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INFLUENCE OF SUMMER CROPPING AND FALLOWING ON FERTILIZER USE EFFICIENCY AND PRODUCTIVITY OF RICE

Rationalization of mineral nutrient consumption and integration of bio-nutrient sources deserve urgent attention in rice fanning to ensure higher profit margin and sustained productivity. Sandwitching suitable crops in between rice crops ensures better exploitation of various resources and add to the economic return. The present study was conducted in this context to identify the most economic rice based cropping pattern and to estimate the possible reduction in fertilizer use that could be achieved by following different crop sequences.

The study was conducted at the Agronomic Research Station, Chalakudy, Kerala for 12 years from 1978-79 to 1989-90 during kharif, rabi and summer. The soil was sandy loam with a pH of 5.5. It contained 0.55% organic carbon, 8.8 kg ha^{-1} of available P_2O_5 and 65.5 kg ha^{-1} of available K_2O. The bulk density was 1.41 g cm^{-3}.

The experiment was laid out in split plot design with four systems of cropping in the main plots and seven fertilizer schedules in the sub-plots, with four replications. Kharif and rabi rices followed by either fallow, daincha (*Sesbania aculeata*), sesamum (*Sesbania*

Table 1. Grain yield of rice during kharif, kg ha^{-1}

Treatments	RRF	RRD	RRS	RRC	Mean
F_1	2413	2594	2537	2401	2486
F_2	2303	2431	2384	2504	2405
F_3	2102	2273	2026	2225	2157
F_4	2086	2318	2111	2181	2174
F_5	2116	2320	2183	2226	2211
F_6	1752	2001	1847	2005	1901
F_7	1893	2174	1980	2175	2056
Mean	2095	2301	2152	2245	-

CD(0.05) : Systems of cropping - 92; Fertilizer schedules - 83; Interaction - NS
RRF - Rice, rice, fallow; RRD - Rice, rice, daincha; RRS - Rice, rice, sesamum; RRC - Rice, rice, cowpea

Table 2. Grain yield of rice during rabi, kg ha^{-1}

Treatments	RRF	RRD	RRS	RRC	Mean
F_1	2080	2046	2105	2092	2081
F_2	2024	1983	2096	1934	2010
F_3	1752	1913	1713	1817	1799
F_4	2107	2105	2164	2114	2122
F_5	1978	1957	2046	2002	1996
F_6	1761	1718	1775	1795	1762
F_7	1694	1718	1773	1757	1735
Mean	1914	1920	1953	1930	-

CD(0.05) : Systems of cropping - NS; Fertilizer schedule - 128, Interaction - NS

Table 3. Performance (yield) of crops during summer

Treatments	Grain yield, kg ha^{-1}		Green matter yield, t ha^{-1}	
	Sesamum	Cowpea	Cowpea	Daincha
F_1	352	464	15.7	22.9
F_2	343	476	15.6	20.1
F_3	285	450	14.6	19.1
F_4	338	461	15.2	20.6
F_5	286	493	15.2	19.1
F_6	256	429	14.0	18.5
F_7	345	504	15.7	20.6
Mean	NS	NS	NS	NS
CD (0.05)	NS	NS	NS	NS

indicum) or cowpea (*Vigna sinensis)* in summer, were the evaluated systems of cropping. The cropping systems are referred as RRF, RRD, RRS and RRC respectively. The fertilizer schedules comprised of : (F_1) recommended dose for each crop; (F_2) 75% of the recommended dose for each crop; (F_3) 50% of the recommended dose for each crop; (F_4) 50% of the recommended dose for kharif and 100% for rabi and summer; (F_5) 50% of the recommended dose for kharif and 75% for rabi and summer; (F_6) 25% of the recommended dose for kharif and 50% for rabi and summer; (F_7) 1/3 N and 100% P and K for kharif, 1/2 N and 100% P and K for rabi and 100% NPK for summer. The test varieties were Jaya for rice, Kanakamani for cowpea and Kayamkulam-1 for sesamum. The recommended fertilizer schedules were 90:45:45 kg NPK ha^{-1} for rice, 20:30:10 NPK kg ha^{-1} for cowpea and 20:15:10 kg NPK ha^{-1} for sesamum. Daincha received no fertilizer application. The 12 year data on grain yield of rice during kharif and rabi from 1978 to 1990 were subjected to pooled analysis and are presented in Tables 1 and 2 respectively.

The data on grain yield of cowpea and sesamum and the green matter production by daincha and cowpea during summer were also pooled and are presented in Table 3.

Grain yield of rice during kharif. There was significant variation in grain yield among the different cropping systems during kharif (Table 1). The highest yield was recorded by RRD which was followed by RRC and both were on par. The significant increase in the yield of rice succeeding daincha and cowpea was attributed to the addition of appreciable quantities of organic matter and the fixation of nitrogen. Antil *et al.* (1989) reported a similar increase in yield of rice due to daincha and greengram.

The effect of fertilizer levels on the yield of rice was significant during kharif. The treatments F_1 and F_2, receiving 100 or 75% doses, recorded comparable yields but out-yielded other treatments. Nitrogen was identified as the critical yield limiting nutrient since the lowering of N dose alone but maintaining P and K dose at 100% (F_7) failed to maintain the yield level. The residual effect of fertilizers applied during the preceding seasons and improved soil texture due to large addition of organic matter might have helped to lower the nutrient dose. Singh (1974) reported savings in fertilizers in a system due to multiple benefits.

Grain yield of rice during rabi: The cropping systems failed to influence the grain yield of rice during rabi showing the necessity of organic manure addition during each season (Table 2). The organic matter decomposition is very fast in tropical soils and it requires matching addition to maintain productivity particularly in coarse textured soils. There was significant variation in yield among the fertilizer levels during rabi season. The treatments (F_1, F_2, F_3

and F_4) receiving either 100 or 75% of the recommended level of NPK during rabi season, irrespective of the level of fertilizer they received during the previous season, recorded the highest and comparable yields. Limiting N alone to 50%, maintaining P and K fertilization at 100%, also resulted insignificant decrease in yield.

Performance of summer crops: The fertilizer levels failed to appreciably influence the grain yield of sesamum and cowpea as well as the green matter yield of cowpea during summer (Table 3). Unfertilized daincha also did not show any variation in green matter yield due to the residual effect of fertilizers.

Performance of the cropping systems and their fertilizer requirement: The data obtained during kharif clearly indicated the influence of daincha and cowpea in increasing the yield of succeeding rice. Organic manure application is a major component of an integrated nutrient management system in rice but the restricted supply and high cost limit its use. Raising daincha and cowpea during summer involves only limited expenditure and hence can successfully substitute other sources of organic manures. Cowpea is additionally advantageous since it yields an economic produce.

Lowering nutrient application to 75% did not affect rice yield during kharif and rabi. Inclusion of leguminous crops in the system reduced the mineral nutrient requirement of rice without any adverse effect on grain yield. The study revealed that chemical fertilizer application in rice can be reduced to 75% when an ideal cropping sequence is followed.

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