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On-farm crop response to plant nutrients in pre-dominant cropping systems

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Abstract

The Pearlmillet and Wheat cropping sequence has gained popularity in scarcity zone of Western Maharashtra. A Field experiment was conducted on cultivator's field during *Kharif* and *Rabi* season of 2017-18 on medium black soil in scarcity zone of Satara district in Western Maharashtra to study the crop response to plant nutrients in pearlmillet-wheat cropping systems. The field experiment was carried out on farmer's field in Randomized block design with twenty four replication and seven treatments the treatment comprised of recommended dose of N, P₂O₅ and K₂O (50:25:25 kg/ha for Pearlmillet and 120:60:40 kg/ha for wheat) along with micronutrient on soil test basis (25 Kg and 20 kg ZnSO₄ / ha for pearlmillet and wheat, respectively.) has obtained significantly higher yield of grain (26.78 q/ha) and straw (42.96 q/ha) of pearlmillet. Such yields of pearlmillet have shown an increase of 35.10 and 52.90 percent, respectively over control treatment. The same treatment accrued significantly higher yield of wheat grain (33.33 q/ha) and straw (52.01 q/ha) as compared to other treatments, which has indicated an increase of 34.28 and 54.46 percent of grain and straw, respectively over control treatment. The highest gross returns, net returns and B:C ratio were observed in respect of *kharif* pearlmillet were `43,931.08, `36,855.46 and 1.19, respectively. In case of *rabi* wheat the highest gross returns, cost of cultivation, net returns and B:C ratio were `67,800.81, `40,010.63 `27790.19 and 1.69.

Keywords: RDF, plant nutrient, pearlmillet-wheat cropping system

Introduction

The Pearlmillet and Wheat cropping sequence has gained popularity in scarcity zone of Western Maharashtra state. Cropping sequence is traditionally a low cost input agriculture system. Information on nutrient management on individual crops is available, while in cropping system it is lacking. Moreover, the single nutrient approach has been replaced by multinutrient to prove balanced nutrient to boost up crop productivity and nutrient use efficiency. In the scarcity zone the soil is also deficit with micronutrient and on the basis of soil sample analysis micronutrients has been added in treatment. Besides nutrient management in cropping system is more efficient and judicious than individual crop, as following crop take care of the residual effects of nutrients N, P, K and micronutrient. The high productivity and low productivity blocks in Phaltan and Khandala, respectively of Satara district (Maharashtra) selected for conducting the experiments on farmers field with farmer's participatory approach. Keeping in view the present investigation was undertaken with the specific objectives in order to know the nutrient response of dominant cropping sequence, to find out the response of N, P and K fertilizers on farmers field and to estimate economics in respect of selected cropping sequence taken on farmers' field.

Material and Methods

The Satara district was purposively selected with intension of carrying out present research on farmers' field in a scarcity zone of western Maharashtra. The two blocks namely Phaltan and Khandala were selected owing to that the production of proposed crops in a selected cropping sequence i.e. Pearl millet in *kharif* and Wheat in *rabi* is relatively higher as compared to other blocks of the district. Three villages each from so selected blocks, thus, in all six villages were also chosen purposely for the year 2017-18. Twenty four farmers were selected for pearlmillet cultivation in *kharif* season and wheat crop for *rabi* season. The details are shown in Table 1 and 2. The data of experiment was collected and analyzed by cost accounting method with the help of specially designed schedule.

The initial soil status of the experimental sites had of pH 8.04 to 8.77, EC 0.11 to 1.10 mmos/m, organic carbon 0.22 to 1.07, available N 97 to 285 kg/ha, P₂O₅ 4 to 24 kg/ha and K₂O 228 to 661 kg/ha. The soil was tested for micronutrient deficiencies and it was found Zn deficient with 0.47 to 4.35 ppm an accordingly ZnSO₄ was applied in treatment T₆.

The experiment was conducted on the same field in both the season.

Table 1: Blockwise selection of villages from Satara district

District	Block	Sr. No.	Name of village
Satara	Phaltan (High productive)	1	1. Aradgaon
		2	2. Chawanwadi
		3	3. Chambharwadi
	Khandala (Low productive)	1	4. Khed
		2	5. Sukhed
		3	6. Nimbodi

Table 2: Village and seasonwise distribution of selected farmers (2017-18)

Block	Sr. No.	Village	Season	
			Kharif	Rabi
Phaltan (High productive)	1	1. Aradgaon	4	4
	2	2. Chawanwadi	4	4
	3	3. Chambharwadi	4	4
Khandala (Low productive)	1	4. Khed	4	4
	2	5. Sukhed	4	4
	3	6. Nimbodi	4	4
	Total		24	24

The particulars of treatments conducted in *kharif* and *rabi* seasons during 2017-18 are given in Table 3.

Table 3: Treatments conducted in *kharif* and *rabi* seasons of the year under study

Treatments	Pearl millet	Wheat (RDF 120:60:40 NPK kg/ha)
T ₁ : Control	No fertilizer	No fertilizer
T ₂ : N	N 50kg/ha	N 120kg/ha
T ₃ : N+P ₂ O ₅	N 50kg/ha+ P-25kg/ha	N 120kg/ha + P 60kg/ha
T ₄ : N + K ₂ O	N 50kg/ha+ K-25kg/ha	N120kg/ha + K 40kg/ha
T ₅ : N+ P ₂ O ₅ +K ₂ O	N 50kg/ha+ P-25kg/ha+ K-25kg/ha	N120kg/ha +P 60kg/ha+ K 40kg/ha
T ₆ : N+ P ₂ O ₅ +K ₂ O + MN*	N 50kg/ha+ P-25kg/ha+ K-25kg/h+ Micronutrient as per soil test	N120kg/ha+ P 60kg/ha+ K 40kg/ha + Micronutrient as per soil test
T ₇ : Farmers Practice	As per farmer	As per farmer

Pearl millet (RDF 50:25:25NPK kg/ha), Wheat (RDF 120:60:40 NPK kg/ha) (RDF: Recommended Dose of Fertilizers)

Results and discussion

Influence of treatment of grain yield

The nutrient response was planned on dominant cropping sequence of *kharif* pearl millet followed by *rabi* wheat in Phaltan and Khandala block of Satara district and the data are presented in Table 4.

It is evident from the data (Table 4) that the treatment differences were found to be significant in case of both *kharif* Pearl millet and *rabi* wheat. The treatment T₆ comprised of recommended dose of N, P₂O₅ and K₂O (50 kg of N/ha + 25 Kg of P₂O₅/ha + 25 kg of K₂O/ha for pearl millet and 120 kg of N/ha + 60 kg of P₂O₅/ha + 40 kg of K₂O/ha for wheat) along with micronutrients on soil test basis (25 kg of

ZnSO₄/ha for pearl millet+ 20 kg of ZnSO₄/ha wheat) obtained significantly higher yield of grain (26.78 q/ha), straw (42.96 q/ha) followed by treatment T₅ grain (24.79 q/ha) and straw (41.65 q/ha) of pearl millet. Such yields of pearl millet have shown an increase of 35.10 and 52.90 per cent, respectively over control treatment (T₁). The same result was obtained in case of wheat crop treatment T₆ has accrued significantly higher yield grain (33.33 q/ha) and straw (52.01 q/ha) followed by T₅ grain (32.43 q/ha) and straw (50.58 q/ha) as compared to other treatments, which has indicated an increase grain of 34.28 and straw 54.46 per cent over control. The result are corroborative with [1] and [3].

Table 4: Mean yield of grain and straw of *kharif* pearl millet and *rabi* wheat cropping sequence

Treatments	Treatment details	Yield (q/ha)			
		Pearlmillet		Wheat	
		Grain	Straw	Grain	Straw
T ₁	Control (No fertilizers)	19.82	32.47	26.54	41.21
T ₂	Recommended dose of N (50 kg N/ha for pearl millet & 120 kg N/ha for wheat)	21.52 (8.56)	33.72 (6.30)	28.44 (9.58)	44.18 (14.97)
T ₃	Recommended dose of N, P ₂ O ₅ (50 kg N/ha + 25 kg P ₂ O ₅ /ha for pearl millet and 120 kg N/ha + 60 kg P ₂ O ₅ /ha for wheat)	22.67 (14.35)	34.97 (12.60)	30.30 (18.97)	47.12 (29.80)
T ₄	Recommended dose of N, K ₂ O (50 kg N/ha + 25 kg K ₂ O/ha for pearl millet and 120 kg N/ha + 40 kg K ₂ O/ha for wheat)	23.67 (19.42)	40.18 (38.90)	31.36 (24.32)	48.82 (38.41)
T ₅	Recommended dose of N, P ₂ O ₅ and K ₂ O (50 kg N/ha + 25 kg P ₂ O ₅ /ha+ 25 kg K ₂ O/ha for pearl millet and 120 kg N/ha + 60 kg P ₂ O ₅ /ha + 40 kg K ₂ O/ha for wheat)	24.79 (25.06)	41.65 (46.30)	32.43 (29.72)	50.58 (47.27)
T ₆	Recommended dose of NPK + Micronutrients (based on soil test) to each of the component crops of cropping system.	26.78 (35.10)	42.96 (52.90)	33.33 (34.28)	52.01 (54.46)
T ₇	Farmer's Practice	21.42 (8.07)	32.82 (1.80)	28.95 (9.08)	43.25 (2.25)
	S. E.+	1.3	3.4	1.61	3.5
	C. D. at 5 %	3.81	9.12	4.90	9.25

[Figures in parentheses indicate percentage increase over Control (T₁)]

Economics

An attempt has been made to estimate the costs, returns and B:C ratio of pearl millet - wheat cropping sequence taken on farmers' field. It is apparent from Table 5 that the highest gross returns, net returns and B:C ratio were observed in

respect of *kharif* pearl millet adopting treatment T₆ i.e. recommended dose of N, P₂O₅ and K₂O (50 kg of N/ha + 25 kg of P₂O₅/ha + 25 kg of K₂O/ha) with micronutrients on soil test basis (25 kg of ZnSO₄/ha). The corresponding estimates were `43,931.08, `36,855.46 and 1.19, respectively.

This was followed by treatments T₅ (recommended dose of N, P₂O₅ and K₂O(50 kg N/ha + 25 kg P₂O₅/ha+ 25 kg K₂O/ha for pearl millet and 120 kg N/ha + 60 kg P₂O₅/ha + 40 kg K₂O/ha for wheat) and T₄ (recommended dose of N, K₂O (50 kg N/ha + 25 kg K₂O/ha for pearl millet and 120 kg N/ha + 40 kg K₂O/ha for wheat). In case of *rabi* wheat the highest gross returns, cost of cultivation, net returns and B:C ratio were

₹67,800.81, ₹40,010.63 ₹27790.19 and 1.69 was observed in treatment T₆ followed by treatment T₅ and T₂ (Recommended dose of N (50 kg N/ha for pearl millet & 120 kg N/ha for wheat). It is inferred that the treatment T₆ was superior in pearl millet - wheat cropping system. The similar findings were recorded by [2] and [4].

Table 5: Economics of kharif Pearlmillet-rabi wheat cropping sequence (₹/ha)

Treatment	Kharif Pearlmillet				Rabi Wheat			
	Gross returns	Cost of cultivation	Net returns	B:C ratio	Gross returns	Cost of cultivation	Net returns	B:C ratio
T ₁	32619.79	30307.92	2311.88	1.08	53953	35725.63	18227.38	1.51
T ₂	35180.83	31093.46	4087.38	1.13	57816.5	36955.63	20860.88	1.56
T ₃	36977.10	32264.50	4712.60	1.15	61606.25	41206.88	20399.38	1.50
T ₄	39165.92	33597.08	5568.83	1.17	63772.44	44508.13	19264.31	1.43
T ₅	40949.94	34650.79	6299.15	1.18	65959.69	39390.63	26569.06	1.67
T ₆	43931.08	36855.46	7075.63	1.19	67800.81	40010.63	27790.19	1.69
T ₇	34911	31536.71	1292.83	1.10	58597.5	38466.46	23131.04	1.52

Conclusions

The significantly higher grain and straw yield of kharif pearl millet and rabi wheat were recorded in case of treatment T₆ comprised of N, P₂O₅ and K₂O (50 kg of N/ha + 25 kg of P₂O₅ /ha + 25 kg of K₂O /ha for pearl millet and 120 kg of N/ha + 60 kg of P₂O₅ /ha + 40 kg of K₂O /ha for wheat) with micronutrients on soil test basis such as 25 kg of ZnSO₄/ha for pearl millet + 20 kg of ZnSO₄/ha for wheat. As a result the gross returns, net returns and B:C ratio for these crops were found highest adopting such treatment T₆.

The pearl millet and Wheat cropping sequence gets better yield to plant nutrient response and net returns on farmer's field. Therefore this cropping system is suitable in Phaltan and Khandala blocks of Satara District.

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