

Agronomic interventions

for enhancing crop productivity under intensive crop cultivation

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Different agronomic interventions under intensive crop cultivation which improve or maintain the field productivity as well as profitability on a long term basis are of immense importance. The practices like green manuring prior to sowing of kharif crops, inclusion of legumes in cereal based cropping systems, use of laser land leveller, and integration of organic manures with inorganic sources can help a lot in conserving natural resources. For successful crop production, stale bed technique can help to get rid of immense weed pressure.

Keywords: Green manuring crop, Farmyard Manure, Nutrient management, Resource conservation, Soil health, Sustainable crop production

EVERYBODY is aware of the contribution of Punjab in the central pool and it is feasible because of the very high cropping intensity, which is 206%. The State has virtually reached saturation point in the expansion of physical area horizontally and vertically due to the high levels of cropping intensity and irrigational constraints. In the present agriculture, unbalanced fertilization, skewed ratio of nitrogen, phosphorus and potassium along with the higher cropping intensity, are the major factors in deteriorating the productivity level of our fields. If this ever deteriorating health goes unchecked, it will be a serious concern in the near future. After harvesting of the *rabi* crops, there is enough time available before the sowing of the succeeding *kharif* crops and this is the time which is very crucial for taking the following steps of interventions for improving the productivity of our fields on long term basis.

Use of the green manures

The best time for green manuring is after harvesting of *rabi* crops and before sowing of the *kharif* crops.

The legumes like *Crotalaria juncea*, *Sesbania aculeate* and *Vigna unguiculata* are very suitable for green manuring because of their inbuilt tendency to fix nitrogen from the atmosphere. Growth of green manure crops is very fast. Within 40-50 days they accumulate 6-10 tonnes of biomass per ha and due to narrow C:N ratio their decomposition is faster. Green manure can add approximately 125-150 kg of nitrogen per ha in the soil. Green manuring crop takes nutrients from the lower layers and when incorporated in the soil adds nutrients to the upper soil layer and slow decomposition of the green manuring crops releases certain organic acids which modify the soil environment to such an extent that ensures slow release of even unavailable nutrients over a longer period of time.

For green manuring, apply pre-sowing irrigation after harvesting wheat or any preceding crop and sow 50 kg of *Sesbania aculeate* (already soaked in water for 8 hours) or 30 kg of *Vigna unguiculata* or 50 kg of *Crotalaria juncea* on hectare basis. Apply 187.5 kg superphosphate per

ha to the green manure crop in the soils testing low in phosphorus and omit its application to the rice crop. The crop is ready for green manuring when it reaches 6-8 weeks old. At this stage, the crop is tender, have maximum biomass and flower initiation has just started. Incorporation of *Sesbania aculeate* should not be delayed as it becomes fibrous and takes longer time to decompose and mineralize nutrients because of high lignin content in the fibrous crop.

Green manure crop can be easily incorporated in the field with disc harrow one day before transplanting nursery of rice in the field and 5-7 days before sowing maize or soybean crop. This practice results in saving of 62.5 kg of N (137.5 kg urea) per ha. Reduce the dose of N fertilizer by one-third in rice if the moong crop after picking of pods has been incorporated one day before transplanting. Green manuring increases the yield of high yielding varieties of rice to the tune of 20-30% depending upon the soil type and other conditions. Other practical implications of green manure crops are given in Table 1.



Fig 1. *Crotalaria juncea* and *Sesbania aculeate* for green manuring

Table 1. Other practical implications of green manure crops

Green manure crop	Practical implication
<i>Sesbania aculeate</i>	Amelioration of problem of iron deficiency in rice Reclamation of <i>kallar</i> soils Preferred in recently reclaimed soils
<i>Crotalaria juncea</i>	Reduce root-knot nematode population
<i>Crotalaria juncea</i> , <i>Sesbania aculeate</i> and <i>Vigna unguiculata</i>	Reduce weed pressure

Inclusion of Summer pulses in the crop rotation

Moong and mash crops can be grown both during the summer as well as in the *kharif* season. Summer moong can be adjusted successfully in different crop rotations *viz.*, sugarcane/potato/cotton/*raya*-summer moong, summer moong-maize/rice-*raya*/wheat, summer moong - maize-potato, summer moong-rice-potato, summer moong- *kharif* moong-*raya*/wheat and summer moong-rice/maize-*gobhi sarson*. Summer mash can be taken after sugarcane/*toria* /*raya*/potato under irrigated conditions.

The data in Table 2 show that the inclusion of pulse crop in conventional rice-wheat system, increases the rice equivalent yield to the tune of 32.2 % and the net returns by 39,300 ₹/ha. Inclusion of pulses in different cereal based

cropping systems can also be a good alternative for diversification of rice-wheat system. Both, maize-potato-summer moong (216.3 q/ha) and basmati rice-potato-summer moong (219.6 q/ha) systems produce higher rice equivalent yield as compared to rice-wheat system (125.9 q/ha) and also resulted in increased net profits to the tune of 55,400 and 52,100 ₹/ha, respectively (Table 3).

Summer moong matures in 60-65 days while summer mash matures in about 70-75 days. Summer moong can also be buried after picking pods one day before transplanting of rice and can help in saving about one third of nitrogen. These two crops vacate the field earlier, involve less

cost of cultivation and save water as compared to other crops.

Application of fertilizers on soil test basis

General fertilizer recommendations of the Punjab Agricultural University are based on the normal soils of medium fertility status. Exact status of various nutrients in the soil can be easily depicted from the soil testing report and the fertilizer application. It is very important to get our soils tested after every 2-3 years. After harvesting of the *rabi* crops, the fields are vacated and there is enough time to get soils tested and fertilize the *kharif* crops as per the results of the report.

Table 2. Yield and net returns of rice-wheat summer moong cropping system (Mean of 3 years)

Cropping System	Rice yield (q/ha)	Wheat yield (q/ha)	Summer moong yield(q/ha)	Rice equivalent yield (q/ha)	Net returns* (10 ³ ₹/ha)
Rice-wheat-summer moong	75.1	54.0	11.6	172.5	175.3
Rice-wheat	73.2	53.5	-	130.5	136.0

*For computation of economics, rate of respective year were taken (2016, 2017 and 2018)

Table 3. Yield and net returns of different cropping systems involving summer moong

Cropping System	Kharif crop yield (q/ha)	Rabi crop yield (q/ha)	Summer moong yield (q/ha)	Rice equivalent yield (q/ha)	Net returns* (10 ³ ₹/ha)
Maize-potato-summer moong	72.9	352.8	14.5	216.3	168.4
Basmati rice-potato-summer moong	29.8	350.7	14.1	219.6	165.1
Rice-wheat	68.4	56.2	-	125.9	113.0

*For computation of economics, rate of 2016-17 year were taken



Fig. 2. Maize-potato-summer moong crop rotation



Fig. 3. Basmati rice-potato-summer moong crop rotation

Inclusion of Farmyard manure in fertiliser/ nutrient management

Integration of inorganic fertilisers with organic nutrient sources is important to harness higher productivity from the field crops while maintaining the sustainability of the whole system. The right time of application of organic manures like Farmyard Manure (FYM) is before the sowing of *kharif* crops. It is applied to many crops like rice, maize, sugarcane, fodders, vegetables, etc. The FYM should be incorporated immediately after spreading in the field so that the nutrients are not destroyed on exposure to the sun rays. The application of 15 tonnes of well rotten FYM per hectare to rice or maize helps in saving of 40 kg nitrogen or 87.5kg of urea. If 15 tonnes or more quantity of FYM is applied to maize, phosphorus, potassium, zinc, as well as nitrogen dose to be applied at the time of sowing, can be skipped. Application of 20 tonnes of FYM on hectare basis can help in saving of 150 kg of nitrogen.

Use of laser land leveller

Declining water table and soil

health are the major concerns to the degrading present Punjab agriculture. The enhancement of water use efficiency and farm productivity at field level is one of the best options to redress the problem of water scarcity. The laser levelling is such technology which not only helps in saving of irrigation water to the tune of 20-25% by precisely levelling the fields but also enhances yield of the crops because of the better utilization of applied nutrients as well as different agrochemicals. This also increases the area under cultivation to the extent of 5-7% and also improves operational efficiency.

Adopt stale seedbed/dab system for weed control

Stale seedbed system is effective for controlling weeds in the fields. In this case, double pre-sowing irrigation is given or field is kept for 8-10 days as such i.e. without crop sowing after land preparation so that weed seeds get sufficient time to emerge. After emergence, these are removed from the field by shallow cultivation before sowing crop. This technique can help in reducing

herbicide load and can be beneficial for direct seeding of rice.

Conclusion

Use of green manuring, not only improves soil health but also improves crop yields by ameliorating nutrient deficiencies and help in saving fertilizers. Inclusion of legumes in cereal-based cropping systems enhances crop productivity and profitability. Integration of organic manures with soil test basis fertilizer application is very important to get higher yields from the crops along with sustaining fertility of the soil. Laser land leveller can help a lot to Punjab, which is presently facing a looming water crisis. Weeds pose a serious problem to crop production where stale seedbed technique can be quite beneficial. These measures can be successfully applied whenever fields are vacated after harvest of *rabi* crops and before sowing of *kharif* crops.

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