

Efficient Water Management for improving Productivity of Rice - Vegetable Pea-Summer Maize System

A K SINGH, ASHUTOSH UPADHYAYA, PAWAN JEET, KIRTI SAURABH,
PK SUNDARAM AND BIKASH SARKAR

ABSTRACT

A filed experiment was conducted at ICAR Research Complex for Eastern Region, Patna Patna to evaluate rice - vegetable pea-summer maize production system under various water management practices. Results revealed that significantly higher grain (4047kg/ha) was produced when water was applied at W_4 (IW: CPE=1.0). Maximum irrigation water productivity (1.470kg/m³) was achieved when water supplied with (IW: CPE=0.4). In case of pea, significantly highest green pod yield (9.78/ha) was recorded in plots which was received water with W_2 (IW: CPE=0.6). Highest irrigation water productivity (9.92 kg/m³) was achieved when pea was irrigated at IW: CPE=0.4. Whereas, maximum (18.41t/ha) maize green cob was harvest when it was managed with W_4 (IW: CPE=1.2. In case of water management, highest irrigation water productivity (6.25kg/m³) was achieved when pea was irrigated at IW: CPE=0.8).

Keywords: Rice, summer maize, vegetable pea, water management

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INTRODUCTION

Efficient land and water management is the key for any crop production system. Role of water is and its importance is gaining importance in agricultural production system (Upadhyaya and Singh, 2019). Land and water productivity of this region is below par than the national average in most of the crop due to poor and faulty crop production practises adopted by the framers of the region (Mishra *et al.* 2021 and Yang *et al.* 2013). In the present scenario, system productivity is worthwhile as compared to component study hence this study is proposed for rice-vegetable pigeon pea and summer maize cropping system. Though this is comparatively new cropping system in Bihar but it would be very remunerative hence it is to be popularised for maximum production and sustainability point of view as well. Since rice is one of the major staple food crops of Bihar, grown in all three agroclimatic zones of Bihar in 33 lakh hectors. Pea for vegetable purpose can be use a cash crop as well as soil fertility restores; because of summer maize is also one of the exhaustive crops which can mine nutrient and water. Summer maize is one of the remunerative crops in Bihar which has been grown on 1.8 lakh ha area in all three agroclimatic zones especially in Zone II (Singh *et al.* 2017). Keeping in view the time and nutrient management point of view this project has been proposed to undertake at ICAR RCER Patna *w.e.f.* Kharif season 2018 with an objective to evaluate efficient water management strategies for the cropping system and to evaluate genotypes suitable for cropping system under study.

MATERIALS AND METHODS

Under the project improving rice - vegetable pea-summer maize system productivity through efficient water

management practices, which was undertaken from Kharif season 2018-19. In this experiment three genotypes of rice, vegetable pea and summer maize for green cob along with 04 water management level (irrigation at IW: CPE) has being tested under cropping system mode. In this experiment three genotypes of pea along with 04 water management level (irrigation at IW: CPE) is being tested under cropping system mode. During Kharif season rice (Genotype: Swarna Shreya) crop was taken and its production was ranged in between 4.43 to 4.49t/ha. During season vegetable pea was grown, three pea genotypes namely V1=Annapurna, V2=Haribhajan and V3=SPL-VS 10 were tested under 04 water regime i.e. W1 (IW: CPE=0.4), W2 (IW: CPE=0.6), W3 (IW: CPE=0.8) and W4 (IW: CPE=1.0). Third crop of cropping system was summer maize, three maize genotypes namely V1=S-999, V2= Visal and V3=S-585, were tested under 04 water regime i.e. W1 (IW: CPE=0.4), W2 (IW: CPE=0.8), W3 (IW: CPE=1.0) and W4 (IW: CPE=1.2).

RESULTS AND DISCUSSION

Under the project improving rice - vegetable pea-summer maize system productivity through efficient water management practices was undertaken from season 2018-19 to 2020-21. In this experiment three genotypes of pea along with 04 water management level (irrigation at IW: CPE) is being tested under cropping system mode. Performance of individual crops in cropping system were presented here

Performance of Kharif Season crop

During Kharif season 2019 three genotypes of rice (Namely V₁=CR Dhan 40, V₂= Rajendra Shweta and V₃= Swarna Shreya) was tested along with 04 water management level (irrigation

at IW: CPE) were tested under rice – vegetable pea-summer maize system in split plot design keeping water management in main plots and genotypes in sub plots at ICAR-Research Complex for Eastern Region Patna-800 014 (Bihar). In case of rice, three genotypes namely V_1 =CR Dhan 40, V_2 = Rajendra Shweta and V_3 = Swarna Shreya were tested under 04 water regime *i.e.* W_1 (IW: CPE=0.4), W_2 (IW: CPE=0.6), W_3 (IW: CPE=0.8) and W_4 (IW: CPE=1.0). Perusal of data presented in **Table 1** revealed that genotype Swarna Shreya produced significantly higher rice (3979 kg/ha) as compare to other tested rice genotypes. Similarly in case of water management practices, water applied at W_4 =(IW: CPE=1.0) level produced significantly higher grain (4047 kg/ha) than other tested level

of water management. It is worth to mention here that yield advantage was recorded with enhancement up to the highest tested level. Similar trend was in case of biological yield with both the tested factors *i. e.* water management and genotypes. Maximum (12262 Kg/ha) biological yield was recorded when water was applied at W_4 =(IW: CPE=1.0) and minimum (10963 Kg/ha) with genotype Rajendra Shweta respectively. None of treatments has significantly influenced harvest index (HI). In case of water productivity, genotype, Swarna Shreya recorded maximum water productivity (1.45 kg/m³), where as in case of water management it was achieved when rice was irrigated at W_1 = (IW: CPE=0.4) corresponding highest (1.79 kg/m³) was noticed in case of water supplied with (IW: CPE=0.4). Water level has maximum influence on the rice production among all the three varieties. The mean rice yield is significantly ($p<0.05$) varying at the four different level of water applied (**Fig. 1**).

Table 1: Rice performance as influenced by water and genotypes.

Treatments	Grain Yield (kg/ha)	Biological Yield (kg/ha)	Harvest Index	IWP (kg/ha)
W_1 = (IW: CPE=0.4)	3580	10227	0.35	1.79
W_2 =(IW: CPE=0.6)	3780	11117	0.34	1.51
W_3 =(IW: CPE=0.8)	3951	11619	0.34	1.32
W_4 =(IW: CPE=1.0)	4047	12262	0.33	1.16
CD (±5%)	113.7	341.7	NS	0.28
V_1 =CR Dhan 40	3812	11118	0.34	1.39
V_2 =Rajendra Shweta	3728	10963	0.34	1.36
V_3 =Swarna Shreya	3979	11702	0.34	1.45
CD (±5%)	82.4	247.3	NS	0.22

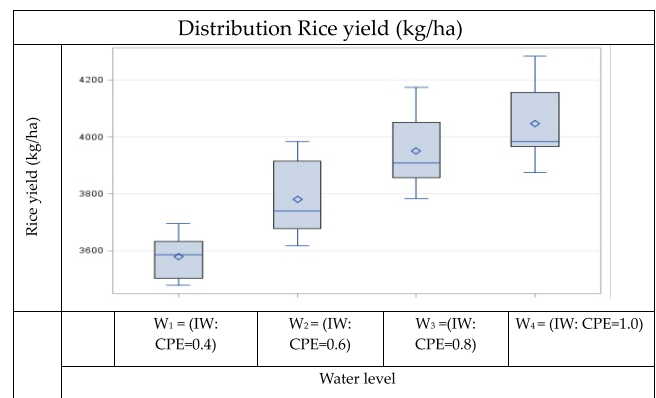


Fig. 1: Box plot distribution of rice yield at four water levels



Fig. 2: Field view of rice at early growth and heading stage

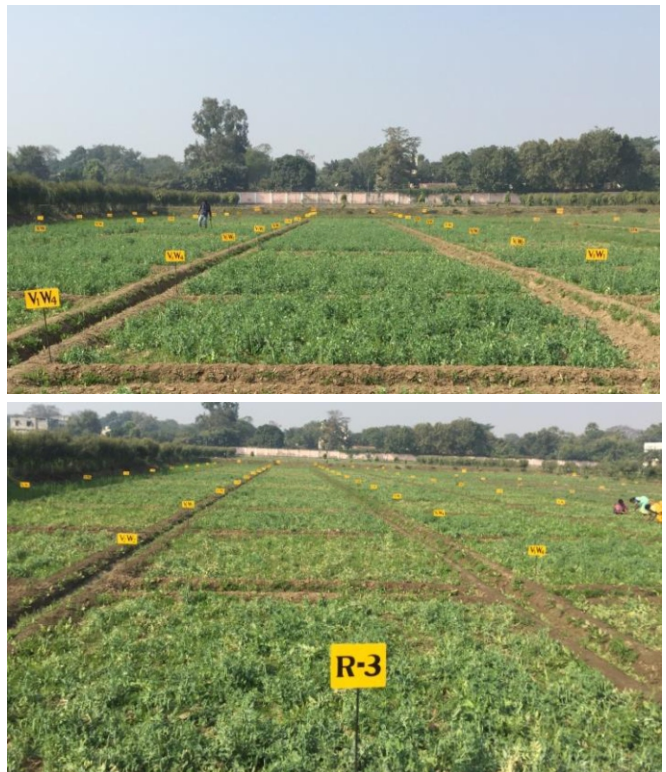
Performance of Rabi season crop

Improving rice - vegetable pea - summer maize system productivity through efficient water management practices, significantly highest green pod yield (9.78 t/ha) was recorded in plots which was received water with (IW: CPE=0.6). In case of genotypes, Haribhajan produced maximum (10.63t/ha) when water was managed with W₂ (IW: CPE=0.6). Highest (9.92kg/m³) was achieved when pea was irrigated at IW: CPE=0.4). During *rabi* season vegetable pea was grown, three pea genotypes namely V₁=Annapurna, V₂=Haribhajan and V₃=SPL-VS 10 were tested under 04 water regime i.e. W₁ (IW: CPE=0.4), W₂ (IW: CPE=0.6), W₃ (IW: CPE=0.8) and W₄ (IW: CPE=1.0). Results revealed that, in case of water management treatment, significantly highest green pod yield (9.78t/ha) was recorded in plots which received water with W₂(IW: CPE=0.6). Among the tested genotype highest mean green pod was (8.73t/ha) was produced by genotype Harbhajan. Perusal of data presented in Table 2, revealed that water management practices and pea genotypes had significant interaction and produced highest green pod (10.63/ha) by

Table 2: Yield attributes and yields of Pea influenced by genotypes and water management treatments

Treatments	Green Pea Yield (t/ha)	WP (kg/m ³)
V ₁ Annapurna	7.82	7.74
V ₂ Haribhajan	8.73	8.12
V ₃ SPL-VS 10	8.15	6.96
CD (P=0.05)	0.63	0.53
W ₁ (IW:CPE=0.4)	6.59	9.92
W ₂ (IW:CPE=0.6)	9.78	9.28
W ₃ (IW:CPE=0.8)	8.31	6.37
W ₄ (IW:CPE=1.0)	8.24	4.86
CD (P=0.05)	0.57	0.68

genotype, Harbhajan when irrigated at IW: CPE=0.6. It is worth to mention here that this crop has received 18.1 mm rain during crop period. Water productivity was also worked out



taking in to account of total water received by plot through rain and irrigation. In case of genotype maximum water productivity (8.12kg/m³) was recorded by Harbhajan, where as in case of water productivity highest (9.92kg/m³) was achieved when pea was irrigated at IW: CPE=0.4, however corresponding lowest (4.86 kg/m³) was recorded, when water was supplied with (IW: CPE=1.0) (Table 2).

Table 3: Interaction effects of genotypes and water management on Green Pea Yield (t/ha)

Treatments	W ¹ (IW:CPE =0.4)	W ² (IW:CPE =0.6)	W ³ (IW:CPE =0.8)	W ⁴ (IW:CPE =1.0)
V ₁ Annapurna	7.55	9.03	7.68	7.90
V ₂ Haribhajan	8.00	10.63	8.33	9.70
V ₃ SPL-VS 10	7.10	10.44	8.93	9.13

Interaction CD (P=0.05) V*W=0.85

Third crop of cropping system was summer maize, threemaize genotypes namely V₁= S-999, V₂= Visal and V₃= S-585, were tested under 04 water regime i.e. W₁ (IW: CPE=0.4), W₂ (IW: CPE=0.8), W₃ (IW: CPE=1.0) and W₄ (IW: CPE=1.2). Results revealed that genotype Visal produced significantly higher

Performance of summer / Zaid season crop

Table 4: Green cob yield (t/ha) yield influenced by genotypes and water management treatments

Treatments	Green cob Yield (t/ha)	WP (kg/m ³)
W ₁ (IW:CPE=0.4)	9.94	6.21
W ₂ (IW:CPE=0.8)	15.01	6.25
W ₃ (IW:CPE=1.0)	16.78	5.24
W ₄ (IW:CPE=1.2)	18.41	3.84
CD (P=0.05)	2.17	0.21
V ₁ =S-999	14.15	4.72
V ₂ =Visal	15.06	5.02
V ₃ = S-585	15.89	5.30
CD (P=0.05)	0.82	0.17

green cob (16.75t/ha) as compare to other tested genotypes (Table 4). In case of water management treatment, significantly highest green cob yield (19.06t/ha) was recorded in plots which was received water with W₄ (IW: CPE=1.2) corresponding minimum green cob was harvested in the plots



Fig. 3: Field view of maize at tesling stage



V₁=S-999



V₂=Visal



V₃= S-585



Maize cob of different varieties as influenced by water management (W_4)

Fig. 4: Maize green cobs of different varieties

receiving water at W_1 (IW: CPE=0.4) level. Maximum irrigation water productivity ($4.79\text{kg}/\text{m}^3$) was recorded by genotype Visal. In case of water management, highest irrigation water productivity ($5.81\text{kg}/\text{m}^3$) was achieved when pea was irrigated at IW: CPE=0.4), corresponding lowest ($3.97\text{kg}/\text{m}^3$) was noticed in case of water supplied with (IW: CPE=1.2).

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