right)}{IW\left(m^{-3}\, ha^{-1}\right)} \quad \text{.................} \quad (5)$$

Statistical analysis

The year wise rhizome yield data for different irrigation level and nutrient management were subjected to analysis of variance using software packages of MS Excel, SPSS 23.0 version and Origin Pro 2021 Version. Least significant difference (LSD) test at $P < 0.05$ was analysed to know the significant differences between means of individual treatments and their interactions (Gomez and Gomez, 1984). Since statistical variation between the experimental years and the treatments imposed were non-significant, only pooled values of the treatments for three consecutive years were presented to draw the inferences.

RESULTS AND DISCUSSION

Ginger yield

The fresh rhizome yields of ginger averaging over three years were significantly affected by different irrigation and nutrient management schedules (Table 3). Higher yield irrespective of various nutrient schedules was observed with higher level of irrigation at IW/CPE 1.2 (I_4), followed by marginal deficit irrigation with IW/CPE at 0.9 (I_3) and higher level of deficit irrigation at IW/CPE 0.6 (I_2). The lower average rhizome yield was recorded with rainfed condition (I_1). The average increase in yield under irrigation scheduling at 1.2, 0.9 and 0.6 of IW/CPE over rainfed was 53.8, 52.8 and 23.4%, respectively. The drastic reduction in rhizome yield under I_1 treatment may be because of the higher soil moisture stress throughout the physiological stages especially during rhizome initiation and rhizome bulking stage which might have proved detrimental for proper growth and development of plant. Similarly, irrespective of various irrigation schedules, the higher average rhizome yield was found with the conjunctive use of 75% RFD as fertilizers + 25% RFD as VC (N_2) which was followed by 100% RFD as mineral fertilizers (N_1) and 50% RDF as fertilizers + 50% RDF as VC (N_3), respectively. Higher crop yield due to the integrated use of mineral fertilizers and vermicompost (3:1) was ascribed to the balanced supply of nutrients of varying releasing capacity into the soil as a result ofhigher mineralization,better availability and uptake of nutrients and increased photosynthetic activity which ultimately reflected inhigher yield (Shaikh *et al.*, 2010).The substitution of 50% recommended fertilizer dose of nutrients through vermicompost addition was not matching for crop requirement to increase the yield due to slow release of nutrients to plant. The interaction effects between irrigation level and nutrient management showed that maximum average rhizome yield of 12.70 t ha^{-1} was under irrigation scheduling with IW/CPE at 1.2 coupling with 75% RFD as fertilizers + 25% RFD as VC (I_4N_2). This treatment combination was on statistical parity with the combined application of irrigation at IW/CPE 0.9 with 75% RFD as mineral fertilizers + 25% RFD as VC (I_3N_2) as 12.63 t ha^{-1}, irrigation with IW/CPE at 1.2 in combination with 100% RFD as mineral fertilizers (I_4N_1) as 11.34 t ha^{-1} and irrigation with IW/CPE at 0.9 coupling with 100% RFD as mineral fertilizers (I_3N_1) as 11.31 t ha^{-1}. The higher amounts of water in conjunction with higher amounts

Table 1:Cost of different levels of irrigation imposed for one hectare ginger production

Irrigation	Depth of irrigation water applied (cm)	Volume of irrigation water applied (L)	Hours of pump operation (h)	Consumption of diesel (L)	Cost of diesel for irrigation(₹)
I_1	0	0	0	0	0
I_2	15	1500000	42.74	21.37	1026
I_3	20	2000000	56.98	28.49	1368
I_4	25	2500000	71.23	35.62	1710

I_1: rainfed, I_2: irrigation at IW/CPE0.6, I_3: irrigation at IW/CPE0.9, I_4: irrigation at IW/CPE1.2; Pump discharge rate: 15 lps; Rate of diesel consumption: 0.5 lph; Cost of diesel: ₹ 48 L^{-1}; Surface irrigation efficiency considered: 65%.

Table 2:Cost of fertilizers and vermicompost imposed for one hectare ginger cultivation

Nutrient schedule (N)	Dose of N, P_2O_5 and K_2O (Kgha^{-1})	Amount of N,P_2O_5 and K_2O added via VC (Kg ha^{-1})	Adjusted dose of N,P_2O_5 and K_2O (Kg ha^{-1})	Amount of urea:SSP:MOP (Kg ha^{-1}) (₹ ha^{-1})	Cost of fertilizers (₹ ha^{-1})	Amount of VC added (Kg ha^{-1})	Cost of VC (₹ ha^{-1})	Total cost of fertilizers and VC (Kg ha^{-1})
N_1	75:50:50	0:00:00	75:50:50	165:313:80	5234	0	0	5234
N_2	56:37:37	0:11:09	56:26:28	123:163:45	3023	748	5236	8259
N_3	38:25:25	0:23:18	38:02:07	84:13:11	848	1500	10500	11348

N_1: 100% RDF as mineral fertilizers, N_2: 75% RDF as mineral fertilizers + 25% RDF as vermicompost (VC), N_3: 50% RDF as mineral fertilizers + 50% RDF as VC; Recommended dose of fertilizer N:P_2O_5:K_2O::75:50:50 Kg ha^{-1}; Cost of urea ₹ 6.50 Kg^{-1}, SSP ₹ 9.00 Kg^{-1} and MOP ₹ 16.8 Kg^{-1}; Cost of vermicompost ₹ 7.00 Kg^{-1}.

of nutrients supply either through chemical fertilizers alone or chemical fertilizers and vermicompost combination (3:1) in the general recommended fertilizer dose displayed the higher yields of ginger which may be due to the better water and nutrients distribution around root zone, higher availability in soil and corresponding uptake of nutrients by crop. On the contrary, significantly the lowest average green rhizome yield (6.74 t ha^{-1}) was obtained under rainfed condition provided with 50% RFD as mineral fertilizers + 50% RFD as vermicompost (I_1N_3).

Economic analysis

The cost of applied irrigation water for ginger excluding the labour charges for application under different irrigation schedules given in Table 1 showed that maximum cost was involved with higher irrigation regime at IW/CPE 1.2 (₹ 1846 ha^{-1}) followed by marginal deficit irrigation regime at IW/CPE 0.9 (₹ 1504 ha^{-1}) and higher level of deficit irrigation regime at IW/CPE 0.6 (₹ 1162 ha^{-1}), respectively. The cost incurred towards conventional rainfed cropwas ₹ 128 ha^{-1} exclusively for common irrigation purpose. Likewise, Table 2 pertaining to the cost expenditure towards fertilizers and vermicompost inputs was found minimum of ₹ 5234 ha^{-1} with general recommended dose of chemical fertilizers (N_1) application which increased to ₹ 8259 ha^{-1} for75% RFD as mineral fertilizers + 25% RFD as vermicompost (N_2) and ₹ 11348 ha^{-1} for 50% RFD as mineral fertilizers + 50% RFD as VC (N_3). This was mainly due to the increasing cost of vermicompost imposed in the integrated nutrient management schedule.

The economic analysis under different irrigation and nutritional schedules on ginger is showed in Table 3. The results depicted that in general cost of production increased with increasing level of irrigation and vermicompost manure application. The gross return and net return increased concurrently with the increase in rhizome yield due to increasing level of irrigation up to IW/CPE 1.2 complemented with integrated use of 75% RDF as chemical fertilizers + 25% RDF as vermicompost. In comparison, gross returns as well as net returns value was lower at each irrigation level when combined with 100% RFD as chemical fertilizers or, 50% RFD as chemical fertilizers + 50% RDF as VC. Maximum gross returns (₹ 635000ha^{-1}), net return (₹ 523571 ha^{-1}) and BCR (4.70) were obtained from irrigation schedule at IW/CPE 1.2 with 75% RFD as chemical fertilizers + 25% RFD as vermicompost (I_4N_2) which was immediately followed by the treatment with irrigation at IW/CPE 0.9 coupling with 75% RFD as chemical fertilizers + 25% RDF as VC (I_3N_2) with the corresponding value of ₹ 631500 ha^{-1}, ₹ 520471 ha^{-1} and 4.69, respectively. The higher economic benefit in

Table 3: Economics of ginger production as influenced by different irrigation and nutritional scheduling (average data of 3-year)

Treatment	Cost of production excepting cost for irrigation, manure and fertilizers (₹ ha^{-1})	Cost for irrigation, manure and fertilizers (₹ ha^{-1})	Application cost for irrigation, manure and fertilizers (₹ ha^{-1})	Total cost of production (₹ ha^{-1})	Average fresh rhizome yield (t ha^{-1})	Gross profit (₹ ha^{-1})	Net profit (₹ ha^{-1})	Benefit-cost ratio
I_1N_1	98470	5234	1800	105504	7.05	352500	246996	2.34
I_1N_2	98470	8259	2600	109329	7.51	375500	266171	2.43
I_1N_3	98470	11348	2600	112418	6.74	337000	224582	2.00
I_2N_1	98470	6260	3100	107830	8.52	426000	318170	2.95
I_2N_2	98470	9285	3900	111655	9.65	482500	370845	3.32
I_2N_3	98470	12374	3900	114744	8.11	405500	290756	2.53
I_3N_1	98470	6602	3500	108572	11.31	565500	456928	4.21
I_3N_2	98470	9627	4300	112397	12.63	631500	519103	4.62
I_3N_3	98470	12716	4300	115486	8.62	431000	315514	2.73
I_4N_1	98470	6944	3900	109314	11.34	567000	457686	4.19
I_4N_2	98470	9969	4700	113139	12.70	635000	521861	4.61
I_4N_3	98470	13058	4700	116228	8.71	435500	319272	2.75
CD (0.05)	-	-	-	-	1.53	-	-	-

I_1: rainfed, I_2: irrigation at IW/CPE 0.6, I_3: irrigation at IW/CPE 0.9, I_4: irrigation at IW/CPE 1.2; N_1: 100% RDF as mineral fertilizers, N_2: 75% RDF as mineral fertilizers + 25% RDF as vermicompost (VC), N_3: 50% RDF as mineral fertilizers + 50% RDF as VC; Prevailing average market price of ginger: ₹ 50000 t^{-1}.

Table 4: Different indices of water productivityof ginger under different irrigation and nutrition scheduling (3-year average data)

Treatment	Crop water productivity (Kg m^{-3})	Irrigation water productivity (Kg m^{-3})	Economic crop water productivity (₹ m^{-3})	Economic irrigation water productivity (₹ m^{-3})
$I_1 N_1$	2.08	-	72.73	-
$I_1 N_2$	2.17	-	76.76	-
$I_1 N_3$	1.94	-	64.51	-
$I_2 N_1$	2.45	5.68	91.55	212.11
$I_2 N_2$	2.76	6.43	106.18	247.23
$I_2 N_3$	2.31	5.41	82.89	193.84
$I_3 N_1$	2.89	5.66	116.78	228.46
$I_3 N_2$	3.22	6.32	132.16	259.55
$I_3 N_3$	2.19	4.31	80.08	157.76
$I_4 N_1$	2.60	4.54	105.02	183.07
$I_4 N_2$	2.90	5.08	119.10	208.74
$I_4 N_3$	1.98	3.48	72.67	127.71

I_1 : rainfed, I_2 : irrigation at IW/CPE 0.6, I_3 : irrigation at IW/CPE 0.9, I_4 : irrigation at IW/CPE 1.2; N_1: 100% RDF as mineral fertilizers, N_2: 75% RDF as mineral fertilizers + 25% RDF as vermicompost (VC), N_3 : 50% RDF as mineral fertilizers + 50% RDF as VC; Prevailing average market price of ginger: ₹ 50000 t^{-1}.

the later two treatments was ascribed to increasing rhizome yield as a result of marginal deficit to a little bit higher level of irrigation water application and proportionate (3:1) supply of nutrients by inorganic fertilizers and vermicompost manure throughout the growth stages. Minimum gross returns (₹ 337000 ha^{-1}), net returns (₹ 224482 ha^{-1}) and BCR (1.99) were obtained under rainfed condition supplemented with 50% RFD as chemical fertilizers + 50% RFD as VC (I_1N_3). Even under scarce or limited water supply condition, the higher level of deficit irrigation at IW/CPE 0.6 in conjunction with 75% RFD as chemical fertilizers + 25% RFD as VC (I_2N_2) proved to be beneficial in exhibiting moderate gross returns, net returns and BCR as ₹ 482500ha^{-1}, ₹ 3371871 ha^{-1} and 3.36, respectively.

Water productivity

Higher crop water productivity (CWP) of 3.22 Kg m^{-3} was recorded with irrigation scheduling of IW/CPE 0.9 coupled with 75% RDF + 25% RDF as VC (I_3N_2) and lower (1.94 Kg m^{-3}) under rainfed condition provided with 50% RDF + 50% RDF as VC (I_1N_3) (Table 4). Imposition of 75% RDF + 25% RDF as VC (N_2) in increasing CWP was more efficient, followed by 50% RDF + 50% RDF as VC (N_3) and least in 100% RDF (N_1) at all irrigation regimes.The remaining irrigation-nutrition treatment combinations did not increase CWP values as there was not proportional yield increase with the increment of water and nutrient application. These results pointed out to the fact that optimum irrigation at IW/CPE 0.9 in conjunction with mineral fertilizer and VC at 3:1 ratio in the recommended fertilizer dose might have created a congenialsoil water-nutrient environment for stimulation of root mass proliferation and elongation leading to higher absorption of soil moisture and nutrients that reflected in better plant growth and thus yield of green rhizome.

Irrigation water productivity (IWP) was consistently decreased with increasing irrigation regimes at each nutritional level (Table 4). Likewise, administration of 75% RFD + 25% RFD as VC (N_2) increased IWP more efficiently, followed 50% RFD + 50% RFD as VC (N_3) and 100% RFD (N_1) at all irrigation regimes. However, higher IWP (6.32 Kg m^{-3}) was recorded with irrigation at IW/CPE 0.9 with 75% RFD + 25% RFD as VC (I_3N_2) and lower (3.48 Kg m^{-3}) with irrigation at IW/CPE 1.2 supplemented with 50% RFD + 50% RFD as VC (I_4N_3).

Economic crop water productivity (ECWP) followed the same trend as in CWP (Table 4). However, higher ECWP (132.16 ₹ m^{-3}) was found with irrigation at IW/CPE 0.9 with 75% RFD + 25% RFD as VC (I_3N_2) and lower ECWP (64.51 ₹ m^{-3}) in rained condition coupled with 50% RFD + 50% RFD as VC (I_1N_3).

Economic irrigation water productivity (EIWP) followed the similar trend as was found in IWP(Table 4). However, higher EIWP (259.55 ₹ m^{-3}) was noticed in irrigation at IW/CPE 0.9 along with 75% RFD + 25% RDF as VC (I_3N_2) and lower EIWP (127.71 ₹ m^{-3}) in irrigation at IW/CPE 1.2 provided with 50% RDF + 50% RDF as VC (I_4N_3).

CONCLUSION

The present study recommended that under assured water supply condition irrigation at 1.2 IW/CPE accompanied with 75% RFD through chemical fertilizers + 25% RFD through VC was found to be the best treatment combinations for achieving greater ginger rhizome yield, maximum monetary profits. Under moderate water supply, marginal deficit irrigation at 0.9 IW/CPE coupled with 75% RFD through chemical fertilizers + 25% RFD through VC was the alternative option to realize an equivalent yield, higher monetary profits, BCR, CWP, IWP, ECWP and EIWP. Under constraint water, higher deficit irrigation at IW/CPE 0.6 complemented with 75% RFD as chemical fertilizers + 25% RFD as VC was observed to be the suited option in displaying moderate yield, monetary profits and BCR..

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