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RESEARCH PAPER

Studies on nutrient use efficiency and water use efficiency of paprika (*Capsicum annuum* var. Longam) cv. KtPl-19 under drip fertigation

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Abstract : Paprika (*Capsicum annuum* var. *longam*) is one of the important capsicum group known for its less pungency. Application of fertilizers through drip irrigation is known to play a vital role in enhancing the productivity and quality of many horticultural crops. In this view, studies on paprika (*Capsicum annuum* var. *longam*) were carried out at the College orchard, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore, during 2006-2009 to find out the effect of different sources and levels of potassium with reference to nutrient use efficiency water use efficiency. The experiment was conducted for two seasons *viz.*, season I (June 2007- Jan 2008) and season II (July 2008- Feb 2009) to get the concurrent result. From the study, it was observed that the crop paprika responded well to the fertigation treatments. The result revealed that application of 100 % RDF as MAP, Multi-K and SOP recorded the highest nutrient use efficiency of 60.50 kg kg nutrient^{-1} and nutrient use efficiency of 37.71 kg ha^{-1}mm^{-1}.

Key Words : Paprika, *Capsicum annuum* var. Longam, Drip fertigation, Nutrient use efficiency, Water use efficiency

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INTRODUCTION

Paprika is the Hungarian word for plants in the genus *Capsicum*, belonging to the family Solanaceae which has its origin from Western Hemisphere of the world. International spice traders use the term paprika for non pungent, red capsicum powder. Capsicum in a fresh state is very rich in vitamin C (ascorbic acid), as was shown by Szent Gyorgyi, the Hungarian scientist, who was awarded the Noble prize in 1937 for isolating vitamin C from paprika fruits (Anu and Peter, 2000).

The word paprika has been derived from the Greek or Latin "Peperi-piper" meaning pepper. Paprika in a fresh state is very rich in vitamin C (ascorbic acid). Paprika being a short duration crop and heavy yielder requires heavy manuring for proper growth and high productivity (Anonymous, 1995). This warranting optimum dose of manuring practices with both organic and inorganic nutrients to get the desired growth and yield (Sharma *et al*., 1996 and Hedge, 1997). It is well known fact that potassium improves fruit colour as well as oleoresin content in capsicum (Yodpetch, 2001). Further, micronutrients such as S, Mg and Ca are also known to considerably influence the growth, yield and quality of paprika. Balanced fertilization with sulphur enhances the quality in paprika, particularly the ascorbic acid content (Ni, 1993). Recently use of sulphate of potash (SOP) which suplies sulphur apart from K is also

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known to improve the growth, yield and quality of certain horticultural crops (Ramesh Kumar, 2004 in banana and Ananthi, 2002 in chillies). The efficient use of fertilizers is necessary for optimum crop growth and yield. Paprika is the ground product from the mild or sweet varieties of capsicum, where as red chilli peppers are blends of different varieties of more pungent pepper (Tainter and Grenis, 2003). Paprika contains remarkable amount of the colouring material and is used as colourant in processed foods as they get the nod over synthetic products in the food colourant market (Prasath and Ponnuswami, 2008). Recently, fertilizer application through drip irrigation (Fertigation) is known to play a significant and vital role in enhancing the productivity and quality of many horticultural crops whether perennial like mango (Sivakumar, 2007), banana (Mahalakshmi, 2000), papaya (Jeyakumar *et al.*, 2001) or annual like tomato (Kavitha, 2005), chillies (Selvakumar, 2006), paprika (Prabhu, 2006) and cucumber (Sumathi, 2007) etc. Further, Water soluble fertilizers have been found to be efficient over conventional fertilization in many horticultural crops (Meenakshi, 2002 in bitter gourd) etc. With this background, an investigation was taken up to determine the effect of certain aspects of fertigation involving water soluble and conventional fertilizers in paprika cv. KtPl-19.

MATERIAL AND METHODS

Field experiment was conducted from 2006 to 2009 at University Orchard, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The soil of the experimental field was clayey loam in texture. The experiment was laid out in Randmized Block Design (RBD) with three replications. The treatments T_1- 100 per cent Recommended normal fertilizer applied to soil with furrow irrigation, T_2-Drip fertigation with water soluble fertilizer at 50 per cent RDF using polyfeed + urea+ MOP, T_3-Drip fertigation with water soluble fertilizer at 75 per cent RDF using polyfeed + urea+ MOP, T_4-Drip fertigation with water soluble fertilizer at 100 per cent RDF using polyfeed + urea+ MOP, T_5-Drip fertigation with water soluble fertilizer at 50 per cent RDF using MAP + Multi-K + SOP, T_6-Drip fertigation with water soluble fertilizer at 75 per cent RDF using MAP + Multi-K + SOP, T_7-Drip fertigation with water soluble fertilizer at 100 per cent RDF using MAP + Multi-K + SOP (Water soluble fertilizers = MAP (12% N and 61%P), MOP (60% K), SOP (50%K and 18% S), Multi K (13 % N and 45 % K) and Polyfeed (19 % N, 19 % P and 19 % K)) will taken up for the experiment. The spacing adopted was 60cm between rows and 45 cm between plants. The fertilizer dose of N: P: K @ 120:100:120 kg per hectare was applied uniformly for all the experiments. Fertigation was scheduled on alternative days starting from second week after planting. The treatments were imposed from 30 days after planting to at harvesting stage. Other cultural practices and plant protection measures were given according to the recommendation of TNAU, Coimbatore. Data on nutrient use efficiency were recorded. The data were subjected to statistical analysis (Panse and Sukhatme, 1985) and the results are presented in Tables 1.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under following heads :

Nutrient use efficiency :

Partial factor productivity (kg kg nutrient^{-1}) :

Significant difference was exhibited by different fertigation treatments for the partial factor productivity. Higher PFP value of 60.50 kg kg nutrient^{-1} was recorded by the treatment T_7. It was followed by the treatment T_6 (49.89 kg kg nutrient^{-1}) and T_4 (48.45 kg kg nutrient^{-1}). While the lowest PFP of 29.18 kg kg nutrient^{-1} was observed by T_1 (control) in the pooled mean.

Significantly higher mean PFP of 59.40 kg kg nutrient^{-1} and 61.61 kg kg nutrient^{-1} during season I and II was observed by T_7, respectively. It was followed by T_6 (48.90 kg kg nutrient^{-}

Table 1 : Effect of fertigation on nutrient use efficiency and water use efficiency of crop growth in paprika cv. KtPl-19

Treatments	Partial factor productivity (kg kg nutrient $^{-1}$)			Water use efficiency (kg ha^{-1}mm^{-1})		
	Season		Mean	Season		Mean
	I	II		I	II	
T_1	28.30	30.06	29.18	14.25	16.50	15.37
T_2	33.90	35.68	34.79	20.04	23.34	21.69
T_3	43.50	45.47	44.48	25.75	29.76	27.75
T_4	47.50	49.41	48.45	28.09	32.34	30.21
T_5	38.80	40.73	39.76	22.97	26.66	24.81
T_6	48.90	50.88	49.89	28.89	33.30	31.09
T_7	59.40	61.61	60.50	35.11	40.33	37.71
SEd	0.367	0.372	0.370	0.239	0.272	0.256
C.D. (P=0.05)	0.801	0.812	0.806	0.521	0.594	0.557
C.D. (P=0.01)	1.123	1.139	1.130	0.731	0.833	0.782

^{1}and 50.88 kg kg nutrient^{-1}, respectively) and T_4 (47.50 kg kg nutrient^{-1} and 49.41 kg kg nutrient^{-1}during season I and season II, respectively). While, the lowest mean PFP of 28.30 kg kg nutrient^{-1} (season I) and 30.06 kg kg nutrient^{-1} (season II) was recorded by T_1 (control) (Table 1).

Water use efficiency (kg ha^{-1} mm^{-1}) :

Significant difference was observed by different fertigation treatments for water use efficiency. Higher water use efficiency value of 37.71 kg ha^{-1} mm^{-1} was recorded by the treatment T_7. It was followed by T_6 (31.09 kg ha^{-1} mm^{-1}) and T_4 (30.21 kg ha^{-1} mm^{-1}). While, the lowest WUE of 15.37 kg ha^{-1} mm^{-1} was however observed by T_1 (control) in the pooled mean.

Significantly higher mean WUE of 35.11kg ha^{-1} mm^{-1} and 40.33 kg ha^{-1} mm^{-1} during season I and II, respectively was observed by T_7. It was followed by the treatments T_6 (28.89 kg ha^{-1} mm^{-1} and 33.30 kg ha^{-1} mm^{-1}, respectively) and T_4 (28.09 kg ha^{-1}mm^{-1} and 32.34 kg ha^{-1} mm^{-1} during season I and season II, respectively). While, the lowest mean WUE of 14.25 kg ha^{-1} mm^{-1} (season I) and 16.50 kg ha^{-1} mm^{-1} (season II) was registered by T_1 (control) treatment (Table 1).

Influence of drip fertigation on nutrient use efficiency :

The positive and better nutrient use efficiency was well documented under drip fertigation in both the experiments. The partial factor productivity of nutrient decreased with increased level of drip irrigation. Drip fertigation at 100 per cent RDF having MAP, SOP and Multi-K registered higher partial factor productivity of nutrient. In surface irrigation efficiency was, however, lower compared to drip fertigation. This might be due to the application of recommended fertilizers in large quantities as single application at planting led to greater losses of applied nutrients due to leaching etc. Hence, during the later growth phases, the uptake of nutrients was low due to limited availability under surface irrigation resulting in poor nutrient use efficiency. Similarly, Suresh kumar (2000) reported that that the PFP was higher under drip irrigation. Efficiency of nutrients was decreased with increased level of nutrients. Mohammad (2004) reported that PFP decreased with increasing rates of fertigation.

Influence of drip fertigation on water use efficiency :

The amount of water required to meet the demand of evapotranspiration and metabolic activity of paprika plants constitute the consumptive use of water including the effective rainfall during the crop growing season. During both the seasons of study consumptive use of water was higher under surface irrigation method compared to drip irrigation. Drip irrigation at 100 per cent RDF as MAP, SOP and Multi-K was found to influence all the growth and yield characters significantly in both the season. The concept of 'luxury consumption' may be correlated here. The comparative role of anions such as SO_4^{-2} (present in SOP) and Cl^- (present in MOP) in damaging the cell wall and improper water balance at cellular level is highly relavant here (Prabhavathi *et al.*, 2008).

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