ABSTRACT

A field experiment entitled, “Effect of integrated nutrient management in rice-potato cropping system” was conducted during kharif and rabi seasons of 2007-08 and 2008-09 under irrigated condition on upland sandy loam soil in the Central Research Station of the Orissa University of Agriculture and Technology, Bhubaneswar. The soil was low in organic carbon (0.541%), N (228 kg/ha), K (122 kg/ha) and medium in available P (18 kg/ha). The experiment was laid out in randomized block design with each treatment replicated thrice which consisted of twelve treatments in rice during kharif season (viz. T_1 - Control i.e. no manure and fertilizer, T_2 - 100% recommended dose of nitrogen (RDN) as chemical fertilizer (CF), T_3 - 75% RDN as CF+25% RDN as FYM, T_4 - 75% RDN as CF+50% RDN as dhaincha, T_5 - 75% RDN as CF + 25% RDN as Azolla, T_6 - 50% RDN as CF + 50% RDN as FYM, T_7 - 50% RDN as CF +50% RDN as dhaincha, T_8 - 50% RDN as CF + 50% RDN as Azolla, T_9 - 1/3^rd N as CF +1/3^rd N as FYM, T_10 - 1/3^rd N as CF +1/3^rd N as dhaincha, T_11 - 1/3^rd N as Azolla, T_12 - 1/3^rd N as Azolla) and twelve treatments in potato during rabi season (viz T_1 - control i.e. no manure and fertilizer, T_2 - 100% RDN as CF, T_3 - 75% RDN as CF + 25% RDN as FYM, T_4 - 75% RDN as CF + 25% RDN as vermicompost, T_5 - 75% RDN as CF + 25% RDN as neem cake, T_6 - 50% RDN as CF + 50% RDN as FYM, T_7 - 50% RDN as CF + 50% RDN as vermicompost, T_8 - 50% RDN as CF + 50% RDN as neem cake, T_9 - 1/3^rd N as CF + 1/3^rd N as FYM, T_10 - 1/3^rd N as CF + 1/3^rd N as neem cake, T_11 - 1/3^rd N as CF + 1/3^rd N as neem cake, T_12 - 50% RDN as CF + 25% RDN as FYM + Azotobacter).

Application of 1/3^rd N each through chemical fertilizer, FYM and Azolla to rice registered the highest average growth attributes and yield components such as plant height (100.12 cm), leaf area index (3.42), number of tillers/hill (16.5), dry matter accumulation (984.95 g/m²), crop growth rate (15.58 g/m²/day), number of panicles/ m² (375.75), grain yield (4.88 t/ha), straw yield (6.23 t/ha) and harvest index (43.95) of rice. This had also the highest protein content (8.13 % in first year and 8.35 % during second year) and protein yield (401.74 kg/ha) of rice grain. The number of grains per panicle (108.33) was highest in the treatment receiving 1/3^rd N each from chemical fertilizer, FYM and dhaincha. Application of 50% RDN as CF + 50% RDN as Azolla showed higher thousand grain weight (22.60 g) in rice. Application of 1/3^rd N each through chemical fertilizer, FYM and Azolla exhibited the highest uptake of N ((93.96 kg/ha) and P (40.80 kg/ha) by rice. However, the potassium uptake was higher (110.34 kg/ha) with the use of 50% N as chemical
fertilizer and 50% N as *dhaincha* in rice crop. Application of 50% RDN as chemical fertilizer + 50% N as FYM to potato crop registered the highest average growth attributes viz. plant height (47.75 cm), LAI (3.9), dry matter accumulation (370.5 g/m² at 75 DAP), CGR (4.04 g/m²/day), highest tuber growth rate (10.50 g/m²/day) and tuber bulking rate (62.88 g/m²/day). The highest quantity of ‘A’ grade tubers as well as yield components viz. number of potato tubers per plant (8.5) and weight of potato tubers per plant (235.9 g) and tuber yield of potato (19.66 t/ha) was achieved from the treatment receiving 50% N as chemical fertilizer + 50% N either through FYM or vermicompost. Potato crop removed highest quantity of total N (130.42 kg/ha), P (17.10 kg/ha) and K (128.35 kg/ha) when the crop was fed with 50% chemical N + 50% RDN as FYM. The average starch content of potato was highest with 50% RDN through chemical fertilizers + 50% RDN through vermicompost (13.19% in 2007-08 and 13.03% in 2008-09). The highest value of available N was found in the treatment receiving 50% chemical N along with 50% N as *Azolla* to rice and 50% chemical N + 50% RDN as *neem* cake to potato (261 kg/ha). The available soil P was highest with 25% inorganic *neem* cake in rice and *neem* cake in potato (19.4 kg/ha). Neither sole use of chemical fertilizers nor integration of organics and chemical fertilizers improved the available soil K over the initial status. The highest net gain of available N was observed with application of 75% RDN through chemical fertilizer + 25% RDN was through FYM to both rice and potato (+17 kg/ha). Build up of P (+1.4 kg/ha) was observed with the supplementation of 25% RDN from *Azolla* in rice and *neem* cake in potato as well as in 1/3rd N as CF + 1/3rd N as FYM + 1/3rd N as *Azolla* to rice or *neem* cake to potato. The expected available K content exhibited heavy depletion. The treatments receiving 100% chemical fertilizer and 75% RDN as chemical fertilizer + 25% N through FYM to both rice and potato exhibited a net loss of K (-10 kg/ha) at the end of two years of rice-potato cropping sequence. After two years of rice-potato cropping systems, the highest rice equivalent yield of 20.45 t/ha was achieved when both rice and potato received 50% chemical nitrogen and rest 50% N through FYM. The highest agronomic efficiency (27.76 kg grain/kg of N) and apparent N recovery percent (65.24%) of the system was attained when 50% RDN was supplied through chemical fertilizer and 50% RDN through *dhaincha* to rice and 50% RDN as chemical fertilizer + 50% RDN from vermicompost to potato. The highest average net return was achieved with use of 50% N through CF + 50% N through FYM to both rice and potato (₹72,064/ha). The return per rupee invested in rice-potato system was highest where 100% plant nutrients were applied through chemical fertilizers to both the crops (₹1.96).