

Enhanced crop productivity and environmental benefits

by adoption of zero-till cultivation in wheat and summer pulses

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Rice-wheat-pulse is an important cropping system of eastern Madhya Pradesh. Farmers are following traditional methods of sowing characterized by intensive tillage and higher crop seed rate. Previous crop residue burning is also prevalent which causes environmental pollution. Under Farmer FIRST Programme, two villages have been undertaken from Panagar block of Jabalpur district. An attempt has been made to demonstrate the benefits of zero-tillage sowing by happy seeder machine and residue mulching. The results at farmer's field were encouraging and showed improved B:C ratio of 70% in wheat, 58.6% in summer greengram, 50.1% in blackgram by intervention of zero-tillage, improved seed, herbicide application, and over farmer's practice. The non-burning of the crop residues reduced the emission of 976.07 mg of CO₂, 25.55 mg of CO, 2.85 mg of CH₄, 0.55 Mg of N₂O and 0.40 mg of SO₂ to the atmosphere.

Key words: Good agricultural practice, Happy seeder, Non-burning of the crop residues, Residue mulching, Zero-tillage

WHEAT and summer green-gram is the major component crops in rice-based cropping systems in Eastern Madhya Pradesh. Traditionally, these crops are grown on well tilled soils after removing or burning the previous crop residues. Intensive tillage operation requires a

higher consumption of energy and increased cost of production. Removal of the crop residues year after year results in reduction of organic matter and biological activity in the soil. Whereas, burning the crop residue poses environmental pollution. Zero-tillage technology

involving sowing of crops in loose and anchored residues by a specialized machine called “Happy Seeder” has given farmers an option to minimize the ill-effects of traditional farming and achieve enhanced crop productivity at a lesser cost of cultivation. The seed



Fig. 1.a. Seed treatment and sowing of wheat crop by happy seeder.



Fig. 1.b.Early stage and harvest stage of wheat crop.

Table 1.a. Technology details: Wheat

Name of technology	Sowing of certified wheat varieties (GW-273) under zero-tillage by happy seeder
Farming situation	Irrigated condition
Problem	Rice residue burning, poor performance of existing varieties, severe weed problem
Potential solution	Zero-till sowing by happy seeder, replacement of seed by improved varieties and weed management
Nature of intervention	Conservation tillage, variety replacement, introduction of low dose herbicides
Source of technology	ICAR-Directorate of Weed Research, Jabalpur
Expected output	Reduced burning of straw, reduced cost of cultivation, increased crop yield
Area /ha.	8 ha.
No. of farm families	20
Critical input	Tractor, happy seeder, DAP, urea, wheat seed, fungicide herbicide, zinc sulphate
Cost of each intervention (₹)	21,990

Table 1.b. Performance indicators: Wheat

Technical Observation	Farmer's practice	Intervention
<i>Yield (q/ha)</i>		
Grain	40.14	48.23
Straw	-	-
<i>Economic indicators</i>		
Cost of cultivation (₹/ha)	31,072	21,990
Net income (₹/ha)	35,154	57,584
B:C ratio	2.13	3.62
<i>Farmers' reaction</i>	Farmers were satisfied with the reduced cost of cultivation and additional income	

requirement for zero-till sowing of crops is also reduced. The inverted T type tynes in the happy seeder opens a slit in the soil where fertilizer is placed below the seed in a single operation. Zero-tillage sowing of crops based on conservation agriculture practices needs to be demonstrated and popularized among farmers.

Under the Farmer FIRST Programme (FFP), ICAR being undertaken at ICAR-Directorate of

Weed Research, Jabalpur, the zero-tillage cultivation of wheat and summer greengram/blackgram was demonstrated at farmer's fields in two adopted villages, Umaria Choube and Barouda in Panagar block of Jabalpur district (Fig. 1). Initially the farmers were reluctant to

undertake sowing of wheat without tillage and without removal of rice crop residues. However, few farmers were persuaded to adopt this technology on one acre area each.

Wheat

The wheat crop was sown on the residual soil moisture without removing the loose and anchored crop residues of rice by happy seeder with a seed rate of 100 kg/ha and fertilizer dose of 120:60:40 N:P₂O₅:K₂O kg/ha. At 30 days after sowing herbicide (clodinafop + metsulfuron 64 g/ha) was applied to effectively control weeds. All good agricultural practices for growing wheat were adopted (Table 1, Fig. 1).

Introduction of certified wheat variety GW-273 seeds under zero-tillage with crop residue mulching gave 20.2% additional seed yield, with saving in cost of cultivation of ₹ 9,082/ha and additional net return of ₹ 13,347/ha over farmers practice. The B:C ratio was 3.6 which was 70% higher than farmers practice.



Fig. 2. Good crop of summer greengram.

Table 2.a. Technology details: Summer greengram

Name of technology	Sowing of hybrid Greengram variety <i>Samrat</i> under zero-tillage
Farming situation	Irrigated condition
Problem	Crop residue burning, poor performance of existing varieties and severe weed problem
Potential solution	Replacement of seed by improved varieties & weed management
Nature of intervention	Zero-till sowing, varieties replacement & introduction of post-emergence herbicide
Source of technology	ICAR- Directorate of Weed Research, Jabalpur
Expected output	Reduced burning of straw, reduced cost of cultivation, increased crop yield
Plot size/area (ha)	20 ha.
No. of farm families	50
Critical input	Tractor, happy seeder, DAP, greengram seed, fungicide, herbicide, biofertilizer
Cost of each intervention (₹)	21,020

Table 2.b. Performance Indicators: Summer greengram

Technical observation	Farmers practice	Intervention
<i>Yield (q/ha)</i>		
Grain	6.82	9.48
Straw		
<i>Economic indicators</i>		
Cost of cultivation (₹/ha)	23,860	21,020
Net income (₹/ha)	2,727	15,971
B:C ratio	1.11	1.76
<i>Farmers' reaction</i>	Farmers were satisfied with the additional crop and income	

greengram variety *Samrat* under zero-tillage gave 39% additional seed yield, which save the cost of cultivation of ₹ 2,840/ha and additional net return of ₹ 13,244/ha over farmers practice. The B:C ratio was 1.76 which was 58.6% higher than farmers practice.

Summer Blackgram

The blackgram crop was sown on the residual soil moisture without removing the loose and anchored crop residues of wheat by happy seeder with a seed rate of 40 kg/ha and fertilizer dose of 20:40 N:P₂O₅ kg/ha. The farmers were trained for seed treatment with fungicides and bio-fertilizer. At 20 days after sowing, imazethapyr 80 g/ha was applied to control weeds. All good agricultural practices for growing blackgram were adopted (Table 3, Fig. 3).

Benefits to the environment

In conservation agriculture, crop residue burning was avoided by the introduction of happy seeder for sowing and residue management.



Fig. 3. Sowing of blackgram by happy seeder and a good crop of blackgram.

Summer greengram

The greengram crop was sown on the residual soil moisture without removing the loose and anchored crop residues of wheat by happy seeder with a seed rate of 40 kg/ha and fertilizer dose of 20:40 N:P₂O₅ kg/ha. The farmers were trained for seed treatment with fungicides and bio-fertilizer. At 20 days after sowing, imazethapyr 80 g/ha was applied to control weeds. All good agricultural practices for growing greengram were adopted (Table 2, Fig. 2).

Introduction of short duration

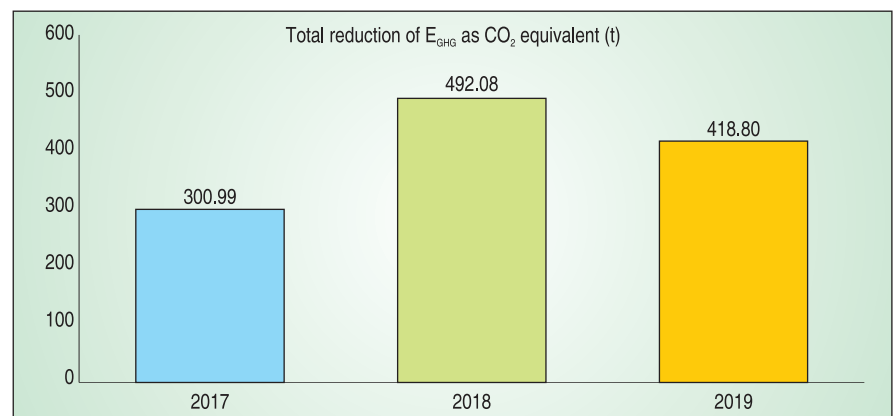


Fig. 4. Total reduction of GHG emission as CO₂ equivalent from different crop cultivation under CA.

Table 3.b. Performance Indicators

Technical Observation	Farmers practice	Intervention
<i>Yield (q/ha)</i>		
Seed	8.30	11.83
Straw	-	
<i>Economic indicators</i>		
Cost of cultivation (₹/ha)	24,725	21020
Net income (₹/ha)	7,641	25,122
B:C ratio	1.31	2.20
<i>Farmers reaction</i>	Farmers were satisfied with the additional crop and income	

Table 3.a. Technology details: Summer Blackgram

Name of technology	Sowing of hybrid Blackgram 'PU-31' under zero-tillage
Farming situation	Irrigated condition
Problem	Crop residue burning, poor performance of existing varieties and severe weed problem
Potential solution management	Replacement of seed by improved varieties & weed
Nature of intervention	Zero-till sowing, varieties replacement & introduction of post-emergence herbicide
Source of technology	ICAR-Directorate of Weed Research, Jabalpur
Expected output	Reduced burning of straw, reduced cost of cultivation, increased crop yield
Plot size/area (ha)	20 ha.
No. of farm families	50
Critical input	Tractor, happy seeder, DAP, Blackgram seed, fungicide, herbicide
Cost of each intervention	₹ 23,984

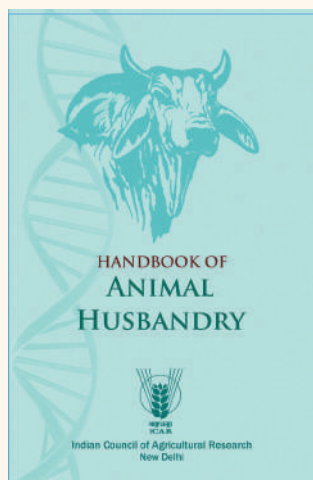
Thus, the previous crop residue was utilized as mulch in the succeeding crops. Around 562.5 tonnes of rice and wheat crops residues were used as mulch instead of burning in the field, during *rabi* and summer season. The non-burning of the crop residues reduced the emission of 976.07 mg of CO₂, 25.55 mg of CO, 2.85 mg of CH₄, 0.55 mg of N₂O and 0.40 mg of SO₂ to the atmosphere.

In addition, introduction of happy seeder also reduces the cost of cultivation around 30-40% over farmers practice. In figure 4, we can see the reduction of different greenhouse gases as a result of non-burning of the crop residues and minimum tillage.

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TECHNICAL SPECIFICATIONS

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