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RESEARCH ARTICLE :

Effect of drip fertigation on chilli - Agronomic use efficiency (*Capsicum annuum* L.) cv. KKM-1

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SUMMARY : A field experiment on water use efficiency, nutrient use efficiency and agronomic use efficiency of chiili (*capsicum annuum.* l) cv. KKM-1 under drip ferigation was carried out in College Orchard of Agricultural College and Research Institute, Madurai, Tamil Nadu during *Kharif* 2007 and summer 2008. The experiments were laid out in Randomized Block Design (RBD) with nine treatments in three replications. The study revealed that the increased water use efficiency, nutrient use efficiency and agronomic use efficiency characters was obtained in T_9 (T_5 + liquid biofertilizers + Panchagavya + Humic acid) for both *Kharif* and summer season. Application of 100 per cent drip fertigation through water soluble fertilizers along with bio stimulants (T_9) significantly higher water use efficiency (6.12 and 6.39 kg. ha mm^{-1}), nitrogen use efficiency (33.75 and 32.58 kg. kg N ha^{-1}), phosphorus use efficiency (67.50 and 65.17 kg. kg P ha^{-1}), potassium use efficiency (135.00 and 130.33 kg. kg K ha^{-1}), agronomic use efficiency of nitrogen (14.92 and 14.17 kg. kg N ha^{-1}), agronomic use efficiency of phosphorous (29.83 and 28.33 kg. kg P ha^{-1}) and agronomic use efficiency of potassium (59.67 and 56.67 kg. kg K ha^{-1}) of chilli (*Capsicum annuum* L.) cv. KKM-1.

KEY WORDS :
Drip Fertigation, WUF, NUF, AUF, Chilli

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BACKGROUND AND OBJECTIVES

Chilli (*Capsicum annuum* L.) is a spice cum vegetable crop belongs to the family Solanaceae. The consumption of chilli is the highest in India, maximum export is also from our country. Indian chillies and its products are brought out by a number of countries. Chillies are nature's wonder. Its fruit, appear in different sizes, shapes and colours. Chillies have two important qualities, they have biting pungency attributed to capsaicin and captivating red colour due to the pigment capsanthin. Capsaicin is a digestive stimulant, prevents heart diseases and curative for many rheumatic troubles. Besides, chilli is very useful in our daily diet since it is a rich source of vitamins A and C and rutin.

Efficient use of available irrigation water is essential for increasing agricultural productivity for the alarming Indian population. With present potential of 114 million hectare meters (MHM) of water, only 97 m.ha. is under irrigation in India. Tamil Nadu is one of the water starving states in India, which

receives a mean annual rainfall of 946 mm. Further, efficient management of water resources is essential to meet the increasing competition for water between agricultural and non-agricultural sectors and the present day share of 70 per cent of water used for agriculture is anticipated to be reduced by 60 per cent in the coming decade. This necessitates scientific management of available water and fertilizer resources in agricultural sector. In this context, drip fertigation has most significant role to achieve higher productivity, water and nutrient use efficiency.

RESOURCES AND METHODS

Experiments were carried out at the College Orchard, Agricultural College and Research Institute, Madurai, Tamil Nadu during *Kharif* 2007 and summer 2008. The experiment was laid out in a randomized block design (RBD) with nine treatments replicated at three times. The field lay out and randomization of treatments was made in each plot size of 45 m^2 (10 m x 4.5 m).

Treatment details :

T_1 = RDF through soil application (120: 60: 30 kg NPK ha^{-1})
T_2 = 75% RDF as Urea + DAP (as basal) + KCl
T_3 = 75 % RDF as Water Soluble Fertilizers
T_4 = 100 % RDF as Urea + DAP (as basal) + KCl
T_5 = 100 % RDF Water Soluble Fertilizers
T_6 = T_2 + liquid biofertilizers + Panchagavya + Humic acid
T_7 = T_3 + liquid biofertilizers + Panchagavya + Humic acid
T_8 = T_4 + liquid biofertilizers + Panchagavya + Humic acid
T_9 = T_5 + liquid biofertilizers + Panchagavya + Humic acid

Note:

- Water soluble fertilizers : Poly feed (19 % N, 19% P and 19% K) MAP (12% N and 61% P) and KNO_3 (13% N and 45 % K)
- Liquid biofertilizers (200 ml /acre), Panchagavya (10 litre/ac) and Humic acid (2 litre/ac) (TNAU recommendations).

Crop and variety :

The chilli, KKM -1 is a hybrid derivative from the cross between Acc. 240 and Co 3. It is an early and high yielding variety. The plants are dwarf, compact and spreading.

Irrigation :

The irrigation was scheduled once in three days. Irrigation water was supplied after subtracting the effective rainfall from the pan evaporation. Irrigation was given on the basis of pan evaporation values (100 % PE) from USWB Class 'A' Open pan evaporimeter installed at Meteorological Observatory, Agricultural College and Research Institute, Madurai.

Fertigation and fertilizer application schedule :

The recommended dose of fertilizer (120: 60: 30 kg NPK ha^{-1}) was taken as 100 % RDF. Urea (46 %), phosphorus in the form of single super phosphate (16%) potassium in the form of muriate of potash (60%) were applied before sowing as basal dose through soil application for the treatment T_1, Phosphorus in the form of Di ammonium phosphate (18% N and 46% P) was applied as basal dose through soil application for the treatment T_2 and T_4. For remaining treatments, fertigation was given as per the treatment schedule.

The recommended dose of 120: 60: 30 kg NPK ha^{-1} was applied in the experimental plots. Fertigation was scheduled once in three days starting from second week after planting. Each plot consists of three laterals for irrigating six rows of crops. A tap is provided at beginning of each lateral for giving controlled fertigation. The required quantity of N, P and K fertilizers as urea, MAP and KNO_3 as per the treatment were dissolved separately in 5 liters of water can to the each laterals of the individual plot.

This study was conducted to find out response of chilli crop with respect to yield and fertilizer consumption under different fertilizer application. The study also found on determination of required dose of water and fertilizer application to maximize water and nutrient use efficiency.

OBSERVATIONS AND ANALYSIS

Result and analysis for the parameters such as water use efficiency, nutrient use efficiency and agronomic use efficiency are presented in this section. It shows that highest water use efficiency of (6.12 and 6.39 kg. ha mm^{-1}) were recorded in both *Kharif* and summer seasons, respectively in T_9 (T_5 + liquid biofertilizers + Panchagavya

+ Humic acid). Application of 100 per cent RDF as normal fertilizer through (T_1) drip system recorded significantly lower water use efficiency than the other treatments in both *Kharif* (3.41 kg. ha mm^{-1}) and summer season (3.61 kg. ha mm^{-1}). Generally, water use efficiency indicated the effectiveness of the applied water in terms of crop yield. The increase in water use efficiency recorded under drip fertigation system was mainly due to better performance of the crop and increased yield by effective utilization of available water and nutrients that were supplied at regular intervals throughout the crop period to meet the crop demand. An increased water use efficiency under drip fertigation was also reported by Muralidhar (1998), Dhanalakshmi (1999) and Banger and Chaudhari (2004).

Application of 100 % RDF along with bio stimulants (T_9) significantly increased the nutrient use effieciency of chilli in both *Kharif* and summer season. T_9 (T_5 + liquid biofertilizers + Panchagavya + Humic acid) recorded higher nitrogen use efficiency of (33.75 and 32.58 kg.

Table 1 : Effect of fertigation on water use efficiency (kg ha mm^{-1}) of chillies cv. KKM-1

Treatments	WUE kg ha mm^{-1}	
	Kharif	Summer
T_1	3.41	3.61
T_2	3.64	3.81
T_3	4.61	4.10
T_4	4.21	4.32
T_5	5.38	5.63
T_6	5.06	5.42
T_7	5.80	6.16
T_8	5.45	5.67
T_9	6.12	6.39

Table 2 : Effect of fertigation on nutrient use efficiency (kg. kg NPK ha^{-1}) of chillies cv. KKM-1

Treatments	Nitrogen kg. kg. kg N ha^{-1}		Phosphorus kg. kg P ha^{-1}		Potassium kg. kg K ha^{-1}	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1	18.83	17.67	37.67	35.33	75.33	70.67
T_2	20.08	19.42	40.17	38.83	80.33	77.67
T_3	25.42	24.00	50.83	48.00	101.67	96.00
T_4	23.25	22.00	46.50	44.00	93.00	88.00
T_5	29.67	28.75	59.33	57.50	118.67	115.00
T_6	27.92	27.67	55.83	55.33	111.67	110.67
T_7	32.00	31.42	64.00	62.83	128.00	125.66
T_8	30.08	28.92	60.17	57.83	120.33	115.67
T_9	33.75	32.58	67.50	65.17	135.00	130.33

Table 3 : Effect of fertigation on agronomic use efficiency (kg. kg NPK ha^{-1}) of chillies cv. KKM-1

Treatments	Nitrogen kg. kg N ha^{-1}		Phosphorus kg. kg P ha^{-1}		Potassium kg. kg K ha^{-1}	
	Kharif	Summer	*Kharif*	Summer	*Kharif*	Summer
T_1	-	-	-	-	-	-
T_2	1.25	1.00	2.50	2.00	5.00	4.00
T_3	6.59	5.58	13.17	11.17	26.33	22.33
T_4	4.42	3.58	8.83	7.17	17.67	14.33
T_5	10.83	10.33	21.67	20.67	43.33	41.33
T_6	9.09	9.25	18.17	18.50	36.33	37.00
T_7	13.17	13.00	26.33	26.00	52.67	52.00
T_8	11.25	10.50	22.50	21.00	45.00	42.00
T_9	14.92	14.17	29.83	28.33	59.67	56.67

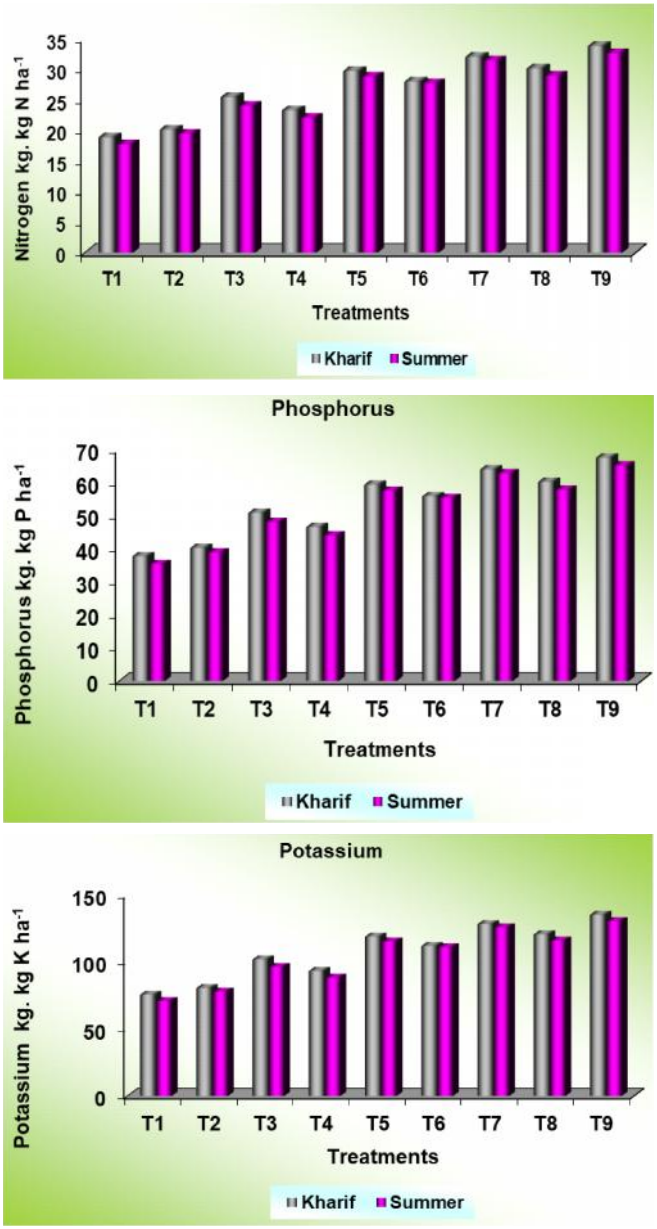

Fig. 1 : Effect of fertigation on nutrient use efficiency (kg. kg NPK h^{-1}) of chillies

kg N ha^{-1}), phosphorus use efficiency of (67.50 and 65.17 kg. kg P ha^{-1}) and potassium use efficiency of (135.00 and 130.33 kg. kg K ha^{-1}). Fertigation reduces the nutrient loss and thus, permits better availability and uptake of nutrients by crops, leading to higher yield with higher nutrient use efficiency. In this experiment, drip fertigation of 100 per cent water soluble fertilizer along with bio stimulants recorded higher nutrient use efficiency. The possible reason for this phenomenon is due to better availability of plant nutrients and irrigation water throughout the crop growth period resulting to higher fruit yield under drip fertigation system. The increase nutrient use efficiency under drip fertigation was also reported by Veeranna *et al.* (2000) in chillies and Shobana (2002) in Radish.

Fertigation of 100 per cent water soluble fertilizer along with bio stimulants recorded higher agronomic use efficiency of nitrogen, phosphorus and potassium than the control during both the seasons. This was mainly due to the application of optimum level of fertilizers, which resulted in higher yield of chillies. Lower agronomic use efficiency under lower level of fertigation might be attributed to lesser yield.

Generally, agronomic use efficiency was considerable by drip fertigation compared to soil application of fertilizers. This could be attributed to continuous availability of nutrients and water to the active root zone of the crop and minimum leaching of nutrients away from the root zone. This is in harmony with the findings of Veeraputhiran (2000) and Aujla *et al.* (2005). They have reported higher agronomic use efficiency under drip fertigation compared to soil application of fertilizer.

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