Research Article

Study of Sweet Corn Based Cropping Sequences under Different Fertigation Levels

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Abstract

The field experiment entitled was conducted to assess the sweet corn-based cropping sequences under different fertigation levels during *kharif* and *rabi* season of 2021 at Research Farm, Zonal Agricultural Research Station (ZARS), Ganeshkhind, Pune. In case of performance of cropping sequence sweet corn-rajmah (CS_2) cropping sequence recorded highest total system productivity (64.31 t ha^{-1}), production efficiency (267.95 kg ha^{-1} day^{-1}) and economic efficiency (₹ 2133 ha^{-1} day^{-1}) which was followed by sweet corn- onion (CS_3) cropping sequence with total system productivity of (58.39 t ha^{-1}),production efficiency (216.25 kg ha^{-1} day^{-1}) and economic efficiency (₹ 1359 ha^{-1} day^{-1}). While among different fertigation levels application of 100 % RD NPK (F_1) through fertigation recorded highest total system productivity (62.70 t ha^{-1}), production efficiency (250.82 kg ha^{-1} day^{-1}) and economic efficiency (₹1897 ha^{-1} day^{-1}) followed by 80 % RD NPK (F_2) and 60 % RD NPK (F_3) through fertigation.While land use efficiency was found maximum (57.53 %) in sweet corn- onion (CS_3) cropping sequence.

Keywords: Cropping sequence, fertigation levels, equivalent yield, production efficiency, system productivity

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Introduction

Cropping system research is gaining importance in modern agriculture. Crop rotation and sequence cropping are the key components of cropping system research. Cropping system refers to the order in which crops are grown on a certain plot of arable land in order to maximize the benefits from the resources at hand. Therefore, increasing production and financial returns is the fundamental strategy in an effective cropping system [1]. Continuously growing similar crops on the same piece of land has adverse effects on soil health, crop growth and productivity and has raised concerns of environmental pollution. This ultimately results into soil degradation, lower productivity of cropping system and environmental pollution. To amend this situation, use of intensive cropping system like sequencing crops in defined patterns based on scientific knowledge is extremely important to make improvements in this situation [2].

At present in irrigated areas mostly rice based cropping systems are followed and among other cereal-based cropping systems maize – wheat, sorghum – wheat, pearl millet – wheat etc. occupy major cultivated area. Continuously following cereals after cereals in cropping system results in reduced soil fertility, crop productivity and net returns from cropping system. Continuous cultivation of same cropping system results in various problems *viz,* deficiency of micronutrients in root zone, infestation of similar kinds of pests and predominance of specific weeds, which is resulting in reduced efficacy and sustainability of cropping systems [3].The choice of component crops must be carefully considered in order to maximize total productivity and ensure the effective use of the resource base [4] . Inclusion of legumes, cash crops, high value vegetables and exotic vegetables in cropping system has greater scope in irrigated and peri-urban areas in terms of total system productivity, remuneration, employment generation, vertical productivity (productivity in time) and economic efficiency of cropping system.

Given its high sweetness and low starch content, sweet corn, one of the specialty corns, is becoming more and more popular in both rural and urban regions [5]. In urban areas, sweet corn is important due to its taste and other processed products for human consumption. Sweet corn is becoming increasingly popular in India and other Asian countries. Increasing demand, premium price and global spread of sweet corn can make them attractive option for the farmers. Its cultivation has increased in areas surrounding big towns and cities of different states of India [6]. Sweet corn has high nutritional value. It has large demand in big towns, tourist places and for processing industries. Thus, it is becoming remunerative practice of growing sweet corn for the farmers in peri- urban areas.

The goal of irrigation-based cropping systems is to increase agriculture's ability to generate money, reduce poverty, and gain a competitive advantage in international trade. With the aforementioned factors in mind, the present assessment was done with the objective to identify the remunerative cropping sequence under different fertigation levels.

Materials and Methods

The experiment was laid out in split plot designat the research farm of Zonal Agricultural Research Station (ZARS), Ganeshkhind, Pune, during the *kharif* and *rabi* seasons of 2021. The main plot treatments comprised of three cropping sequences *viz.*, CS_1: sweet corn- broccoli; CS_2: sweet corn-rajmah and CS_3: sweet corn- onion, and sub plot treatments comprised of three fertigation levels *viz.*, F_1: 100 % RD NPK through fertigation; F_2: 80% RD NPK through fertigation and F_3: 60% RD NPK through fertigation with three replications.The soil of the experimental field was clayey in texture, low in available nitrogen (232.13 kg ha^{-1}), medium in available phosphorus (23.41 kg ha^{-1}), and high in available potassium (406 kg ha^{-1}). The soil was alkaline in reaction (pH 8.27) with electrical conductivity 0.28 dSm^{-1} and 0.49 percent organic carbon content.Sweet corn was the common crop in *kharif* season and it was followed by broccoli, rajmah and onion in *rabi* season for three different sequences. For assessing cropping sequences, the yield of *rabi* crops i.e., broccoli, rajmah and onion was converted into sweet corn equivalent yield. Cropping sequence assessment was done by using formulae:

$$\text{a) sweet corn equivalent yield} = \frac{\text{Rabi crop yield (t ha-1)} \times \text{Market price of that crop (₹ t-1)}}{\text{Market price of sweet corn (₹ t-1)}}$$

$$\text{b) Production efficiency (Kg ha-1day-1)} = \frac{\text{Sweet corn equivalent yield (kg ha-1)}}{\text{Total duration of crops in system}}$$

$$\text{c) Economic efficiency}(₹ha^{-1}day^{-1}) = \frac{\text{Net monetary returns from cropping sequence (₹ ha}^{-1})}{\text{Total duration of crops in system}}$$

$$\text{d) Land use efficiency (\%)} = \frac{\text{TDN (i)} \times 100}{365}$$

Where, TDN = total number of days field remained occupied by crops in sequence (i = 1….n). 365 = total number of days in a year

The data recorded on *kharif* sweet corn and various *rabi* sequence crops on various characteristics was analyzed following the analysis of variance for split-plot design. The common indices studied for assessment of cropping systems *viz*., sweet corn equivalent yield in *kharif* and *rabi* season and total system productivity were statistically analyzed by using the technique of analysis of variance [7] and test of significance [8] in split-plot design for cropping systems. Wherever, the treatment differences were found significant (F test), critical differences were worked out at 5% level of significance and furnished along the mean values of parameters concerned in tables.

Results and Discussion

Effect of cropping sequence

Data from **Table 1** revealed that the sweet corn equivalent yield was affected non-significantly in *kharif* season due to crop sequence. While it was affected significantly in *rabi*season by different cropping sequences. In rabi season, rajmah crop recorded significantly highest sweet corn equivalent yield (50.08 t ha^{-1}). However, onion recorded at par sweet corn equivalent yield (45.13 t ha^{-1}) (Fig. 1).Sweet corn- rajmah (CS_2) cropping sequence recorded significantly higher total system productivity (64.31 t ha^{-1}) in terms of sweet corn equivalent yield which was followed by sweet corn- onion (CS_3) cropping sequence with total system productivity of 58.39 t ha^{-1}. The higher total system productivity in sweet corn- rajmah (CS_2) sequence obtained due to higher green pod yield of rajmah obtained in *rabi* season and the higher market rate of rajmah green pods.

Among cropping sequences sweet corn- rajmah (CS_2) cropping sequence recorded maximum system production efficiency (267.95 kg ha^{-1} day^{-1}) and economic efficiency (2133 ₹ ha^{-1} day^{-1}) followed by sweet corn onion (CS_3) cropping sequence. (Fig. 2 and 4) This might be due to high total system productivity of sweet corn- rajmah (CS_2)

cropping sequence in terms of sweet corn equivalent yield and relatively shorter duration of cropping sequence than other two cropping sequences. Sweet corn- onion (CS_3) was at second rank due to the higher yield potential of onion but relatively longer duration of the sequence. Longer duration of the onion in field resulted into longer duration of cropping sequence and hence sweet corn- onion (CS_3) sequence recorded highest land use efficiency (57.53%) followed by sweet corn- broccoli (CS_1) (46.58 %) cropping sequence. (Table 1) (Fig 3)

Table 1 Sweet corn equivalent yield, system production efficiency, land-use efficiency and economic efficiency as influenced by different treatments

Treatment	Sweet corn equivalent yield (t ha^{-1})			System production efficiency (kg ha^{-1} day^{-1})	Land use efficiency (%)	Economic efficiency (₹ ha^{-1} day^{-1})
	Kharif	*Rabi*	Total system productivity			
Main: Cropping sequences (CS)						
CS_1: Sweet corn- Broccoli	13.27	33.01	46.27	192.81	46.58	1335
CS_2: Sweet corn- Rajmah	14.22	50.08	64.31	267.95	45.21	2133
CS_3: Sweet corn- Onion	13.26	45.13	58.39	216.25	57.53	1359
SE(m) ±	0.46	1.61	1.31	-	-	-
C.D. at 5%	NS	6.34	5.16	-	-	-
Sub: Fertigation levels (F)						
F_1:100 % RD NPK	15.08	47.62	62.70	250.82	-	1897
F_2: 80 % RD NPK	13.81	44.84	58.65	234.59	-	1715
F_3: 60 % RD NPK	11.86	35.76	47.62	190.47	-	1186
SE(m) ±	0.55	1.12	0.98	-	-	-
C.D. at 5%	1.69	3.45	3.03	-	-	-
Interaction (CS X F)						
SE(m) ±	0.90	2.26	1.91	-	-	-
C.D. at 5%	NS	NS	NS	-	-	-

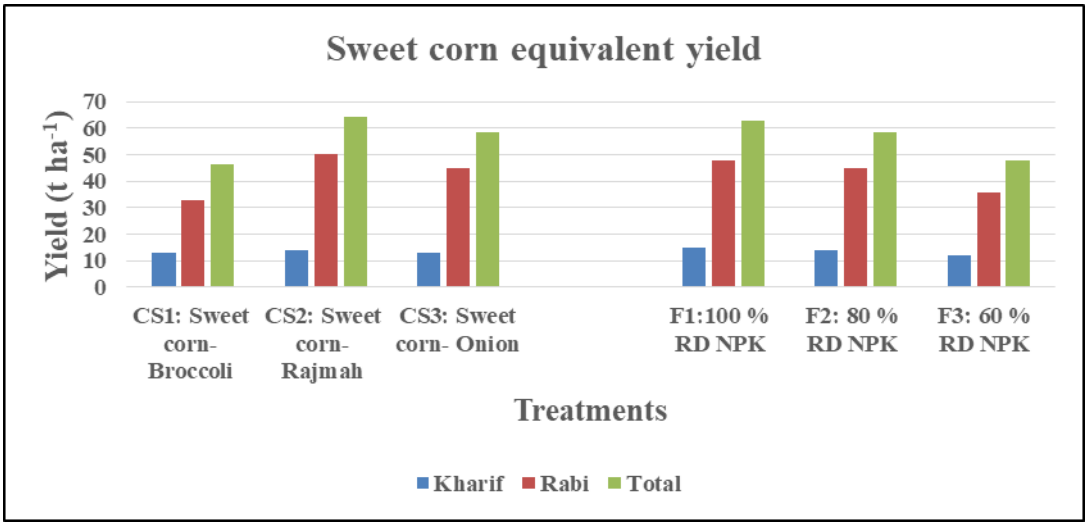

Figure 1 Sweet corn equivalent yield of cropping sequences as influenced by different treatments

Effect of fertigation levels

Application of 100 % RD NPK (F_1) through fertigation recorded significantly maximum sweet corn yield (15.08 t ha^{-1}) in *kharif* season, sweet corn equivalent yield (47.62 t ha^{-1}) in *rabi* season and total system productivity (62.70 t ha^{-1}) at the end of cropping sequence. However, it was found at par with 80 % RD NPK (F_2) through fertigation in *kharif* and *rabi* season. This might be due to application of adequate amount of nutrients through fertigation led to higher uptake, less losses, more production of source and sink and better translocation of nutrients from source to sink resulted into better growth and higher yield of crops in sequence. Similar results were recorded by [9-12] for corn and [13] and [14] for cabbage crops. (Table 1)

Similarly, the system production efficiency (250.82 kg ha^{-1} day^{-1}) and economic efficiency (1897 ₹ha^{-1} day^{-1}) was recorded maximum with the application of 100 % RD NPK (F_1) (Fig. 2 and 4) through fertigation which was followed by 80 % RD NPK (F_2) through fertigation. This might be due to application of more amount of nutrients at frequent

interval through 100 % RD NPK through fertigation resulted into more yield of individual crops in sequence, total system productivity and more net monetary returns from cropping sequences (Table 1).

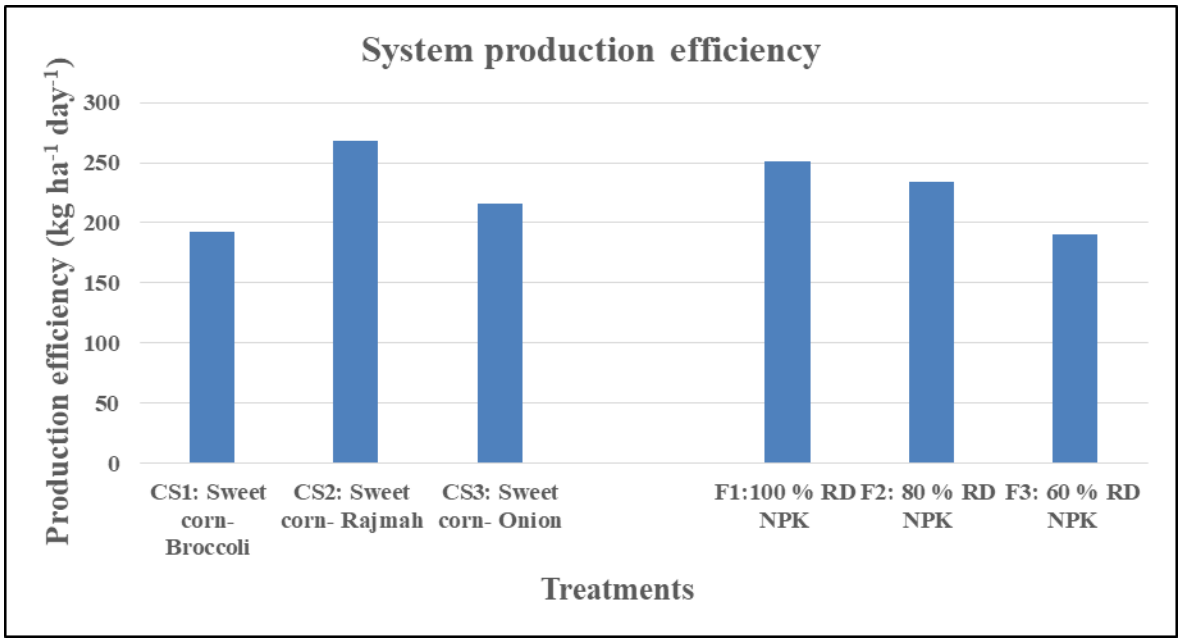

Figure 2 System production efficiency of cropping sequences as influenced by different treatments

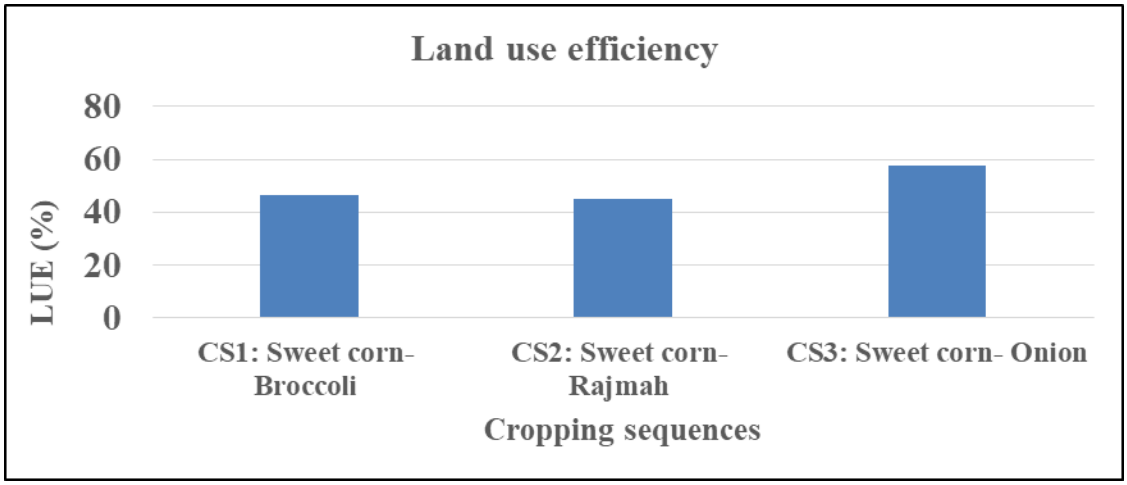

Figure 3 Land use efficiency of cropping sequences as influenced by different treatments

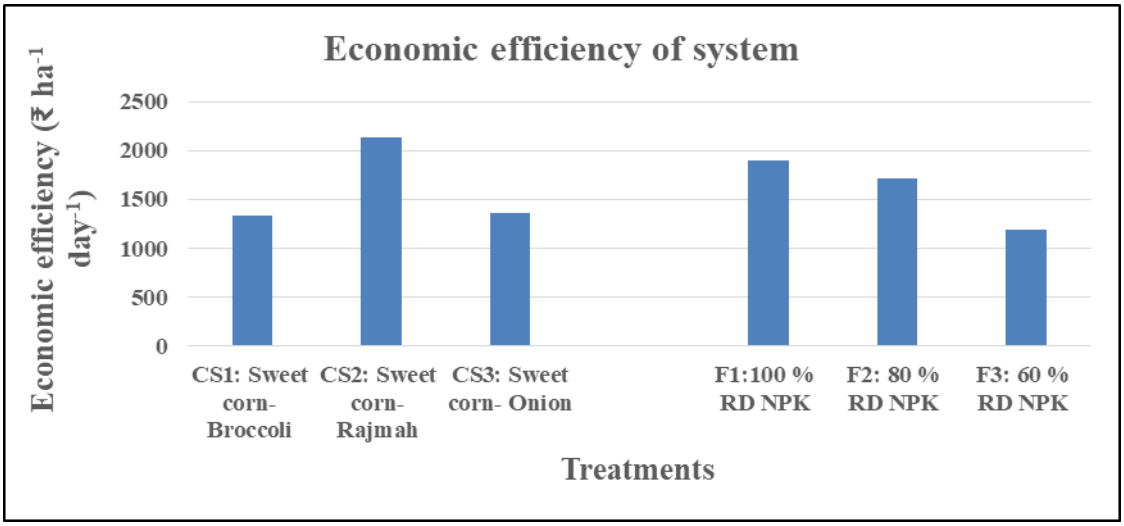

Figure 4 Economic efficiency of cropping sequences as influenced by different treatments

Economics

Among cropping sequences sweet corn- rajmah (CS_2) cropping sequence recorded highest net monetary returns (₹512040) and B: C ratio (2.73) and among fertigation levels, 100 % RD NPK (F_1) through fertigation recorded highest net monetary returns (₹ 474202) and B: C ratio (2.49). (Table 2) (Fig 4)

Table 2 System economics of cropping sequences as influenced by different treatments

Treatments	Cost of cultivation (₹ha^{-1})	Gross returns (₹ ha^{-1})	Net returns (₹ ha^{-1})	B:C
Main: Cropping sequences (CS)				
CS_1: Sweet corn- Broccoli	271687	592174	320486	2.18
CS_2: Sweet corn- Rajmah	296555	808595	512040	2.73
CS_3: Sweet corn- Onion	370874	737782	366908	1.99
Sub: Fertigation levels (F)				
F_1:100 % RD NPK	317843	792045	474202	2.49
F_2: 80 % RD NPK	313064	741788	428724	2.37
F_3: 60 % RD NPK	308209	604718	296509	1.96

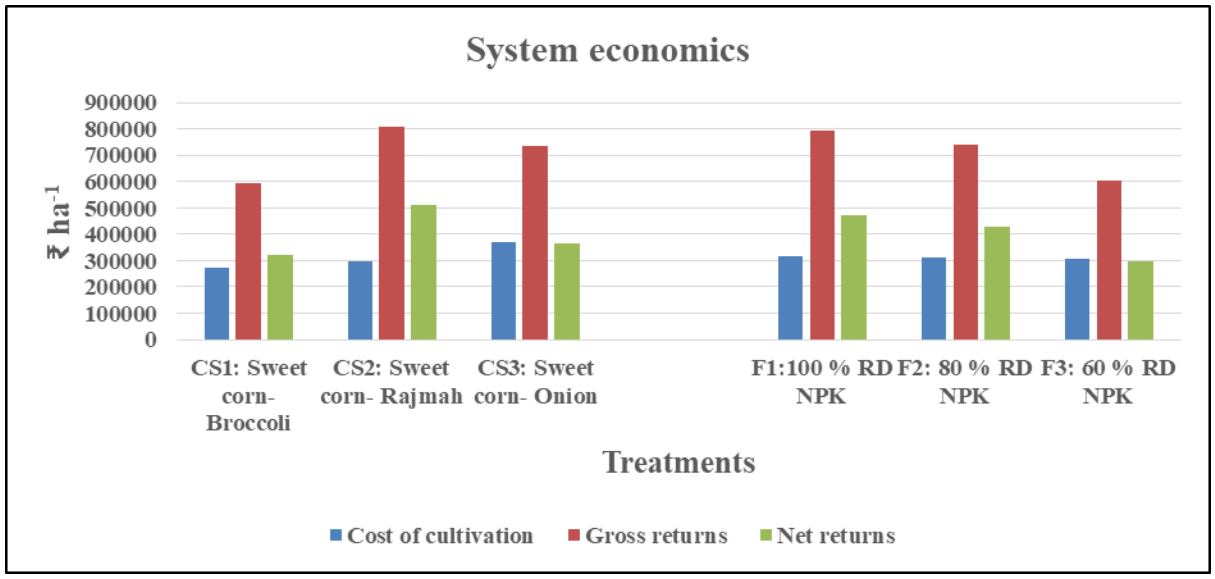

Figure 5 System economics of cropping sequences as influenced by different treatments

Conclusion

Sweet corn-rajmah cropping sequence with application of 100 % recommended dose of NPK through fertigation recorded maximum sweet corn equivalent yield, total system productivity, production efficiency, economic efficiency, net monetary returns and B: C ratio and found more remunerative. This system will be remunerative practice of growing sweet corn and vegetables for the farmers in peri- urban areas. Market prices of crops used for assessment of sweet corn equivalent yield: Sweet corn: ₹ 12 kg^{-1} Broccoli: ₹ 100 kg^{-1} Rajmah pods: ₹ 60 kg^{-1} Onion: ₹ 20 kg^{-1}.

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