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SUSTAINING RICE-WHEAT CROPPING SYSTEM THROUGH GREEN MANURING

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ABSTRACT
The rice-wheat cropping system is believed to cause a considerable depletion of soil nutrients and thereafter long-term productivity is threatening as both the crops in the system are exhaustive in nature. In such a situation, green manuring had an imperative role towards improving crop productivity along with maintaining soil fertility. Green manuring with dhaincha, sunhemp and mungbean after the harvest of wheat crop in summer months and consequently incorporated in to the soil that add organic matter, nitrogen and other essential plant nutrients. In addition, these crops are able to fix atmospheric nitrogen and thus contribute to nitrogen needs of the subsequent crop *i.e.* rice.

Introduction

Rice-wheat cropping system is the one of the most extensively followed cropping system having considerable significance in ensuring the food security of country. As both of the component crops of this system are exhaustive in nature which resulted in deterioration of soil health, therefore, inclusion of green manuring crops in the existing cropping system after harvesting of wheat aids to soil health, crop yield as well. It can effectively utilize the fallow period of 45-70 days (up to 90 days in basmati rice) between harvesting of wheat and sowing/transplanting of rice.

A crop grownup to a certain physiological stage with the objective of burying its green matter in the soil to decompose into humus and to improve the soil productivity, is called green manure crop and their use in cropping system is called green manuring. Green manuring provides a balance supply of nutrients and increases the soil organic matter content. The use of green manuring can reduce the soil pH, improve soil fertility, water holding capacity and partially fulfill the N requirement of rice crop also it helps to uproot the emerging weeds during incorporation and thus, reduces weed problem in rice crop.

Selection of crop for green manuring

Crop selected for green manure should be a legume because it fixes atmospheric N in the root nodules through symbiotic association with a bacterium Rhizobium and provide a part of it for succeeding crop and also leguminous crops have the advantage of faster decomposition because of narrow C: N ratio as compared to cereals. Important crops which can be used for green manuring in rice- wheat cropping system include dhaincha, sunhemp, mungbean etc. Amount of biomass obtained from the green manure crop and nutrients added in the soil decides the usefulness of green manure crop. Biomass production depends widely on the species of legumes, fertility of soil, crop management, environmental conditions and age of crop at harvest. Dhaincha and sunhemp are known to have

higher biomass production and better nutrient composition compared to other legumes.

Agronomy of green manure crops in rice-wheat cropping system

Dhaincha (*Sesbania aculeate*)

For sowing of dhaincha with drill requires 50-60 kg/ha seed. The seeds are sown in lines 20 cm apart during the month of April immediately after wheat harvesting. Though higher seed rate helps in producing plant with thin and succulent stem. Seed can be broadcasted in the field after giving 1 or 2 ploughing and having good moisture conditions followed by light ploughing to cover the seed with the soil. Dhaincha can be grown under water logging. Therefore, it could also be directly seeded after harvesting *Rabi* crop, provided the field is free from excessive weed growth. Apply 30 kg P_2O_5/ ha at the time of sowing to improve the growth and N fixing capacity of green manure crop. The crop sown during summer period requires 3-4 irrigations depending upon prevailing weather conditions. It makes good growth in 2-4 months and produce abundant green matter ranging from 20-25 t/ha, depending upon the age at harvest. Dhainha must be incorporate into the soil at knee height stageat 8 weeks after sowing for its better decomposition.

Fig. 1. Green manuring through Dhaincha

Fig. 2. Mungbean in anchored wheat stubbles

Sunhemp (*Crotolaria juncea*)

For green manuring, sunhemp can be sown from April to July by using 50-60 kg/ha seed either with drill in rows 22.5 cm apart or by broadcast. Seeds are soaked in water prior to the sowing for better emergence. Apply 40 kg P_2O_5/ha at the time of sowing as starter dose for vigorous crop growth and to increases N fixation by root nodules of the crop. The crop sown during summer period requires 2-3 irrigations depending upon prevailing weather conditions. It is incorporated into the soil at flowering stage 45-60 days after sowing when plant attains the height of 160-220 cm. Sunhemp adds 10-16 tonnes green biomass per hectare to the soil when buried.

Summer Mungbean (*Vigna radiata*)

Short duration summer mungbean varieties like SML-668 can be grown in the month of April or in first week of May by using 25-30 kg/ha seed. Seed is sown at the row spacing of 30 cm after two or three ploughings followed by planking to crush the clods and cover the seeds. Mungbean can also be grown without seed bed preparation with zero till drill in anchored wheat residues. In case the field is infested with weeds, these can be controlled by spraying half litre of Gramoxone (paraquat) in 500 litre of water before sowing. Apply 40 kg/ha of P_2O_5/ ha at the time of sowing. Crop grown during summer requires 1-2 irrigations depending upon prevailing weather conditions. The crop should be harvested when 80% of the pods mature either by using sickle or mechanically by combine harvester after spraying Gramoxone (paraquat) @ 2 litre/ha using 500 litre of water for drying of crop foliage.

Burying or Incorporation

For proper decomposition there should be adequate moisture in the soil and green matter buried deep enough (15-20 cm) with a soil turning plough. Growing dahincha after wheat and burying it 10-20 days before transplanting rice is effective in saline soils. Rice is transplanted immediately after burying, water standing in rice field helps in quick decomposition of green matter. However, un-decomposed or partially decomposed green manure may hinder during transplanting. In case, transplanting of paddy is delayed due to green manure crop. Dhaincha can be incorporated in standing water by using rotavator, which incorporate the dhaincha besides puddling the field for rice transplanting without any further delay.

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