INTEGRATED NUTRIENT MANAGEMENT SYSTEM FOR PRODUCTIVITY POTENTIAL OF HYBRID RICE (Oryza sativa L.) - MUSTARD [Brassica juncea (L.) Czernj. & Cosson] CROPPING SEQUENCE

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By
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ABSTRACT

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Rice (Oryza sativa L.) is the most important food grain crop in India. It is the staple food of East, South East and South Asia where 90% of the world’s rice crop is produced and consumed. Rice is the staple food of more than 500 million people, which accounts for about 60% of the population in India. Therefore, in order to meet the food needs of a large and expanding population top priority should be given to increase rice yields.

Indian mustard [Brassica juncea (L.) Czernj. & Cosson] commonly known as raya, rai and laha is one of the most important edible oilseed crops among the various oilseed crops grown in the country. It occupies a prominent place being next to groundnut both in area and production meeting the fat requirement of about 50% population of the northern and eastern parts of India.

The continuous unbalanced use of fertilizers in a cropping system often leads to disproportionate nutrient availability and adverse effect on physical properties and chemical composition of soil, which finally results in declining crop yields. The integrated use of green manures and chemical fertilizers can help to maintain optimum crop yields and required soil nutrient pool on sustained basis. There is a vast scope for increasing nutrient supply through use of green manures and adoption of proper cropping system and these together can contribute significantly to the required nutrient pool.

The fertilizer needs of a crop in a cropping system mainly depend upon the characteristics of the preceding crops and kind and quantities of fertilizers applied to
them. Therefore, there is a need for systematic approach of nutrient supply to the system so as to increase the fertilizer use efficiency and economize the use of costly mineral fertilizers by accounting the residual effect of the applied fertilizers and preceding crops. However, a technology package has to be developed depending upon the cropping system, soil type, ecological conditions and socio-economic conditions of the farmer. Therefore, the study has been formulated to sustain the productivity of cropping and resource base with integrated nutrient supply system under hybrid rice-mustard crop sequence with the objectives to quantify the direct, residual and cumulative effect of organic as well as inorganic fertilizers on growth and yield of hybrid rice and mustard in the lateritic soils of Konkan region.

Field experiments were conducted during 2000-2001 and 2001-2002 on loam soil of Agronomy Farm, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. The soil of the experimental plot was medium acidic in pH and low in organic carbon content. It was medium in available nitrogen and phosphorus while low in available potassium. The experiment was laid out in Randomized Block design in *kharif* season and Split Plot design in *rabi* season with three replications. The treatments comprised of different NPK fertilizers alone and combined with gliricidia green manure.

The results revealed that the highest height, number of functional leaves, panicles per hill, length of panicle (cm), filled grains per panicle as well as grain and straw yield of hybrid rice was recorded by Fertilizers 150:75:75 kg ha$^{-1}$ followed by Fertilizers 75:75:75 kg ha$^{-1}$ + 5 t ha$^{-1}$ gliricidia. These treatments resulted into higher nitrogen, phosphorus and potassium uptake by hybrid rice grain and straw. Application of 10 t ha$^{-1}$ gliricidia alone significantly reduced the bulk density and also increased water holding capacity and organic carbon after rice.

Available nitrogen in soil showed improvement with the highest availability under Fertilizers 50:50:50 kg ha$^{-1}$ + 5 t ha$^{-1}$ gliricidia during 2000 and by Fertilizers 75:75:75 kg ha$^{-1}$ + 5 t ha$^{-1}$ gliricidia during 2001 after harvest of hybrid rice. Application of Fertilizers 75:75:75 kg ha$^{-1}$ + 5 t ha$^{-1}$ gliricidia showed the highest availability of available phosphorus and potassium after harvest of hybrid rice. The residual effect of Fertilizers 75:75:75 kg ha$^{-1}$ + 5 t ha$^{-1}$ gliricidia recorded highest number of branches, number of functional leaves, dry matter accumulation, yield contributing characters, grain and stover yield, nitrogen and phosphorus uptake as well as protein yield of mustard. The residual effect of application of 10 t ha$^{-1}$
Gliricidia alone significantly increased water holding capacity and organic carbon after mustard.

Available nitrogen in soil showed improvement with the highest availability under residue of Fertilizers 100:50:50 kg ha\(^{-1}\) during 2000-2001 and by Fertilizers 150:75:75 kg ha\(^{-1}\) during 2001-2002. Application of Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia showed the highest residual effect on availability of available phosphorus and potassium in soil after harvest of mustard.

The results revealed that all the growth characters, yield contributing characters, grain and stover yield, nitrogen, phosphorus and potassium uptake by grain and stover, oil production and protein yield in mustard was significant by Fertilizers 90:45:45 kg ha\(^{-1}\) followed by Fertilizers 45:45:45 kg ha\(^{-1}\) and control in that descending order. No application of fertilizers significantly increased the water holding capacity during both years and organic carbon during 2001-2002 after mustard. Available nitrogen in soil showed improvement with the highest availability under Fertilizers 90:45:45 kg ha\(^{-1}\) followed by Fertilizers 45:45:45 kg ha\(^{-1}\) and control after mustard.

Fertility dynamics of soil indicated that Fertilizers 150:75:75 kg ha\(^{-1}\) to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard recorded the highest gain of nitrogen to the extent of 157.38 kg ha\(^{-1}\), followed by Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (145.59 kg ha\(^{-1}\)) while the highest nitrogen loss was shown by absolute control (T\(_1\)M\(_1\)) (-161.16 kg ha\(^{-1}\)). It was observed that the maximum gain of phosphorus was due to Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (28.95 kg ha\(^{-1}\)) followed by Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 45:45:45 kg ha\(^{-1}\) to mustard (25.73 kg ha\(^{-1}\)) while highest phosphorus loss was shown by absolute control to hybrid rice and mustard (-15.50 kg ha\(^{-1}\)). The maximum improvement in potassium status was recorded by Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard to the extent of 106.46 kg ha\(^{-1}\) followed by Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 45:45:45 kg ha\(^{-1}\) to mustard (105.95 kg ha\(^{-1}\)) while highest potassium loss was observed in absolute control (-20.56 kg ha\(^{-1}\)).

Highest net return in hybrid rice-mustard cropping sequence was observed due to Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (Rs. 38982.56) and was closely followed by Fertilizers...
75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 45:45:45 kg ha\(^{-1}\) to mustard (Rs. 38519.64) and Fertilizers 50:50:50 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (Rs. 38320.01). The highest benefit cost ratio of 1.93 was noted due to Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard and Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 45:45:45 kg ha\(^{-1}\) to mustard.

Highest production potential (q ha\(^{-1}\)) was recorded due to Fertilizers 150:75:75 kg ha\(^{-1}\) to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (83.60 q ha\(^{-1}\)). It was closely followed by Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (83.48 q ha\(^{-1}\)) and Fertilizers 150:75:75 kg ha\(^{-1}\) to hybrid rice with Fertilizers 45:45:45 kg ha\(^{-1}\) to mustard (83.10 q ha\(^{-1}\)). The lowest production potential was seen in T,M (40.68 q ha\(^{-1}\)).

It was noted that hybrid rice yield equivalent (q ha\(^{-1}\)) of hybrid rice-mustard cropping sequence was the highest due to Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (196.90 q ha\(^{-1}\)) followed by Fertilizers 150:75:75 kg ha\(^{-1}\) to hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to mustard (195.91 q ha\(^{-1}\)) and Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to hybrid rice with Fertilizers 45:45:45 kg ha\(^{-1}\) to mustard (194.99 q ha\(^{-1}\)).

It can be said from the investigation in hybrid rice-mustard cropping sequence that Fertilizers 150:75:75 kg ha\(^{-1}\) should be applied to hybrid rice while mustard should be given dose of Fertilizers 90:45:45 kg ha\(^{-1}\). However, looking at the residual effect and the effect of the treatments on the physical properties, chemical composition and nutrient status of the soil we can say that Fertilizers 75:75:75 kg ha\(^{-1}\) + 5 t ha\(^{-1}\) gliricidia to *kharif* hybrid rice with Fertilizers 90:45:45 kg ha\(^{-1}\) to *rabi* mustard is the best combination.

Hence, the results by and large suggest growing of hybrid rice-mustard instead of keeping the land fallow after rice. The study has brought out the results that there is need for taking in to cognizance the cropping system as a whole rather than individual crop while formulating nutrient requirement. Hence, integrated use of chemical fertilizers and the locally available gliricidia is a judicious blend in South Konkan region to stabilize yields at maximum level without deteriorating soil health under hybrid rice-mustard cropping sequence.