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Research Paper

Assessment of nutrient combinations for economical sustainability of pearlmillet – mustard cropping system

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ABSTRACT: *The present study was carried out two consecutive year i.e. Kharif 2020 to Rabi 2021-22 with aimed to see the effect of different nutrient combination on productivity and economics of pearl millet-mustard cropping system in alluvial soil. The result revealed that the maximum economic yield of both crops obtained in 100% NPK + 10 t FYM $ha^{-1}Yr^{-1}$ treatment (2.17 and 2.24 t ha^{-1} in pearl millet and mustard, respectively) which was statistically at par with 150% NPK and 100% NPK + 25 kg $ZnSO_4$ $ha^{-1}Yr^{-1}$ treatments. Application of 150% NPK recorded maximum stover yield of both crops but was statistically at par with 100% NPK+ 10 t FYM $ha^{-1}Yr^{-1}$ treatment. Under pearlmillet-mustard cropping system, maximum return was observed in mustard as compared to pearlmillet crop in all the treatments. Maximum net income (Rs. 113734 ha^{-1}) and B:C ratio (2.92) was also observed with100% NPK+ 10 t FYM $ha^{-1}Yr^{-1}$ treatment*

KEYWORDS: *B:C ratio, cropping system, Economic yield, FYM , Net income, Pearlmillet- mustard*

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I. INTRODUCTION

Nutrient management is an important key operation in crop production. For this purpose, sole use of inorganic fertilizers in imbalance and indiscriminate manner has led to the adverse effect on economical production as well as soil health. Earlier mustard crop is grown under mono cropping system in the northern Madhya Pradesh and Nearly 2.85 lakh hectares of land is kept fallow in *Kharif* followed by mustard in *Rabi*, resulting in low cropping intensity and productivity. Therefore, replace this traditional practice and to increase the cropping intensity as well as profit per unit area. Introduce high yielding and short duration varieties of hybrid Pearl millet by different agencies in the market and MSP of pearlmiilet was also increase year by year so that hybrid Pearl millet– mustard cropping system got popularized under limited and assured irrigated condition [1]. As a general practice of this region farmers apply only N and P regularly in imbalance and indiscriminate manner and some of the farmers apply variable amounts of farm yard manure (FYM) along with imbalanced fertilizers. Under these conditions economical yield of both crop as well as sustainability of this cropping system are affected and not reach the economical productivity of the system. With these considerations, the present investigation was carried out with different nutrient combination for finding economical sustainability of pearlmillet – mustard cropping system in alluvial soils.

II. MATERIALS AND METHODS

Present investigation was carried out during two consecutive year i.e. *Kharif* 2020 to *Rabi* 2021-22 at experimental farm of soil science department, college of agriculture, Rajmata Vijayraje Sciendia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh. The experimental soil was sandy clay loam in texture belong to alluvial soils which was normal in pH (7.87) and low in organic carbon content. Status of available N, P and K was observed as per standard methods [2] and available N found in low whereas P and K were medium category. The recommended N, P and K dose, was 80 kg N, 40 kg P_2O_5 and 20 kg K_2O ha^{-1} for both crops which applied through urea, single superphosphate and muriate of potash. Farm yard manure applied @ 10 t ha^{-1} yr^{-1} as per treatments before sowing of pearl millet crop during *Kharif* season. The variety of Hybrid Pearl millet (86M90) and mustard (NRCHB-101) was used in present experiments. At maturity stage, crops were harvested separately from the net experimental plots and tied in bundles and kept for sun drying for 3-4 days, and then weighed to record biological yield per plot. Threshing was done by manual labour separately with wooden sticks, followed by winnowing with the help of indigenous winnower *Supa* (Local name). Yield per plot was recorded after

cleaning the seeds. Straw yield was calculated by subtracting grain yield from bundle weight (biological yield) of total produce. Economics of the cropping system were studied on the basis of two year pooled data and prevalent market prices of the different input.

III. RESULTS AND DISCUSSION

3.1: Crop productivity

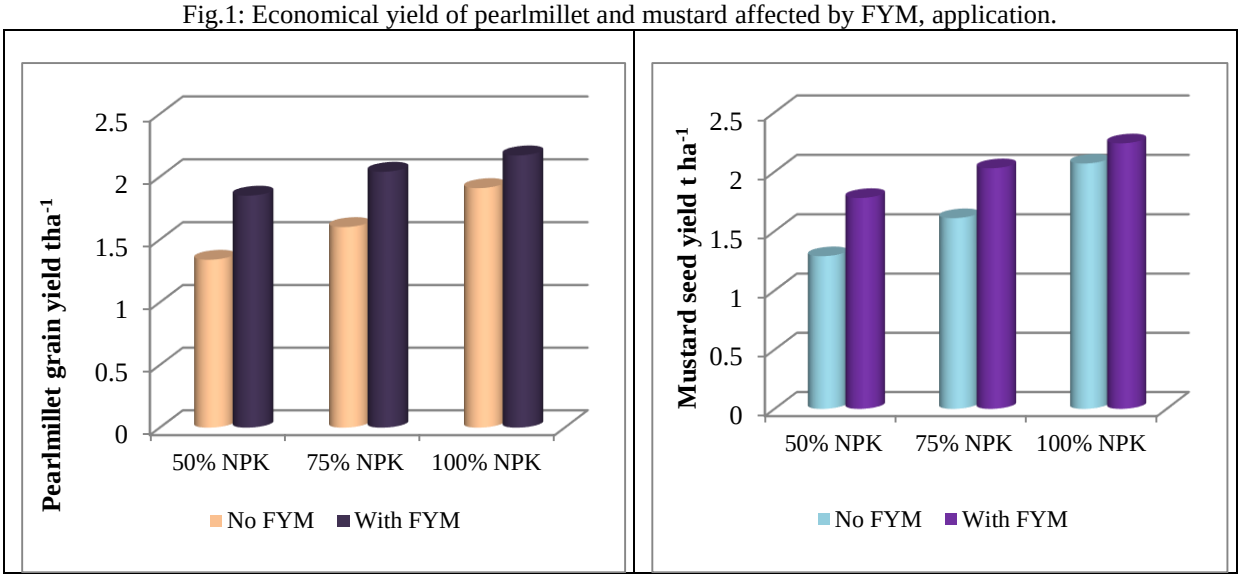
Mean data of yields presented in table 1, revealed that Application nutrients applied treatments recorded significantly higher grain and stover yields as compared to control and 100% NPK recorded significantly higher grain yield of pearlmillet and mustard over potassium free i.e. 100% N and 100% NP treatments. The increase in grain and stover yield might be due to adequate quantities and balanced proportions of plant nutrients supplied to the crop as per need during the growth period resulting in favourable increase in yield attributing characters which ultimately led towards an increase in economic yield. The findings confirm the results of [3] and [4]. Yield improvement in yield due to potassium was also reported by [5]. Maximum grain yield (2.17 t ha^{-1}) of pearlmillet and seed yield (2.24 t ha^{-1}) of mustard recorded in 100% NPK + 10 t FYM ha^{-1} yr^{-1} treatment was significantly higher than other all treatments except 150% NPK and 100% NPK + 25 kg $ZnSO_4$ $ha^{-1}Yr^{-1}$ treatments. Supplemental application of FYM (10 t FYM ha^{-1} yr^{-1}) or ZnSO4 (25 kg ha^{-1} yr^{-1}) with 100% NPK noticed significantly higher economical yield over alone 100% NPK treatments. The probable reason may be that the optimum NPK levels resulted in greater accumulation of carbohydrates, protein and their translocation to the productive organs, which in turn, improved all growth and yield attributing characters, resulting more economical yield. Besides this, the addition of either FYM or $ZnSO_4$ provided adequate balanced quantity of sulphur and zinc to the plant. The findings confirm the results of [6] and [7] .

Table -1: Trends in yields of pearlmillet and mustard as influenced by different nutrient combinations
(Pooled mean of two years)

Tr. No	Treatments	Pearlmillet		Mustard	
		Yield (t ha^{-1})			
		Grain	**Stover**	Seed	**Stover**
T_1	Control	0.87	2.25	0.76	2.08
T_2	100% N	1.25	2.93	1.10	2.87
T_3	100% NP	1.63	3.66	1.45	3.23
T_4	50% NPK	1.34	3.11	1.29	2.93
T_5	75% NPK	1.60	3.52	1.61	3.48
T_6	100% NPK	1.91	4.00	2.07	4.21
T_7	50% NPK+ 10t FYM $ha^{-1}Yr^{-1}$	1.85	4.17	1.78	3.63
T_8	75% NPK+ 10t FYM $ha^{-1}Yr^{-1}$	2.04	4.38	2.03	4.01
T_9	100% NPK+ 10t FYM $ha^{-1}Yr^{-1}$	2.17	4.39	2.24	4.31
T_{10}	100% NPK + 25 kg $ZnSO_4$ $ha^{-1}Yr^{-1}$	2.08	4.31	2.16	4.24
T_{11}	100% NPK + 40 Kg $FeSO_4$ $ha^{-1}Yr^{-1}$	2.03	4.33	2.13	4.22
T_{12}	150% NPK	2.10	4.41	2.16	4.46
	C. D. (0.05 P)	**0.10**	**0.24**	**0.10**	**0.26**

The application of organic manure (10 t FYM ha^{-1} yr^{-1}) along with different NPK dose (50, 75 and 100% NPK) was observed to be beneficial in enhancing the crop productivity of pearl millet and mustard over their respective NPK alone (Fig. 1). The beneficial effect of FYM clubbing may be due to additionnal nutrient supply from its decomposition, enhanced mobilization of nutrients from the soil, activation of beneficial soil biological activities through which nutrient availability was increased as well as improved physical condition of soil which provided the plant a good food hold to grow and develop. The similar beneficial effects of FYM along with NPK have been reported by [8]. The lowest grain/seed and stover yields of pearl millet and mustard were recorded in control treatment.

Fig.1: Economical yield of pearlmillet and mustard affected by FYM, application.



3.2: Economical studies

Economics of the pearlmillet-mustard cropping system were studied on the basis of two year pooled data and prevalent market prices of the different input.

3.2.1: Cost of cultivation:

General cost of cultivation i.e. excluding treatment was common @ 48700/- ha for all the treatments which include land preparation, cost of seed, sowing, irrigation, inter-culture, plant protection irrigation, harvesting and Threshing operations in both crops of the system. Treatment cost was calculated as per market price of various fertilizer and FYM used in present treatment and it was found minimum (Rs. 00 ha^{-1}) in control and maximum (Rs. 11305 ha^{-1}) in 150% NPK treatment. Total cost of cultivation (Table -2) was observed in the range of 48700 to 60005 $Rs.ha^{-1}$. The variation in total cost of cultivation in the treatments was due to different nutrient combination and doses which affect the cost.

3.2. Gross income:

Under different treatments, gross income was recorded in the range of Rs. 63294 to 172971 ha^{-1}. Data embodied in Table 2, revealed that maximum gross income Rs. 172971 ha^{-1} was in 100% NPK+ 10t FYM ha^{-1} Yr^{-1} which is closely followed by 150% NPK treatment with Rs. 67748 ha^{-1} while the minimum under control treatment. These results are similar to yield of crop obtained from different treatments and confirm to the findings of [9] and [10].

3.2.3: Net income:

Data encamped in Table 2 propel that the nutrient applied all treatments gave more net return as compared to control. The maximum net return of Rs. 113734 ha^{-1} was obtained from 100% NPK+ 10t FYM ha^{-1} Yr^{-1} which is closely followed by 100% NPK+ 25 kg $ZnSO_4$ ha^{-1} Yr^{-1} treatment with Rs. 109411 ha^{-1} while the minimum under control treatment. This might be due to the fact that these treatments supplied balanced proportions of plant nutrients to the crop as per need which increase in grain and stover yield and finally net income.

3.2.4: Benefit : cost ratio :

All the nutrient which was applied in different combination and doses resulted more benefit : cost ratio over control. Under different treatment maximum B:C ratio (2.92) obtained from 100% NPK+ 10t FYM ha^{-1} Yr^{-1} which is closely followed by 100% NPK+ 25 kg $ZnSO_4$ ha^{-1} Yr^{-1} treatment with 2.89 B:C ratio. Whereas minimum B:C ratio was observed (1.30) under control treatment. Similar finding were also reported by [11] . Application of 100% NPK alone or with either micronutrient (Zn/Fe) or FYM recorded the higher benefit : cost ratio as compared to 100 % N and 100% NP applied alone. The net returns and benefits obtained were highest in FYM applied treatments due to the low cost of FYM application because it is a byproduct of milch animal and easily available in rural farm. The additional cost of FYM was compensated by the additional yield of pearlmillet as well as in mustard. Integrated application of NPK fertilizers along with FYM in field crops not only influences growth and production of plant but at the same time also reduces the production budget [12].

IV. CONCLUSION

The results revealed that the balanced NPK fertilization increased the productivity as compared to 100% N & 100% NP treatments. Integration of FYM with different levels of NPK increased the productivity of pearl millet and mustard over NPK alone treatments. Further, the results obtained in present study indicate that of all the treatments tested, balanced NPK fertilization along with an adequate amount of FYM in addition was a 'win–win' technology for sustainability of pearlmillet-mustard cropping system and increasing farm income.

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Table 2: Economics of pearlmillet - mustard cropping system as influenced by different treatments (Mean data of two years)

Tr. No.	Treatments	Economics of pearlmillet - mustard cropping sequence							
		Cost of cultivation (Rs./ha)			Return (Rs./ha)*		Gross income (Rs./ha)	Net income (Rs./ha)	B:C Ratio
		Excluding treatment	treatment	Total	Pearlmillet	Mustard			
T_1	Control	48700	0	48700	18953	44340	63294	14594	1.30
T_2	100% N	48700	2436	51136	26834	63931	90765	39629	1.77
T_3	100% NP	48700	5936	54636	34857	82976	117833	63197	2.16
T_4	50% NPK	48700	3768	52468	28772	73939	102710	50242	1.96
T_5	75% NPK	48700	5653	54353	34154	92353	126507	72154	2.33
T_6	100% NPK	48700	7537	56237	40433	118201	158633	102396	2.82
T_7	50% NPK+ 10t FYM/ha/ Yr	48700	6768	55468	39556	101779	141335	85867	2.55
T_8	75% NPK+ 10t FYM/ha/Yr	48700	8653	57353	43293	115861	159155	101802	2.77
T_9	100% NPK+ 10t FYM/ha/Yr	48700	10537	59237	45720	127251	172971	113734	2.92
T_{10}	100% NPK+ 25 kg $ZnSO_4$ / ha/yr	48700	9037	57737	43896	123252	167148	109411	2.89
T_{11}	100% NPK + 40 Kg $FeSO_4$/ ha/yr	48700	11137	59837	43079	121188	164267	104430	2.75
T_{12}	150% NPK	48700	11305	60005	44461	123287	167748	107743	2.80

*Calculated as on Sale price of Pearlmillet grain = 18/-kg, Mustard seed= 54/-kg, Stover of both crops 1.5/-kg