

Recycling of waste material

through bio-decomposer and their impact on succeeding crop

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A large portion of the residues is burnt on-farm primarily to clear the field for sowing of the succeeding crop. Because crop residues interfere with tillage and seeding operations for the next crop, farmers often prefer to burn the residue in situ. Burning of crop residues is intensifying problems in recent years due to shortage of human labour, high cost of removing the crop residues by conventional methods and use of combines for harvesting of crops. In this situation use of bio-decomposer for fast decomposition of crop residue or livestock waste materials will be very helpful. Bio-decomposer consortium producing digestive enzymes that they release into their surroundings helps in decomposition of residue. They absorb the breakdown products and release nutrient ions for plant uptake in the process. This activity is important for carbon and nutrient cycling through recycling of waste material by the use of available resource to enhance the production and productivity of crops and also reduces the cost of cultivation and environmental pollution.

Keywords: Bio-decomposer, Crop residue management, Recycling, Waste material

EXPECTED 500 million tonnes of crop residues produce annually, out of this about 141 million tonnes of surplus which are mostly burn, resulting in nutrient losses and polluted environment. In this situation KVK introduced bio-decomposer for fast decomposition of waste material of crop residue and maintain the C: N ratio by addition of 5% foliar spray of nitrogen on cereal crops residue. Recycling of agro-waste particularly crop residues has gained significant importance in the recent past which is considered as the precious resource for soil health restoration besides its importance as a source of nutrients. One of the alternative options of utilization large quantity of nutrient rich agricultural wastes is by converting them in to value added product like compost and recycle them back to the field which have drawn the attention of scientist to reduce environmental pollution and increase efficiency of carbon and nutrient rich input for



Spray of bio-decomposer on *in situ* wheat crop residue

Partial decomposed of wheat crop residue at 30 days after spray of bio-decomposer

higher production and productivity in modern intensive Agriculture. In view of this KVK, Chhatarpur conducted trial on assessment of biodecomposer for recycling of (*in situ/ex situ*) crop residue at farmer's field.

Where are the problems

In areas where mechanical harvesting is practiced, a large quantity of crop residues are left in the field and farmers burns them *in situ* which can be recycled for nutrient supply in intensive cropping system and for restoring of the soil nutrients.

Converting them in to value added product like compost in 51 days of FYM heap, 60 days of legume crop residue heap and 120–130 days are required for cereals crop residue heap under the use of bio-decomposer along with 5% foliar spray of nitrogen at 30 Days after spray against the normal 90–100, 120–130 days and 180–200 days which are required respectively under farmers traditional practices. On the basis of the trial finding it may be concluded that the waste decomposer decomposed the crop residue in almost half duration in comparison to traditional composting.

Farmers are facing difficulty during *in situ* or *ex situ* decomposition of crop residue

The process of conversion of inorganic nitrogen into organic nitrogen during decomposition required assimilation of nitrogen by organism carrying out the decomposition process called nitrogen immobilization by microbes. Therefore yellowness symptom was shown in early stage of succeeding crops in our trials at KVK, Chhatarpur. Under such circumstances, spray of bio-decomposer for fast decomposition of the crop residue either *in situ* or *ex situ* along with spray of 5% additional dose of nitrogen for quickly recovery of nitrogen deficiency during flowering/early stage of groundnut crop at 30 days after sowing was done. The spray of 5% additional dose of nitrogen either *in-situ* or *ex-situ* on heap of cereal crops residue is required to fulfill the nitrogen requirement of microorganism to stimulate their activity for future synthesis of N from the residues for fast decomposition and recovery of nitrogen deficiency in succeeding groundnut crop. In groundnut pods achieve maximum number at 55–60 days after sowing and their pod fill is maximum at 80 DAS. In this situation maintaining

the high partitioning of assimilates to pods is the main desirable character by additional supply of nitrogen through foliar spray.

Data pertaining to yield and economics of groundnut are presented in Table 1, Significantly higher yield (15.05 q/ha) and net monetary returns (57300 ₹/ha), and B:C ratio (2.7) were obtained under the application of bio-decomposer along with 5% additional spray of nitrogen solution for quick decomposition of crop residue over the farmers Practices. Not only the recycle of these crop residue increases yields of succeeding crops by increase the population and diversity of the beneficial microorganisms in the soil but also improves many soil characteristics and allows the slow release of nutrients for crop use in subsequent year.

Management of C: N ratio for quick decomposition of waste material

C: N ratio is one of the major factors affecting the quality of compost, also decomposition of organic matter is largely depended on C: N ratio. Their high ratio makes the process very slow as there is an excess of degradable carbon for the microorganisms, but low C: N

ratio indicate an excess of nitrogen which may be lost from the process. Therefore, inadequate C: N ratios may need to be corrected by adding another material to get a balanced content of both elements, because microorganism which degrades organic wastes use carbon for energy and nitrogen for protein. Organic matter contains carbon and nitrogen in varying amounts and ratio. A C: N ratio of 25-30:1 in legume residue is considered ideal for finished compost. While C: N ratio 80-85:1 (cereals residue) or very large particle size slows down the process and reduced the mobilization of nitrogen by immobilization process, because it is locked up in complex molecules which take much longer to break down due to presence of lignin in the materials which is decomposed slowly. In this situation deficit of nitrogen in the soil and after decomposition which release nitrogen through mineralization process in soil and by other source of nitrogen becomes available in the soil. Therefore surplus nitrogen in the soil will be available for growing plants, or soil microorganisms to decompose other residues that might have a C: N ratio greater than 24:1. While in the presence of excess nitrogen than carbon 10-13:1 (livestock dung), decomposition process is very high, but there is nitrogen losses (10–44%) in the form of ammonia (from livestock dung heap), which also has the unpleasant odour. In this situation scientist suggested addition of animal litters or waste straw to maintain C: N ratio and reduced ammonia volatilization during aerobic decomposition. Besides these in case of cereal crop, residue fixes N during early stages of decomposition of soluble carbohydrates resulting in N deficiency in succeeding crops and their heap. Therefore decomposition process is very slow. In this situation inorganic N should be added to

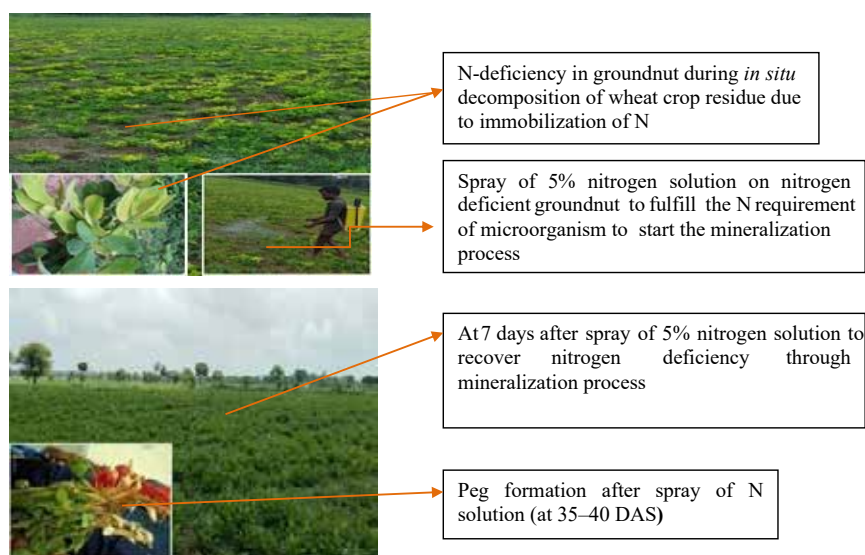
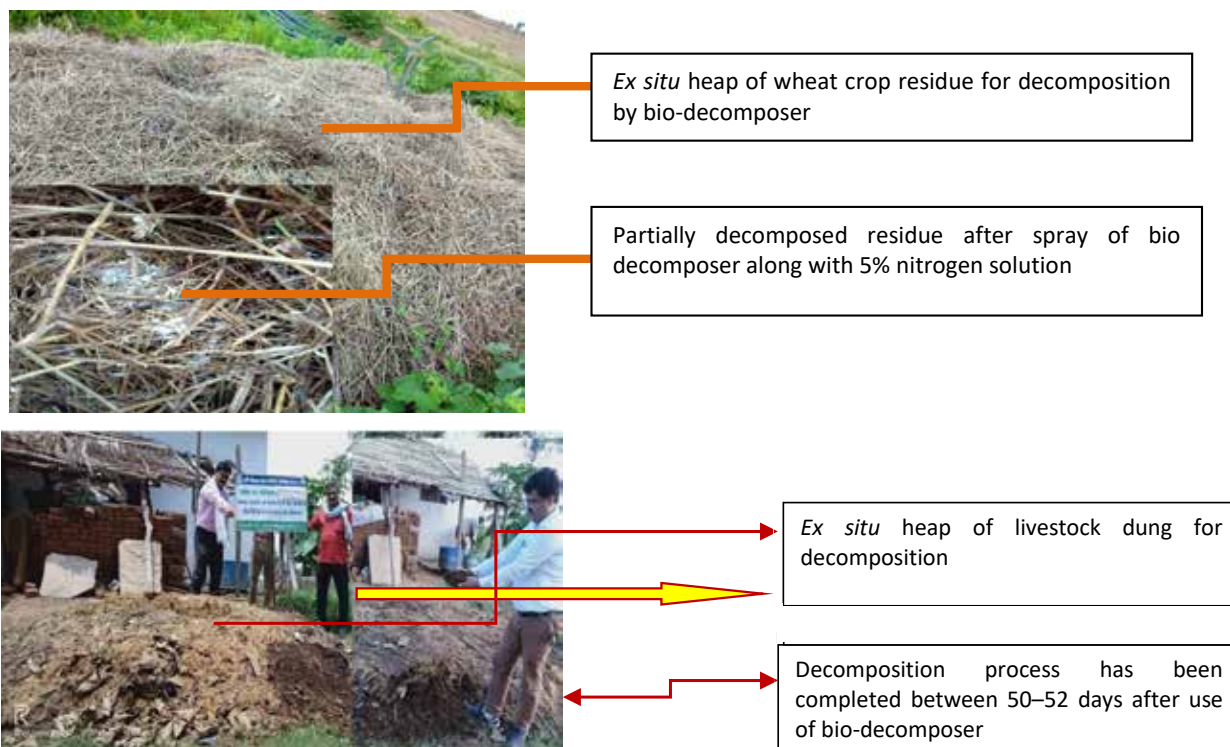


Table 1. Impact of *in situ* crop residue management on succeeding crop groundnut and their economics

Characters of parameter	No. of pegs/plant	No. of grains/ pegs	Test weight (g) of 1000 seed	Yield (q/ha)	Percentage increase in yield	COC (₹/ha)	GR ₹/ha)	NR (₹/ha)	B:C ratio
Management of crop residue	16	2	405	1505	34.7	33000	90300	57300	2.7
Farmers practice	12	2	387	1117	-	29500	67020	37520	2.3



promote decomposition of straw in time. Added N enhances the rate of decomposition measured in terms of CO₂ production and loss of total C from soil/heap. Spray of 5% nitrogen solution on *in situ* straw incorporation increases yields of succeeding crops as compared to straw burned soil or its separately incorporation in the soil. Therefore, a higher dose of urea-N application with wheat straw incorporation is necessary to get good yields of succeeding crop. In another study, incorporation of wheat straw (10 t/ha) saved 50% of the recommended fertilizer dose (60 kg N + 13.1 kg P + 25 kg K/ha) and helped in achieving higher yield of succeeding crops.

Effect of crop residue management

Incorporation of crop residues in conservation agriculture has direct and indirect effects on pests. Because residues directly affect egg laying of beetles and cutworms and lower soil temperature, and higher soil moisture content under

crop residues would also affect pest infestation. Indirectly, residues change the type and density of weeds, which in turn influence insects and natural enemies. The decomposition of residues brings out a chemical change in soil which may affect the host reaction to pests. A change in weed ecology is expected to influence the survival of several of those insects which tend to develop on weeds, particularly during the fallow period. Therefore the use of appropriate bio-decomposer for fast decomposition of residue reduces the risk of above mentioned problems.

SUMMARY

Recycling of agro-waste material through incorporation in to soil by their fast decomposition can be done by the use of bio-decomposer. But some difficulties arise during their decomposition due to imbalance carbon: nitrogen (C:N) ratio in cereal crops residue. Therefore nitrogen deficiency occurs during the decomposition process at early

stage of succeeding crop. In this regards KVK, Chhatarpur introduce some intervention's to maintain the C: N ratio by additional spray of 5% nitrogen solution in cereal crops residue to fulfill the requirement of microorganism for the recovery of nitrogen deficiency in succeeding crop to start the mineralization process. Which resulted in minimization of decomposition period under the use of bio-decomposer and spray of 5% nitrogen solution on *in situ* or *ex situ* cereal crops residue. In other way increased the population and diversity of the beneficial microorganisms in the soil and improved many soil characteristics and allows the slow release of nutrients for crop use in subsequent year. Which resulted in enhance production and productivity of succeeding crop.

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Know Krishi Unnati Yojana

The *Krishi Unnati Yojana*, a central sector scheme, is envisaged as umbrella programme for focusing on food security, by merging schemes on Soil-health Card, Integrated Scheme on Agricultural Co-operation and Agricultural Marketing, National Mission on Agriculture Extension, Horticulture Development, Price Stabilization Fund, National Mission on Sustainable Agriculture and other programmes.