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Getting Agriculture to Work for People and the Environment

Biological Approaches to Achieve Sustainable Health of Soils in the Rainfed Region

O.P. Rupela, Former Principal Scientist, Microbiology, ICRISAT

Residue retained as mulch in cotton crop

On-farm produced plant biomass, including crop residue is an important potential source of soil organic matter, whose availability is very low in the tropics. Even today, large quantities of crop residue are burnt [worth US$15 million annually in Punjab, India, alone] resulting in loss of N and potential soil carbon, also leading to environmental pollution. Biological approaches such as use of plant biomass (including crop residue) as surface mulch, for intercropping with legumes, organic manures and microbial inoculants (produced on-farm or purchased from market) are widely accepted good agricultural practices of low-cost agricultural systems. These interventions and integration of trees and animals (through excrements as source of microbial agents and not necessarily as compost) into cropped fields have been reported to enhance soil health, and have resulted in sustainable high productivity in the rainfed semi-arid tropics as well.

This article is based on already published two research publications by Dr. Rupela. The papers report the results from a long-term experiment started at ICRISAT in June 1999 on a rainfed Vertisol at Patancheru, Andhra Pradesh, India. It examines the possibility of achieving high yields using low-cost inputs, plant biomass in particular, that are available within the vicinity of the farm or that could be produced *in situ*. The relevant treatment of the large plot field trial (on one ha area) utilised biological approaches reported in the published literature, as also from traditional knowledge. The experiment was conducted on a deep Vertisol, pH 8-8.2, and electrical conductivity of 0.16 to 0.22 dS/m. The area is fully rainfed, with annual mean rainfall of 783 mm that allows two crops (as intercrops) to be sown during rainy season. Details of each treatment comprising year of start, treatments, and cropping sequences have been described while giving details on the long-term experiment at Patancheru, Andhra Pradesh.

A variety of crops and practices are known to contribute to success of a farming system that should be sufficiently productive and profitable, as well as sustainable, to improve the livelihoods of farmers. It is widely agreed that no single farming system would be optimal for all areas, and thus local factors and natural resource base has to be harnessed. Effort of this study was to design a crop production system that could be particularly beneficial for small landholdings. It drew on existing knowledge that:

- Legume and non-legume crops can improve soil fertility when grown as intercrops
- Crop residue produced *in situ* can improve the soil's physical and biological properties when retained as surface mulch, without tillage
- Weeds are potential source of plant biomass, if managed/ removed before seed formation
- Large quantity of compost and green manuring is not essential to harvest high yield without synthetic fertilisers, as widely believed by scientific community
- Where relevant or required, some amount of external inputs, eg. cattle excrements as source of microbial inoculants (cowdung and cowdung based products has been reported to have large population of agriculturally beneficial micro-organisms) and plant biomass will be needed, in the initial three years
- Extracts of locally available weeds (botanicals) sprayed on crops as prophylactic, according to traditional knowledge, can protect crops from many, if not all insect pests
- Compost is to be viewed as a soil building substance and a source of beneficial micro-organisms and not as source of crop nutrients
- Trees grown in modified alleys potentially bring soil nutrients from deep down and can be used for meeting needs of annual crops grown between alleys
- Plant biomass contains all the 33 nutrients a crop needs for balanced growth while only few like N, P, K can be readily purchased from market. But these are in bound form and can be solubilised by relevant micro-organisms and right environmental conditions

These practices are quite compatible with one another, and trees and cattle should be regarded as an important component of a sustainable farming system. In the relevant crop husbandry treatments (T1 and T2) that

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were designed and tested, only the grain produced is exported. Crop stover is retained as surface mulch. Where stover is needed for economic purposes such as cattle feed, an equivalent quantity of biomass having no such economic value is returned to the field, i.e., foliage or loppings from shrubs or trees grown on field bunds or from outside the farm. The system is understood to function as a single entity, within which all functions in the soil, among plants, and at the soil–plant interface are highly interactive for producing yield. About three-quarters of farmers in India have either small holdings (0.4 to 1.4 ha) or marginal holdings (0.4 ha). They have little scope to benefit from technologies or implements designed for larger farms. This does not mean, however, that these small holdings are less productive. Actually, on a per-hectare basis, they usually outperform larger farms, even by order of magnitude. The model suggested assumes that small and marginal farmers can, and will mobilise family labour, to undertake intensive crop and animal management if it is productive and profitable i.e., if they can get higher returns per hour or per day of labour invested. While some of these methods require considerable labour, many large farmers might be able or willing to invest, they could be relevant to a large number of small and marginal farm households in the semi-arid tropics that have family labour available but very little cash. Interventions stated here are proving to be profitable in terms of their returns to labour as well as to other factors of production.

Design of Long-Term Field Experiment

To examine whether yields comparable to conventional agriculture can be attained using the kinds of strategies and interventions stated in the preceding section, a multiyear experiment was designed to compare and evaluate four different treatments of crop husbandry: T1, T2, T3 and T4, of 0.21 ha. each. Boundary of each treatment plot (60m x 35m) had densely sown (20-30 cm distance) single row of *Gliricidia* at lay-out of the experiment in June 1999. It was found that lopping of branches commenced by end of year 2, and was applied to all the four treatments. Relevant base line data was collected at the start of the experiment. After a five–year experimental cycle, close to the period of harvesting, soil sampling was done during fifth and sixth year from these treatment plots (Table 1). Since it was assumed that most smallholder farmers would own few animals and therefore would not have enough manure, the use of other organic matter was planned for. However, the systems being tested benefited from the use of animal excrement. The results reported can quite certainly be improved to the extent that animals are integrated into the farming system.

The major objective of the experiment was to learn whether plant biomass, added to three of the four crop-husbandry treatments, could be profitably used as surface mulch (serving as a source of crop nutrient) instead of being burned, which is a common practice in South Asia, including the semi-arid tropics. Details of these four treatments are given in Table 1. The experiment is providing an excellent field site for testing the overall hypothesis that treatments receiving high biomass as a source of nutrient exhibit high soil biodiversity and support higher levels of biological activity (both intervening variables being tested in the experiment) will produce good agronomic results.

Findings from the Experiment

Sampling was done from 0-10 and 10-20cm depth with a 40 mm diameter soil core. Soil samples were collected from each depth of all the 30 plots of a given treatment, but pooled depth-wise for the 5 plots of six different strips of a given treatment (total 48 samples at one sample time: 2 depths x 6 strips x 4 treatments), mixed well and used for analysis. The samples were air dried and passed through 2mm sieve to prepare these for analysis of chemical and biological properties. Soil quality analysis was based on parameters that included study of biological indicators, microbial indicators and chemical indicators. Crop productivity indicators involved yield assessment that was based on all the 30 plots in each of the four crop-husbandry treatments.

Biological Indicators

In case of soils with more microbial biomass, a source and sink for nutrients will be able to release nutrients more rapidly. When microbial biomass is increased, the availability of N and P is also increased that is reflected with improved soil quality and productivity. In this study, biomass C and N of plots T2 and T4 was significantly higher than T3 (Table 2). With an increase in biomass C (23-32%), there was an increase in mineral N (22-55%), microbial biomass N (22-35%) and total N (15-29%) in the treatment plots Tl and T2 when compared to T3. Net nitrogen mineralised in T2 was found to be negative (-0.30), indicating immobilisation of N and the availability of organic matter for microbial growth. Biomass C, as a proportion of total soil C, serves as a proxy for soil quality. Acid and alkaline phosphates of treatment plots Tl, T2 and T4 were higher than T3 (Table 2). The physio-chemical properties of soil in turn influence the respiration rate and enzyme activities.

Interventions	Treatment Plots			
	Tl	T2	T3	T4
Tillage	Zero-till	Zero-till	Conventional (bullock plough)	Conventional (bullock plough)
Sowing	Seed drill	Seed drill	Seed drill	Seed drill
Microbial inoculants*	+	+	-	-
Biomass (t ha-1 yr-1, first 3 years only)	10 Rice straw as surface mulch	10 Farm-waste, stubble and hedgerow foliage as surface mulch	None	10 Farm waste, stubble and hedgerow foliage incorporated
Compost (t ha-1)	1.5-1.7 annual	1.5-1.7 annual	1.8 (1 in 2 year)	1.8 (1 in 2 year)
Fertiliser (N) Urea (kg N ha-1)	0	0	80	80
Fertiliser (P) kg P ha-1 (1 in 2 year)	20 (RP)	20 (RP)	20 (SSP)	20 (SSP)
Pest management	Biopesticides*	Biopesticides	Chemical Pesticides	Chemical Pesticides
Weeding	Manual, weeds retained	Manual, weeds retained	Manual, weeds discarded	Manual, weeds discarded

Table 1: Four different crop husbandry treatments in a continuing long-term experiment (Rupela et al., 2006) at ICRISAT

Same crops were grown in all treatments each year: Year 1 pigeonpea-chickpea sequential (June 1999-May 2000); Year 2 sorghum/pigeonpea intercrop (June 2000-May 2001); Year 3 cowpea/cotton intercrop (June 2001-May 2002); Year 4 maize/pigeonpea intercrop (June 2002-May 2003); Year 5 cowpea/cotton intercrop (June 2003-May 2004); Year 6 maize/pigeonpea intercrop (June 2004-May 2005), Tl = Low-cost system 1, No tillage, Rice straw as surface mulch+Biological inputs for plant growth and pest management. T2 = Low-cost system 2, No tillage, farm waste as surface mulch+Biological inputs for plant growth and pest management. T3 = Conventional system, tillage, integrated nutrient management and chemicals for plant growth and pest management. T4 = Same as T3+Farm waste as biomass as in T2.

Properties	Treatment Plots					
	TI	T2	T3	T4	LSD (p = 0.05)	CV (%)
Soil respiration (mgCkg-1, 10 day-1)	123 (±11.5)	137 (±10.5)	100 (±5.5)	147 (±3.5)	17.3	4.3
Microbial biomass C (mgCkg-1, 10 day-1)	529 (±5.0)	524 (±1.5)	404 (±2.0)	492 (±14.0)	38.5	2.5
Mineral N mg N kg-1	11 (±1.0)	11 (±0.0)	9 (±0.0)	14 (±1.0)	2.6	7
Net N mineralisation mg N kg-1	1.8 (±0.1)	-0.30 (±0.3)	1.7 (±1.01)	1.02 (±0.8)	1.9	89
Microbial biomass N (mgCkg-1, 10 day-1)	34 (±1.0)	36 (±1.5)	26 (±0.5)	32 (±1.0)	4.9	5
Acid phosphatase (μg p-NP g-1 h-1)	309 (±1.0)	362 (±30.1)	289 (±5.5)	333 (±24.1)	100.9	10
Alkaline phosphatase (μg p-NP g-1 h-1)	947 (±10.0)	1031 (±22.6)	860 (±30.6)	1024 (±13.0)	105.5	3.4
Dehydrogenase (μgTPFg-124h-1)b	139 (±5.5)	137 (±0.0)	125 (±5.0)	138 (±4.0)	21.5	5

Table 2: Biological indicators of soil from four crop husbandry treatments (2003-05)

A balance sheet of nitrogen and phosphorus was prepared for all four treatments. T1 and T2, which received plant biomass, compost, and micro-organisms as their major source of crop nutrient, ended up receiving substantially more nitrogen (27 to 52%) and phosphorus (50 to 58%) than was added to T3.

Microbial indicators: Characterisation of microbial indicators of soil quality was assessed through overall results on microbial population. Results strongly suggested that soil from plots TI and T2 were more active than that of T3. The overall results on different soil biological parameters strongly suggest that the soils from T1 and T2 were consistently more active microbiologically than those of T3 (Table 3).

In conventionally managed plot T3, there was not much difference in the microbial count such as bacteria and fungi. However, there appeared significant difference in the population of micro-organisms that have role in plant growth promotion such as *siderophore* producers, *pseudomonas* and *antagonistic* bacteria. It might be due to the inoculation of such bacteria to the fields at the time of sowing (Table 1) or from the application of composts and crop-residue that might have provided an environment for enhancement of beneficial groups of bacteria. Unfortunately, limited information exists as to the extent and activity of micro-organisms on surface exposed residue themselves. However, it would be expected that significant transformations of nutrients might take place, including mobilisation and immobilisation as well as gaseous evolution due to application of crop residue. Changes in microbial community in soils take time to develop, since they are a result of complex process and interactions in soil and three to six years are often needed to effect significant, visible changes.

Chemical indicators: These were explored through characterisation of nutrient indicators of soil quality. In different crop-husbandry treatments, there was an increase of 15-29% total N and 17-23% total P, 25-33% available K and 6-23% available P in TI and T2, relatively more than in T3. However, the organic carbon (OC) content did not vary significantly among the four treatment plots (Table 4).

Microorganism, Functional Groups*	Treatment Plots					
	TI	T2	T3	T4	LSD (p = 0.05)	CV (%)
Bacteria	5.6 (±0.05)	5.7 (±0.02)	5.4 (±0.05)	5.7 (±0.04)	0.21	1.2
Fungi	3.2 (±0.05)	3.4 (±0.10)	3.1 (±0.10)	3.1 ±0.10)	0.33	3.3
Actinomycetes	4.7 (±0.05)	4.4 (±0.0)	3.8 (±0.30)	4.2 (±0.15)	0.59	4
Pseudomonas	4.1 (±0.15)	4.1 (±0.50)	3.3 (±0.10)	3.3 (±0.05)	1.04	9
Siderophore	3.6 (±0.10)	4.2 (±0.35)	2.9 (±0.50)	3.7 (±0.60)	0.98	9
PSB*	1.4 (±0.05)	2.3 (±0.55)	0.6 (±0.6)	1.2 (±0.75)	2.66	62
Phytase producers	3.8 (±0.55)	4.3 (±0.10)	3.2 (±0.40)	3.9 (±0.10)	1.01	8
Antagonistic bacteria	4.0 (±0.00)	3.9 (±0.10)	3.4 (±0.40)	4.0 (±0.25)	1.25	10

**plant growth promoting and antagonistic bacteria,*
PSB = phosphate solubilising bacteria

Table 3: Microbiological indicators (population log 10 g-1 soil, ICRISAT (2003-05)

Chemical Properties	Treatment Plots					
	TI	T2	T3	T4	LSD (p = 0.05)	CV (%)
Total N (ppm)	754 (±16.5)	842(±43.6)	653 (±68.2)	605 (±37.1)	202	9
Total P (ppm)	344 (±11.5)	363 (±53.7)	297 (±50.1)	286 (±54.2)	92.6	9
Available K (ppm)	220 (±3.5)	234 (±9.5)	175 (±5.0)	192 (±3.0)	23.3	4
Available P (ppm)	2.1 (±0.55)	1.8 (±0.59)	1.4 (±0.18)	1.9 (±0.10)	1.66	29
OC (kg C ha"1)	12 (±1.0)	12.5 (±2.5)	10 (±2.0)	12 (±1.0)	3.4	9

Table 4: Chemical (nutrient) indicators of soil from four crop-husbandry treatments (2003-05)

The nutrient status of TI and T2 was more when compared to T3 (Table 4). However, this does not mean, that crops in these two plots have access to more N and P. Nutrients when added as biomass are not in available form for crops unless mineralized by microbial activity and only a small portion of it is recovered by crop. There was not much variation in organic carbon content across the four treatments. Increase in soil organic carbon content can be due to application of organic manures or higher crop residue to soil. It has been also observed that there is an increase in soil organic carbon content with application of inorganic fertilisers and farmyard manure.

Productive Indicators: Results were explored through characterisation of crop yield as productive indicators of soil-quality. It is important to note that both TI and T2, produced similar yields of crops that were grown during the fifth and sixth year when compared to T3 that received chemical fertilisers. Stover yield of both the crops was

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Constraints in Diverting Crop Residue for Soil Cover

Experiences From NAIP Project in Mewat, Haryana

Sustained improvement in crop productivity, and resilience of farming systems can only be realised if crops are grown on healthy soils. To maintain a healthy state of soil, one of the key efforts needed is to retain crop residue on soil surface. Keeping residue on soil surface as mulch is one of the essential principles of CA in conjunction with other principles such as minimal soil disturbance and crop rotation. These principles, if adopted in a holistic manner, help in establishing and sustaining healthy soil systems that positively impact the farming system, thereby improving crop, and livestock productivity. Among other benefits, these help in reducing soil erosion, promote *in situ* water conservation, and enhance soil quality through improved biological activity, and organic matter content.

It is affirmed that most benefits of CA accrue only when minimal or no soil disturbance (zero-tillage) is practiced along with retention of residue or by growing cover crops. There is ample scientific evidence from literature on CA that no-till without soil cover results in poor yields. The practice of removal of crop residue in rainfed regions, and burning it in irrigated regions has resulted in degraded soil structure compared to when residue have been retained on them. This has had a direct implication on crop production; largely on account of being influenced by improved soil quality parameters such as soil aggregation, water infiltration, and microbial biomass.

Benefits of Crop Residue as Soil Cover

Residue maintained on soil surface serve as a protective layer from the impacts of excessive rainfall and temperature. It helps in improving soil health by increasing infiltration, reducing surface sealing, soil crusting, and moisture evaporation. However, there are only few options available to farmers to divert residue for reaping such benefits. Though CA advocates this approach, socio-economic factors govern its adoption, given the opportunity cost attached to crop residue. Depending on local specificities, scarcity of sufficient crop residue as soil cover for the succeeding crop makes establishment of CA based practices more challenging.

Crop residue comprises an important source of fodder/feed for livestock in majority of farming systems in India. The integrated crop–livestock farming system approach lays much emphasis on needs of livestock to contribute to income and food security of the household. Given the importance of crop residue as a soil cover, it is important to understand farmer's perception towards it. Some aspects of this dimension were explored as part of the baseline survey done within the region.

Farmer's Perception Towards Crop Residue

As part of baseline survey carried out by NCAP (Dr. Usha Ahuja and Neelu Nanwani) under NAIP Mewat Project, farmers shared their views associated with retention of crop residue. A sample of 170 farm families from 17 selected villages (10 from each village) formed the basis of farm/village level study covering important aspects of agriculture and allied activities. Some key constraints affecting crop residue availability for needs of soil cover in Mewat is mentioned in table alongside.

From the table it can be seen that, non-availability of fodder for animals and fuel for household are key constraints with majority of farmers who approve of the practice of retention of crop residue as soil cover. Termite infestation, and need for increased plouging was perceived by the farmers as other important reasons preventing farmers from retaining crop residue on the fields.

Keeping these constraints in view, the following sections deliberate on current farming system, and availability and usage of crop residue in its pursuit. This is based on interactions with farmers and other stakeholders at Mewat.

Farming System in Mewat

Mewat is located in the southern part of Haryana and is a backward region of the state. With a predominant rural population, agriculture is the main occupation of people of Mewat, with livestock forming the secondary source of livelihood. There is strong dependence of households on livestock with majority farmers involved in dairying activity owing to the large population of buffalos in the region.

The prevailing cropping pattern during rabi and kharif are wheat/mustard and pearl millet/sorghum, respectively. Rabi crops are primarily irrigated with tube wells and to a limited extent with canal water, whereas kharif crops are totally dependent on monsoon for their irrigation needs.

Enhancing agricultural productivity in the face of widespread problem of resource degradation is the key challenge to improve livelihoods of predominantly agricultural population residing in Mewat. Such regions can benefit from CA practices that have potential to address goals of enhanced productivity while improving the resource base quality.

Constraints Noted in Mewat Region	Clusters* (number of HHs)		
	Cluster I	Cluster II	Cluster III
Non-availability of fodder for animals	21 (29.6)	13 (43.3)	8 (36.4)
Non-availability of fodder for animals and fuel for household	26 (36.6)	8 (26.7)	6 (27.3)
Need for increased ploughing	8 (11.3)	0	0
Termite infestation	10 (14.1)	8 (26.7)	6 (27.3)
Affects sowing of next crop	6 (8.5)	1 (3.3)	0
No constraint	0	0	2 (9.1)
Total housholds (HHs)	71	30	22

Source: NAIP Mewat Sub-Project Baseline Survey Report, 2009, prepared by NCAP.

** Cluster I: consists of resource rich villages with cereal based cropping system Cluster II: comprises of resource poor villages with emphasis on livestock, Cluster III: comprises of villages having prevalence of vegetable cropping system, [Figures in parentheses indicate percentage of total households]*

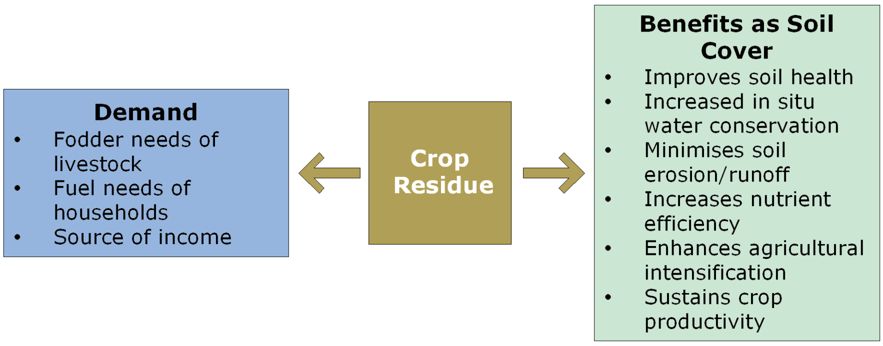
Constraints preventing use of crop residue as soil cover

While availability of an appropriate seed drill can enable seeding crops without tilling the soil, the availability of crop residue for keeping the soil covered will pose as a key issue to farmers in the context of prevalent crop-livestock farming system of the region. Apart from household consumption, a significant amount of these crop residue/by-products are sold in the market for cash income. There is competitive demand for crop residue for diversified uses such as fuel, fodder or even construction material and roofing and could constitute a serious bottleneck to the implementation of zero-till system with residue retention. The key issue lies in making farmers understand its judicious applicability to take needed decisions.

Crop Residue Availability and its Usage in Mewat

Pearl millet, sorghum, wheat, and mustard crops grown in the region are a major source of crop residue. These residue are already being put to diverse usage in making it essential to look for alternatives that would help in making residue available for soil cover.

Based on the baseline survey report, the major areas of crop



Routine Demand for Crop Residue and its Benefits as Soil Cover

residue usage are fodder for livestock, and fuelwood for cooking needs. Pearl millet, sorghum, and wheat are the major source of fodder for livestock while mustard is mainly used as fuelwood. About 16% of the farmers in Mewat sell pearl-millet straw while 58% of the farmers use it as dry fodder for livestock. Further, 15 % of farmers partly sell it and use it as fodder for livestock. Sorghum grains are used as a concentrate feed for livestock, while its straw is mainly consumed as green fodder by livestock. Large portion of crop residue from wheat crop is devoted to use as dry fodder for livestock, while some part of it is retained for sale. Wheat straw is burnt and also left on the fields by some of the farmers. Mustard straw is mainly used as household fuel by 38% of the farmers, while 13% of the farmers sell the straw as a source of preferred fuel for households, and brick kilns.

Though crop residue are being used for various purposes, existing crop residue usage of the area heavily banks upon them and their by-products to meet fuel demand for household and fodder demand for livestock. The section below makes an effort to highlight emerging issues that need to be pursued for Mewat region, based on interventions envisaged in the NAIP-Mewat project plan.

Emerging Pointers for Diverting Crop Residue

Based on the initial baseline survey of the region on crop residue availability, it is clear that successful transition to CA based farming systems will demand deeper understanding of issues involved and laying down of mechanisms that would facilitate CA adoption in the region. Issues that need to be further explored to encourage the practice of soil cover through ongoing research effort include:

- Understanding prevailing crop residue scenario and usage in selected clusters of the region
- Identification of alternate mechanisms of meeting fodder & fuel needs of farmers to help make crop residue available as soil cover. These would include encouraging generation of more biomass to meet fodder and fuel needs of the region through pursuit of three areas of effort:
  - o COVER CROPS: The choice of cover crop depends on climatic features, prevailing soil condition (pH, salinity, water logging), farming system, and seed availability. A broad range of species could serve as cover crops mostly during rabi season in Mewat, due to availability of more moisture. Some of the fodder crops being tried as cover crop are Oats, Berseem (*Trifolium sp.*) and local varieties such as Chikori, intercropping with legume crops such as cowpea (*Vigna unguiculata*), Sesbania sp., and beans such as Mung (*Vigna mungo*), Clusterbean/Guar (*Cyamopsis tetragonolobus*) along with short-duration variety of pearl-millet (*Pennisetum glaucum*) maize (*Zea mays*), and sorghum
  - o GRASSES: Some of the arid forage grasses that could be introduced for pasture, grazing, and hay crops after the onset of monsoon (kharif season) include: Napier (hybrid), Stylos, Guine, Anjan and Dinanath grass varieties. Forage legumes could be seeded in perennial grasses to provide protein in animal diets and nitrogen to soil from rhizobium fixation.
  - o AGRO-FORESTRY: This intervention will include introduction of trees and shrubs to serve needs of fodder and fuel for the region. Trees and shrubs with potential for fodder, owing to their good growth characteristics, cause minimal soil disturbance, help to prevent nutrient losses, and provide biomass for feed in a short time. In addition to providing fodder, fuel, wood, and other products, trees & shrubs selected will promote soil and water conservation, enhance soil fertility, and act as windbreaks for nearby crops. Promotion of trees/shrubs suitable to the area for alternate biomass generation could be *Leucaena* and *Prosophis*. More options will be explored with ICAR institutes dedicated to research in the arid zones in India.

Women involved with daily chore of residue gathering for fuel and fodder need

Generating more biomass for fodder and fuel needs through above options would require effective use of available land in the region. Overall, these interventions will address the need to lay down a strategy with direct policy implications for gradual conversion to CA based farming system, and to help increase availability of crop residue/biomass while keeping the livestock & fodder needs intact for farmers in regions such as Mewat.

4 New Publications Available for Download

We have translated the FAQ, Factbook, and Soil Series #2 into Hindi language. The Soil Education Series #3 in English is also ready and all these can be downloaded from www.conserveagri.org/content.htm

Argentine Association of No-Till Farmers (AAPRESID) Initiates Conservation Agriculture Certificate Project

The article is based on PACA's communication with Juliana Albertengo, Agricultural Engineer Program Manager, AAPRESID

AAPRESID, an Argentine based NGO, established in 1989 is continuously working in the area of strengthening and promoting the concept of Conservation Agriculture (CA). The organisation presents themselves as an open network of innovative farmers, receptive to scientific and technological advances that aim to acquire knowledge; integrating research, and technical assistance. Enhancing agricultural productivity in the face of widespread resource degradation and increasing consequences of climatic events is a key challenge. CA provides a model agricultural system driven by cleaner technological mechanisation, resulting in resource use and management with limited emissions of GHGs and increased sequestration of CO_2.

In this context, AAPRESID has developed the Agricultura Certificada (AC) with the objective of "providing tools for a professional agronomical management, by the analysis of management and efficiency indicators; and to show to the rest of the society how are the production processes and its impact on the environment, in order to capture the value that conservation agriculture makes in it. The protocol is based on principles and criteria developed from international initiatives that focus on sustainability".

The AC concept promotes rational and sustainable use of basic resources of agricultural ecosystems such as soil, water, air and biodiversity. The certification is based on the fact that AC principles (absence of tillage, crop rotation and stubble coverage on soil surface, diversified cropping system) has changed the reigning paradigm proposing new agriculture that is much closer to solve the dichotomy between productivity and environmentally friendly practices as shown in table below:

AC Principle	Impact on Environment
Minimal soil disturbance + presence of soil residue cover	• Minimised soil erosion • Reduced use of fuel • Lower carbon emissions • Improved water-use efficiency • Improved soil biological activities • Improved soil fertility
Diversified cropping system	• Improved pest management • Improved nutrient management • Improved physical, chemical and biological properties of soil

Impact of AC Principles on Environment

For smooth and systematic implementation of this certificate program, AAPRESID has produced a Good Agricultural Practices (GAP) Manual and defined science based indicators that quantify the impact of agriculture on the environment. In the same context, they have developed the "Environmental and Productive Quality Management System in Conservation Agriculture" a scheme that offers new tools to perform more responsible and precise agriculture and cattle production from an environmental and productivity point of view. The GAP manual and soil management indicators were devised to describe and monitor productive actions and behaviours so as to certify the agricultural production process based on many obligations including Legal, Social, Work, Environmental and GAP. The detailed information about GAP is depicted in the table at bottom of page.

Thus, Agricultura Certificada constitutes a clear evidence of an economic, environmental and socially sustainable production that adds value to the agricultural production through information management for the decision-making process and administrative procedures achieved through the implementation of good agricultural practices that were selected and agreed with researchers and specialists. In turn, indicators allow measuring the impact of management practices, quantifying the current state of the production system, and developing a professional and science-based agronomic management.

The first version of this AC-certificate project is mainly focused on Argentinean agriculture, but aims to achieve global scope by getting involved with other organisations around the world. Besides, it is applicable to all agricultural productions - food for human or animal consumption, meat, milk, biofuel, etc.

There are about 90,000 ha under implementation of Agricultura Certificada and the first farms whose productive process is certified would be notified soon. AAPRESID is strongly lobbying at international levels with its Agricultura Certificada enterprise, such as in the EU conference on "Climate change – can soil make a difference?" Similarly, it was during the COP13-conference in Bali that carbon credits for No-till practices were mentioned for the first time under their leadership.

Efforts initiated by AAPRESID to promote the AC programme seems to be very positive and there is a need that stakeholders at global level appreciate as well as promote this with great enthusiasm by facilitating creation and adoption of similar programs at different regions of the world.

Criteria	Indicator
No Soil Disturbance / Presence of Soil Residue Cover	Records of crop/field and crop rotation sequence is maintained.
Crop Rotation	There is evidence of a crop rotation sequence, and it is maintained. The sequence should be agronomically justified.
Integrated Pest Management (IPM)	The farmer completes a pest monitoring record and agro-chemical application (including deficiency periods).
Efficient and Responsible Phyto-Sanitary Products Use	It is mandatory to follow record of phyto-sanitary's containers treatment and its disposal. Product applications are documented and justified by the pest monitoring record. Sprayers are calibrated and this activity is recorded. The farmer keeps records of the training courses taken by the employees involved in this activity.
Balanced Nutrition	Fertiliser application records and crop/field lists are maintained.
Stockbreeding Information Management	Cattle management and sanity records are kept.

Criteria and indicators of Good Agricultural Practices (GAP)

Biological Approaches to Achieve Sustainable Soil Health

...continued from page 3

marginally higher in T4 when compared to the other three plots Tl, T2 and T3 (Table 5)

Stover/yield (t ha"1)	Treatment Plots					
	Tl	T2	T3	T4	LSD (p = 0.05)	CV (%)
Cotton and maize yield	3.2 (±1.91)	3.1 (±1.83)	3.3 (±1.93)	3.8 (±2.22)	0.77	7
Cotton and maize stover	7.5 (±3.73)	7.3 (±3.30)	7.7 (±3.4)	8.7 (±4.3)	2.16	9
Legume yield	0.7 (±0.24)	0.7 (±0.21)	0.6 (±0.27)	0.6 (±0.25)	0.13	6
Legume stover	2.0 (±0.37)	2.2 (±0.56)	2.0 (±0.08)	2.5 (±0.49)	0.94	13

Table 5: Productive Indicators (crop yield and stover dry weight (2004-05)

Characterisation of Sustainable Indicators was also done to assess soil-quality in these experimental plots. The application of inorganic and organic nutrients improved soil health and thereby increased the yield of T1 and T2 similar to T3 (where chemicals were applied) and T4 (where chemicals and farm waste was applied). Tl and T2 that received plant biomass, compost and micro-organisms as source of nutrients showed substantially more N (15-29%) and P (17-23%), than that was added to T3, (Table 4) largely as chemical fertilisers. In all four treatments, nutrient, biological, microbial and crop indices were calculated. The biological, microbiological, nutrient and crop indices were 1.07, 1.09, 1.11 and 1.00 (Table 6), respectively for treatment T2, with a sustainability index of 2.29. In T3, the sustainability index was 1.56 and all four indices were lower than the least sustainability index. Abiotic characteristics such as pH, cation exchange capacity, moisture content, temperatures etc. allow a better understanding of the physical and biochemical data obtained and support the final evaluation of soil quality. Though in this study, only few physical parameters were characterised, they were not used to derive the sustainability values. As soils vary widely in biological and microbiological activity, the parameters studied here can be used as components of a universal composed index for determining soil quality in relation to plant growth.

Treatment Plots	Biological index	Micro-biological index	Nutrient index	Crop index	Sustainability Index	System
Tl	1.01	1.02	1.07	0.98	2.07	S
T2	1.07	1.09	1.11	1	2.29	S
T3	0.85	0.85	0.86	0.97	1.56	US
T4	1.08	0.98	0.95	1.09	2.1	S

Table 6: Sustainability Indicators of soil quality

Economic Benefits

Most significant for farmers, the net income from crops in each year except year 1, which was essentially the year of learning, has been higher — even much higher — in T1 and T2 than T3. The differential has ranged between 1.3 and 4.6 times indicating that in economic terms, the low-input strategy is proving to be much more profitable. In this calculation, each input was taken into account (except the cost of biomass and labour). Biomass was assumed to be available with little or no opportunity cost, having been saved from burning and being handled by family labour. The low-input strategy of T1 and T2 has, therefore, in some years performed much better agronomically than the more costly conventional cropping system. This makes the economic advantages even greater.

Discussion & Recommendations

From the data collected during the first 5 years of the long-term experiment presented here, it is apparent that the two crop-husbandry treatments, T1 and T2, which received locally available, low-cost and eco-friendly materials such as biomass and compost, along with agriculturally-beneficial micro-organisms, were able to produce yields that match those from the T3 treatment that relies on purchased inputs, e.g., chemical fertilisers and pesticides, along with continued conventional tillage practices. Labour was the major input in T1 and T2. While this has opportunity costs for small and marginal farmers, these producers have relatively more access to labour than cash, so their binding constraint is land and capital rather than labour. Inputs of the agriculturally-beneficial micro-organisms used in this study can be a constraint in some situations. From year 2004, these were replaced by cowdung based traditional knowledge products such as '*Amrit-Paani*' after it was established that it contained large population of agriculturally beneficial micro-organisms *(Rupela 2006)*.

Sowing crops in the presence of surface mulch is a potential hindrance to adoption. Sowing in the long-term experiment described here was done using a bullock-drawn implement. Manual sowing is an option, but it has high labour requirements. Before using the bullock-drawn implement for sowing, biomass was taken off (largely crop stems) from the soil surface and spread gain soon after sowing. Over time, it has become possible to mechanise such an operation.

It was apparent that plant biomass was the engine of crop productivity in T1 and T2, mediated by biological processes that enhance soil fertility. It is generally argued that biomass is required to feed cattle in South Asia, and therefore is not available for application to the soil to enhance crop production as has been done in T1 and T2. Being able to apply the levels of biomass used in T1 and T2 over time will require special efforts from farmers who want to utilise this biologically-based cropping system. However, there are many ways in which biomass supply can be augmented for a system such as this. Fallen leaves and loppings of tree branches on-farm are an important source of biomass used in the study from year 4 onward. From year 5, at least three ton of biomass was harvested from lopping of Gliricidia grown on boundary of the four treatments. Production can be 3 to 5-times more in well endowed areas for soil moisture. We grew *Gliricidia sepium*, but a number of locally adapted fast growing trees species with economic and medicinal value, such as *Moringa oleifera* (drum stick plant) could be a better choice for use as surface mulch. Farmers practicing alternative agriculture need to appreciate the value of biomass and develop multiple practices and technologies that can harness this source of nutrient for crop production. Producing yields at par with or higher than their neighbours without incurring the cash costs of chemical fertilisers and pesticides offers farmers a significant incentive for change.

This study suggests that biological approaches to crop production can sustain soil systems profitably for farmers; provided they have sufficient labour and its opportunity costs are not too high. Cost of production per unit of output also needs to be assessed, including water-use efficiency. This was however not considered in this experiment because water provision was beyond control in a purely rainfed system. However, rainwater harvesting was better in the low-cost systems (T1 and T2) than from the conventional system (T3), as seen from the reduced runoff.

Conclusions

Overall, the biological approaches reported here, i.e. use of plant biomass as surface mulch, agriculturally beneficial micro-organisms, and other practices have enhanced soil

Concludes on page 11 column 2 ...

Happenings

No-till Farmers Launch Campaign for Carbon Credits

Climate change is an important global environment challenge affecting almost every aspect of the ecosystem. Efforts are underway to understand the nature and element of change, its impact, and strategies needed to cope with consequences. In this context, the Saskatchewan Soil Conservation Association (SSCA) with support from the Saskatchewan Pulse Growers has launched an awareness campaign on 17th Feb, 2010 to advocate on behalf of no-till farmers' right to benefit from carbon credits that could be a part of a climate change management policy.

The campaign was based on the fact that no-till farming practices capture more carbon dioxide from the atmosphere than they produce, reducing greenhouse gas levels that contribute to global warming. No-till farmers thus contribute to carbon sequestration - storing carbon in their land, thereby creating credit that has commercial value in a carbon trading system.

The awareness campaign was accompanied by the launch of a website that explains why no-till farming should earn credits. The theme was "No-till farming. Give it credit".

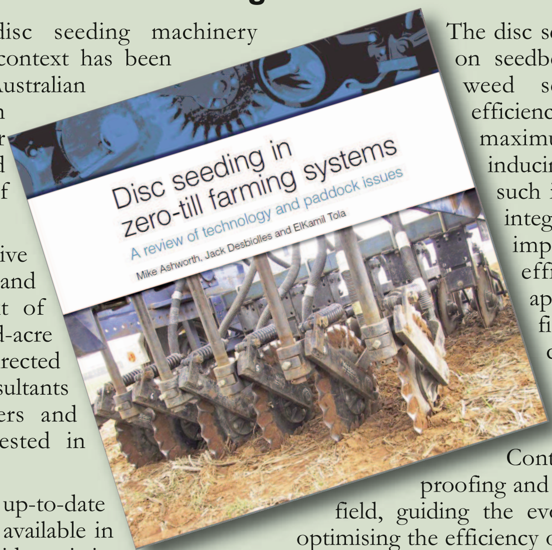
One of the objectives of the campaign was to profile the fact that no-till farming is a part of the solution to address various aspects of climate change, as it captures and stores more carbon than it produces; advocating that the value of carbon capture credits belong to the farmers who create them.

The key features of the campaign are:

- Recognising farmers' contribution - If a price is put on carbon, farmers' fuel, power and input costs would increase. Considering this fact, at least part of the carbon price should flow back to the farmer who stores it - via credit.
- Farmer owns the credit: The carbon-storing capacity of agriculture shouldn't be counted as a pre-existing "national asset". It is created by farmers who invest their time and money. The asset should be credited to the farmer, for his or her benefit.
- Independent verification: Verification and trading should be separate functions such that farmers need not have to sell their credits to a middle-man in order to certify that an asset exists.

New Book on Disc Seeding in Zero Till Farming Systems

A new book focussing on disc seeding machinery performance in zero-till farming context has been recently published by the Western Australian No-Tillage Farmers Association in collaboration with the Institute for Sustainable Systems and Technologies at the University of South Australia.



The book offers a comprehensive reference on issues of selecting and using disc seeders in the context of highly mechanised Australian broad-acre dryland agriculture. It is primarily directed at leading farmers, agricultural consultants and advisers, students, researchers and manufacturers involved or interested in zero-till farming.

The 226 page book presents an up-to-date review of disc seeding technology available in Australia and forms a technical guide assisting the adoption of disc seeders and optimisation of their field performance in zero-till cropping context. It draws on wide range of published literature as well as extensive research experiences of the authors to paint a comprehensive picture of the principles surrounding various facets of disc seeding and associated interactions within a farming system.

The practical book explores how the disc opener design and features interact with field operation, crop residue, soil conditions and agronomic factors. It examines the field management implications of optimising disc seeder performance, integrating best practice such as controlled traffic and inter-row sowing with 2cm accuracy satellite guidance. Its 18 chapters cover key topics such as zero-tillage philosophy, disc opener classification and technology, soil strength, stickiness and furrow compaction issues, residue cutting principles and management aspects - including residue managers, weed management and fertiliser placement considerations, holistic approach under controlled traffic farming, and Australian farmers' experiences gauged from a nation-wide survey and case study highlights.

The disc seeder machinery has a direct impact on seedbed moisture conservation, reduced weed seed stimulation and improved efficiency of crop water use by enabling maximum crop residue retention and inducing minimum soil disturbance, and as such is presented as a key tool within an integrated farming system, integral to the implementation of an effective and efficient conservation farming approach. Their successful use in the field incorporates challenges which can be minimised with the use of precision guidance, and ultimately, disc seeders perform best in well managed, healthy soil environment. Continued research will play a key role in proofing and fine tuning adaptive practices in the field, guiding the evolution of disc seeder design and optimising the efficiency of machinery.

This book is also of international relevance to all professionals involved in wider conservation agriculture arena by providing an unique insight into zero-till farming system challenges encountered in highly mechanised dryland farming context of Australia, and in the principles involved in developing management solutions.

The publication also includes as an Appendix, a suppliers' register with web page references around 50 identified disc seeder brands available in Australia.

The book retails at AUD 40.0, and can be ordered via the WANTFA website (www.wantfa.com.au). Further information may be obtained from the co-authors Jack Desbiolles at jacky.desbiolles@unisa.edu.au or Mike Ashworth at mike.ashworth@wantfa.com.au

Citation: Ashworth M, JMA Desbiolles and EKH Tola (2010). Disc seeding in zero-till farming: A Review of Technology and Paddock Issues. Western Australian No-Tillage Farmers' Association, Northam, Western Australia. 226p. ISBN 978-0-646-52876-2.

- Reward foresight: Early adopters of no-till should be recognised. Industrial businesses that anticipate changes and move early to reduce carbon are expected to receive credit. So should farmers.

Source: *www.ssca.ca*

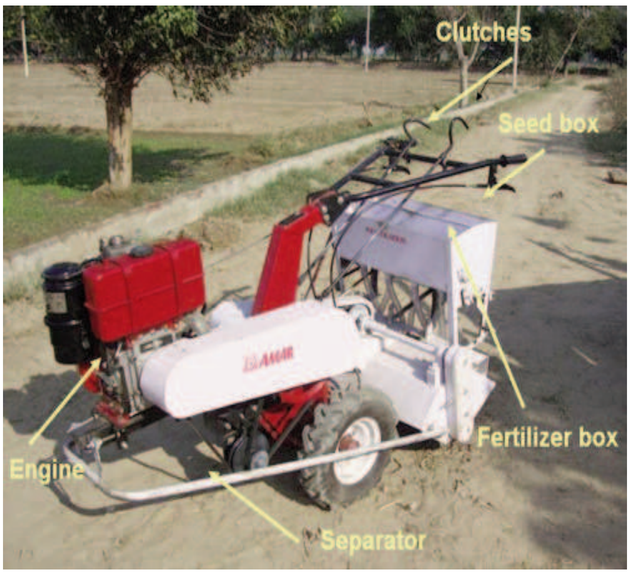
aWhere Develops an Innovative Decision Making and Monitoring Tool Deployed by CSISA

The USAID and Gates Foundation supported project CSISA has collaborated with aWhere for the effectiveness of their Hub Communication Platform (HCP). HCP is a linking, information sharing and communication platform between farmers, public-private sector and scientific community within and outside CSISA stakeholders. aWhere software 4.0 has emerged as an effective tool in HCP as it can transform complex data into actionable insights through location intelligence, and also helps to manipulate, analyse and present these data via info-rich, interactive maps. It also provides a powerful foundation for researchers, analysts, production planners, and sales and marketing professionals in allocating resources and measuring performance through mapping of agronomic and hydrological data over existing crop and livestock productoin. Additionally, it eases an exchangeable "knowledge base" sharing within and between different objectives, hubs, public-private sector partners, donor community, stakeholders for futuristic decisions. Contrary to other software, aWhere 4.0 is a user friendly tool that can be used by scientist, innovative farmer, and also the public-private sector stakeholders for sharing aWhere data visualisations (maps). http://www.awhere.com/CSISA/Homepage.aspx

Newly Developed Self Propelled Relay Planter

A two wheel self propelled relay planter has been recently developed by Amar Agricultural Implement Works under the CSISA initiative for intercropping zero till wheat into standing crop of cotton.

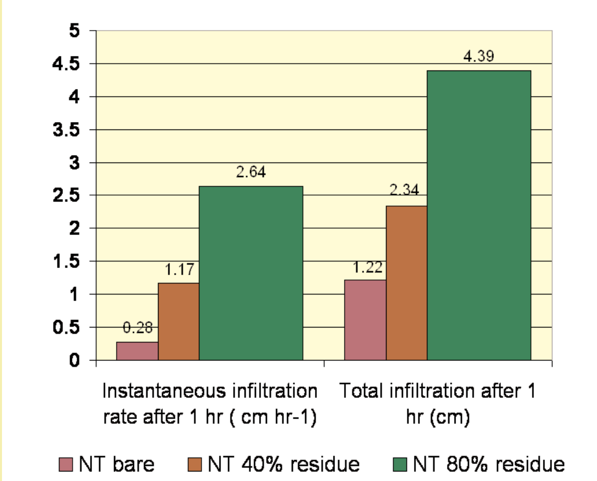
This system allows wheat planting 3-5 weeks earlier than when wheat planted after cotton is harvested and the cotton stalk is removed. It is expected that wheat yields can increase by 1000+ kg/ha simply due to the earlier, more timely seeding date.

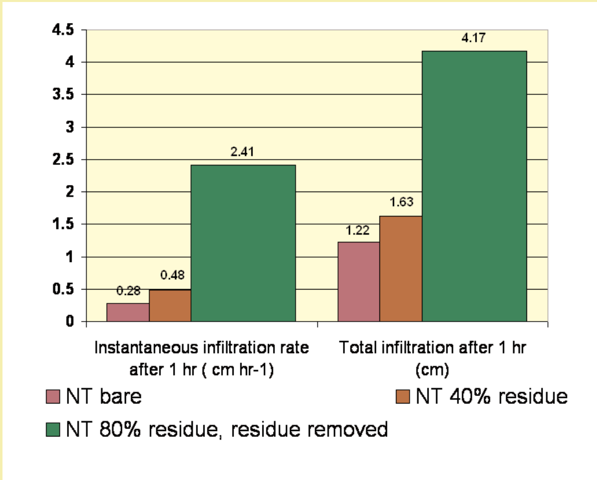


INFOPIX

This section will present research data in pictorial form from past studies for benefit of readers

Better Infiltration Results With Residue Retained as Compared to No-Till (NT) Bare





Triplett et al (1968) determined the infiltration rate on a non-cracking soil with a sprinkling infiltrometer on different No-Till (NT) treatments at Ohio, USA, after three years of corn production. The treatments included NT bare, NT with normal surface residue (40%), and NT with double application of surface residue (80%) for the study period. The infiltration rates were calculated both for NT with residue present and with residue removed. It was observed that infiltration increased when residue was retained and was also significantly greater with double-mulch treatment than under NT bare. It is interesting to note that the infiltration was greater than NT bare even when the residue was removed as the soil surface was stabilised and macropores formed under the residue were maintained and functional.

Source: Triplett, G. B. Jr., D. M. Van Doren, Jr., and B. L. Schmidt. 1968. Effect of corn (*Zea mays* L.) stover mulch on no-tillage corn yield and water infiltration. Agron. J. 60:236-239

Conservation Agriculture for Crop Sustainability in North-West Himalayas

Dr. Sanjeev K Sandal, Dr. Pradeep K Sharma, and Dr. Lav Bhushan
CSK Himachal Pradesh Agricultural University Palampur, H.P., India

In North-west Himalayas, about 70 per cent of the cultivated area is rainfed. Generally, subsistence agriculture is practiced in these areas since 82 per cent of the farmers have average land holding of less than 0.5 ha. Crop sustainability through efficient moisture conservation practices is a major challenge.

Owing to various constraints associated with hill agriculture, special attention needs to be drawn towards it. In hills, wherever irrigation facilities are available, water demanding high-value cash crops are grown.

Major constraints towards increasing crop yields are:
- Uneven distribution of rainfall in time and space
- Poor seedling emergence and subsequent early crop stand
- Rapid desiccation of seed-zone moisture
- Sub-optimal soil temperature
- Low fertiliser consumption and
- Poor socio-economic condition of farmers

Small and scattered land holdings coupled with soil and climatic constraints do not permit the Himalayan farmers to go for adoption of improved technology being practiced by farmers of the plains. In Himachal Pradesh, for example, in spite of the increase in area under high yielding varieties (35 per cent in maize and 84 per cent under wheat), there is not much increase in the average yields of these crops. The grain yields averaged over the past 10 years, are 1,758 kg/ha for maize and 1,248 kg/ha for wheat compared to national averages of 1,327 kg/ha and 1,972 kg/ha, respectively.

Rainfall data indicates that most of the rain showers are received during mid-June to mid –September. Winter rains are meagre and erratic. During September to December and from March to June, due to excess evaporation, moisture reserves in soil get depleted. These periods coincide with sowing of rainfed kharif and rabi crops, respectively. Quite often, the frequent light showers are not sufficient for preparation of seed bed as the evaporation during this period is quite high. If these showers are conserved and carried over for few days in the seed-zone, it is possible to get kharif crops germinated without pre-sowing irrigation. Similarly, the soil profile is wet at the withdrawal of monsoon, but continuously tends to lose moisture till sowing of succeeding wheat crop. If right from its withdrawal (mid-Sept), soil moisture is conserved *in situ,* it is possible to germinate the succeeding wheat crop well in time (Mid October–November). Also, post rainfall, the surface soil dries out very rapidly due to its poor moisture retention characteristics. It creates problem for seeds to germinate or for germinated seedlings to establish its roots downward even though the layers below seed-zone remain wet.

The agro-climatic conditions are favourable for growing maize. However, maize sown with onset of monsoon experiences the problem of excessive soil wetness and poor aeration. To mitigate the problem, maize can be sown with pre-monsoon rains so that it attains knee-high stage before the onset of heavy rains.

Tillage, immediately after harvest of maize is done in order to conserve and carry over the post-monsoon residual moisture for sowing of rainfed wheat. By doing so, the wet soil profile is exposed to lose moisture in seed-zone depth that results in moisture stress conditions during sowing of wheat. If right from the time of harvest of maize (September), seed-zone moisture is conserved and carried over, it is possible to obtain optimum seed-zone moisture during sowing of wheat.

Maize and wheat crops are usually grown under conventionally tilled land. Maize being shallow rooted with adventitious root systems does not affect soil physical conditions much; rather it may improve soil porosity through soil aggregation. Minimum tillage for wheat may result in conservation and carry over of residual moisture for sowing of wheat on time. It can also result in saving of energy, labour and time. Also, the wheat seed has been found to be comparatively more sensitive to adverse seed-zone moisture condition. Even a

Rainfed Wheat under conventional tillage (2005-06)

Rainfed Wheat under Conservation tillage (2005-06)

small increase in seed-zone moisture has favourable effects on germination and early establishment of the wheat crop.

Each species has to attain specific moisture for initiation of germination process that it derives from the soil. During the imbibition process, due to rapid desiccation of surface layer, considerable moisture stress is experienced by the germinating seed to emerge out, and also by the ultimate seedling, resulting in stunted growth. Pre-soaking of wheat seed before sowing may be an alternative for efficient utilisation of soil moisture before its depletion. This will also reduce pre-emergence absorption time.

Soil tillage under conventional system is considered an important soil management practice. These practices alter soil physical environment and affect the plant and root growth, thereby impacting water and nutrient uptake and crop yields. Conservation tillage is a generic term encompassing different soil management practices. It is generally defined as any tillage system that reduces loss of soil or water relative to conventional tillage, often a form of non-inversion tillage that retains protective amount of residue mulch on soil surface. Any material used at the surface of the soil, primarily to minimise the loss of water by evaporation or to keep down weeds may be designated as mulch. Mulches such as sawdust, manure, weeds, straw, leaves, crop residue amongst others are highly effective in slowing down evaporation. A surface mulch of plant residue prevents the soil against beating action of raindrops and keeps the soil surface open, thus increasing infiltration over that of bare soil. Plant residue mulch controls soil erosion and conserves soil moisture. Thus, mulch is an important agricultural tool to conserve soil, maintain the quantity and quality of the water flow of the agricultural land, regulate soil temperature and moisture regimes, and improve soil physical conditions by enhancing biological activity of soil fauna and increasing soil fertility.

Himachal Pradesh being a hill state and situated in the lap of Western Himalayas has abundance of waste materials like wild sage (*Lantana camara*), kali basuti (*Epatorium adenophorum*) amongst others. These materials are growing on the bunds and in pastures nearer to the cultivated land. They have little or no value either as fuel or fodder to farming community. Hence, these can be used as mulch materials for conservation and carry over of soil moisture without any additional cost, particularly under minimum tillage practice.
The moisture stress conditions prevailing from September to December/January delays the sowing of rainfed rabi crops like wheat, resulting in poor germination & early crop establishment, sub-optimal nutrient uptake and ultimately low yield. One way to conserve moisture *in situ* is to apply mulch to the previous standing maize (the most important crop in hills) at the withdrawal of monsoon rains. The application of tender twigs of *Lantana* to the previous standing maize help in conservation and carry over of moisture. Its application immediately after harvest of maize and wheat crops may help in the conservation of rain water, particularly pre-monsoon showers for sowing of rainfed maize. Light showers received before sowing of wheat may enhance the conserved moisture in the seed-zone for sowing of wheat crop.

Field experiments conducted at the experimental farm of CSK HPKV, Palampur, during 2005-07 have shown that soil water content before sowing, at sowing and during crop growth period of rainfed maize-wheat were higher in conservation tillage treatment at surface and sub-surface depths compared to conventional tillage. Higher moisture content in conservation tillage significantly improved root volume, root length density and root mass density at 0-0.60 m soil depth. Similarly, plant height and dry matter accumulation at critical growth stages were higher under conservation tillage as compared to conventional tillage. Better root and shoot growth with conservation tillage ultimately improved yield attributing parameters that enhanced grain and straw yields.

The importance of conservation tillage has been well recognised for agriculture of plains; however, it has added advantages with respect to hill agriculture. Conservation tillage being less expensive in nature, matches with the socio-economic conditions of hill farmers, promotes the timely agricultural operations and supports the resource conservation technologies generated for hills.

Ken Sayre honoured with Louis Malassis International Scientific Prize

In a special ceremony at the "Global Conferences on Agricultural Research for Development (GCARD)" meetings in March 2010, former CIMMYT wheat agronomist Ken Sayre became the first-ever recipient of the Louis Malassis International Scientific Prize. The prize was awarded by the Agropolis Foundation in recognition of more than two decades of work by Sayre in promoting bed planting, diversification of traditional wheat cropping systems, and varied conservation agriculture principles. To read more, click the link http://blog.cimmyt.org/?p=3373

Biological Approaches to Achieve Sustainable Soil Health

...continued from page 7

biological and chemical properties of a rainfed Vertisol in the semi-arid tropical environment in southern India. Yields were comparable to the conventional system of crop production that used standard agrochemical inputs. There is a need, however, to evaluate such systems in other locations for soil and climatic differences to better understand the many interfaces between biotic and abiotic sub-systems as they respond to anthropogenic interventions in pursuit of human livelihoods and sustenance. Similar studies have been initiated in the rainy season of 2009-10 on eight farmers' fields in Andhra Pradesh by planting trees in alleys, 15 to 18 m apart.

Although the development of alternative agricultural systems is generally considered important, it is not clear which practices will improve sustainability and maintain adequate productivity. Field studies of four different crop husbandry treatments showed a great potential of application of microbial inoculants (technology) in low input agricultural practice and environmental pollution abatement for non-use of chemical fertilisers and pesticides. From the present study, it was apparent that plant biomass was the engine of crop productivity mediated by biological processes that enhanced soil fertility and productive (crop yield) potential of soil.

Note: This article is based on the experiments and findings, and the literature cited in the following publications:

Hameeda, B., Rupela, O. P., Wani, S. P., and Reddy, G., 2006. Indices to Assess Quality, Productivity and Sustainable Health of Soils Receiving Low Cost Biological and/or Conventional Inputs. International Journal of Soil Science, 1(3), p. 196-206.

Rupela, O. P., Gowda, C. L. L., Wani, S. P., and Hameeda, B. Evaluation of Crop Production Systems Based on Locally Available Biological Inputs. Pages 501-515, Chapter 35. in Biological Approaches to Sustainable Soil Systems (N. Uphoff et al. eds.), CRC Taylor & Francis, Boca Raton, Florida, USA..

Rupela, O.P. 2008. Organic farming: Building on farmers' knowledge with modern science. Pages 28 to 45 in Organic farming in Rainfed Agriculture: Opportunities and Constraints (eds. B. Venkateswarlu, S.S. Balloli and YS Ramakrishna), Central Research Institute on Dryland Agriculture (CRIDA), Hyderabad.

Rupela, O.P. 2006. Microbial properties of cattle excrements and their fermentation products. Pages 366-367 in ICRISAT Archival Report, Global Theme-Crop Improvement, 2005-2006.

SNIPPETS

5th World Congress on Conservation Agriculture, Brisbane, Australia

The 5th World Congress on Conservation Agriculture is being organised at Brisbane, Australia, from 26-29 September 2011. The congress intends to bring together scientists and practitioners to discuss current and future developments in the field of sustainable agriculture.

Deliberations will be centered around themes below:

Theme 1: More efficient CA practices to improve livelihoods/profitability/food security and to reduce environment footprint

Theme 2: Farming systems design and multi-scale systems approaches for integrative solutions and optimised trade-offs in commercial and smallholder agriculture

Theme 3: Achieving impact through more effective consultation, participation and knowledge sharing

Theme 4: Informing policy development and supporting market effectiveness

Details regarding registration, abstract submission, and other related information will be provided soon. More details about the conference can be availed from the conference website http://www.wcca2011.org, or by contacting the Conference Secretariat at infoWCCA5@icmsaust.com.au.

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Cornell University Launches CA Website

A new website that will function as a global knowledge resource on conservation agriculture has been recently launched by the College of Agriculture and Life Sciences, Cornell University. The website has been designed as a one-place knowledge hub that contains all useful information on basic conservation agriculture (CA), issues pertaining to soil health, and latest research, news, and reports related to CA. It also hosts varied resource database in the form of blogs, discussions and newsletters amongst others and can be accessed by clicking the link http://conservationagriculture.mannlib.cornell.edu/

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Conservation Agriculture Database at AquaStat, FAO, Being Updated

The conservation agriculture (CA) land area data base displayed at AquaStat is being updated. Those interested in providing information on the land area under CA systems at the national and sub-national level, together with any relevant historical information on adoption, cropping pattern, farm size, agro-ecology, constraints, etc. are encouraged to participate to help strengthen the database. For recording the same and to understand the quantification of CA definition, please refer to the FAO-CA website http://www.fao.org/ag/ca/6c.html.

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United Nations University Invites Applications for Master's Degree Programme 2010-11

The International Master's Degree (MSc) Programme for Drylands (2010-2011) being offered by United Nations University, International Network on Water, Environment and Health (UNU-INWEH), in partnership with six other institutions aims to enhance the capacity of developing countries to manage their dryland resources. The programme will provide young professionals and scientists a perspective on integrated resource management approaches in drylands, along with practical experience in different dryland countries. Students enrolled for the programme will undergo an intensive course in China, focusing on international dimension of dryland management and a wide range of research methods. Application deadline for the programme is 10th June 2010. To know more, click the link http://www.inweh.unu.edu/drylands/MS.htm

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Professional Vacancy Announcement

TechnoServe announces vacancy for the post of a team leader to lead a four-month study to assess how smallholder farmers across five countries (Guatemala, Honduras, Nicaragua, Malawi and Zambia) can improve their livelihoods through conservation agriculture. The study hopes to demonstrate efforts that could not only be sustainable but also scalable if linked into a larger, robust market system. This study will also lay the foundation for helping both staple and cash crop farmers to help improve their yields and preserve their farming livelihoods – from both an environmental and commercial point of view. Application deadline for this post is 15th June 2010. More info regarding eligibility criteria, duties and responsibilities, and application procedure can be obtained by clicking the link http://www.idealist.org/if/i/en/av/Job/375885-158/c

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Tenth International Conference on Development of Drylands

The Tenth International Conference on Dryland Development (ICDD) on "Meeting the Challenge of Sustainable Development in the Dry Lands under Changing Climate- Moving from Global to Local" is being organised at Muscat, Oman, from 12-15th December 2010.

Papers are invited covering scientific and development aspects within the framework of the topics suggested above. Those interested in presenting papers at the Conference are requested to submit a one-page abstract by 30th June 2010. More details regarding the Conference, registration, paper submission etc. can be downloaded from: http://www.apaari.org/wp-content/uploads/2010/02/icdd-conference.pdf

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PUBLICATIONS

Tigist Oicha, Wim M. Cornelis, Hubert Verplancke, Jan Nyssen, Bram Govaerts, Mintesinot Behailu, Mitiku Haile and Jozef Deckers. 2010. Short-term effects of conservation agriculture on Vertisols under tef (Eragrostis tef (Zucc.) Trotter) in the northern Ethiopian highlands. Soil and Tillage Research, Volume 106, Issue 2, January 2010, pp 294-302

Akpalu, W. and E. Anders. 2010. Bio-Economics of Conservation Agriculture and Soil Carbon Sequestration in Developing Countries. University of Gothenburg School of Business, Economics and Law, Working Papers in Economics No 431, Feb 2010

Mileusnic, Z.I., Petrovic. D.V. and Devic, M.S. 2010. Comparison of tillage systems according to fuel consumption. Energy, Volume 35, Issue 1, January 2010, pp 221-228

Javier A. Ceja-Navarro, Flor N. Rivera, Leonardo Patino-Zuniga, Bram Govaerts, Rodolfo Marsch, Anton Vila-Sanjurjo and Luc Dendooven. 2010. Molecular characterization of soil bacterial communities in contrasting zero tillage systems. Plant and Soil, Issue no. 1-2, April 2010, Volume 329, pp. 127-137