PRECISION AGRICULTURE PRACTICES FOR SUSTAINING PRODUCTIVITY AND PROFITABILITY IN RECLAIMED SODIC SOILS IN NORTHWEST INDIA

Gurbachan Singh
Director, Central Soil Salinity Research Institute, Karnal-132 001, India
Email : director@cssri.ernet.in

Indo-gangetic alluvial plain comprising of Punjab, Haryana and Uttar Pradesh states is a food bowl of India. These states contribute significant quantity of food grains particularly rice and wheat to the central pool. However, in the recent past, the productivity of the dominant rice-wheat cropping system in reclaimed alkali (sodic) soils is either stagnating or decreasing with the associated problems of declining water table levels, decreasing levels of organic matter in the soil, nutrient imbalance, emerging deficiencies of secondary and micronutrients and extensive tillage and residue burning practices. This calls for upgrading of water, nutrients and energy use efficiency through better management of land and water resources to sustain agriculture in this food bowl of the country. In last about three years, several long term field experiments have been set up at the experimental farm of CSSRI, Karnal to develop conservation agriculture and precision farming techniques to increase use efficiency of water, nutrients and energy. In one of the experiments laid out in strip plot design conventional tillage is being compared with reduced tillage, no-tillage, bed planting, brown manuring with and without residue incorporation and keeping residue on the soil surface in rice-wheat cropping sequence. The maximum yield of Basmati rice (CSR 30) in this experiment was obtained in unpuddled treatment (4.0 t/ha) followed by conventional puddled transplanted rice (3.69 t/ha). Direct seeded rice (DSR) with *Sesbania* co-culture as a brown manuring yielded 3.65 t/ha compared to 3.24 t/ha in DSR without brown manuring practice. The rice transplanted on raised beds yielded 2.95 t/ha. The trend in water saving followed the order: DSR plus *Sesbania* (43.56%) > DSR (39.68%) and raised bed transplanted rice (24.60%) Table 1.

Table 1. Effect of tillage and crop establishment methods on productivity and water use of rice in rice-wheat cropping system.

Tillage/Crop establishment methods	Grain yield (t/ ha)	Water used (m)	Irrigation water productivity (kg m^{-3} water)	Rainfall (m)	Gross water productivity (kg m^{-3} water)	Water saving (%)
Conventional transplanting	3.69	1.26	0.29	0.20	0.25	-
Unpuddled transplanting	4.00	1.25	0.32	0.20	0.27	-
Raised bed transplanting	2.95	0.95	0.31	0.20	0.26	24.60

Direct seeded rice (DSR)	3.24	0.76	0.42	0.23	0.32	39.68
DSR + Sesbania	3.65	0.71	0.51	0.23	0.38	43.65
DSR at transplanting time	2.91	0.64	0.45	0.23	0.43	49.20
CD at 5%	0.32	-	-	-	-	-

Similarly, in another field trial important *Kharif* and *Rabi* crops are grown continuously following conventional and no tillage practices. The results are presented in Table 2. Comparatively similar or higher yields of pigeonpea, soybean, green gram (during Kharif) and wheat, gram and mustard (during Rabi) are being obtained from no till plots thus saving expenditure on water, nutrients and energy and higher income.

Table 2. Effect of different tillage options on yields of different crops (q/ha).

Crops	Conventional Tillage (CT)	Zero Tillage (TZ)
Pigeon pea	5.86*	11.29*
Soybean	5.62	6.59
Clusterbean	8.56	9.96
Barley	25.67	27.50
Wheat (PBW-343)	40.60	43.50
Mustard (CS 54)	9.20	11.50
Mustard (CS 52)	11.40	10.85
Oat	20.33	28.67

(* Varieties are different: CT pigeonpea-ICPL-88039, ZT pigeon pea- UPAS-120)

In another experiment on multiple use of water for multienterprize agriculture, crops, horticulture, fisheries, dairy and bee keeping is practiced in an integrated mode to increase use efficiency of inputs (through better recycling of bi-products of these components), and to improve soil health and enhanced farmer income. This model is being tried on a 2 ha reclaimed sodic soil. Role of leaf colour chart, green seeker and laser leveler in improving water and nutrient use efficiency both under experimental plots and on the farmers fields in reclaimed soils is also discussed. The comparison of conventionally leveled and laser leveled fields based upon experiments conducted by CSSRI on the farmers fields is given in Table 3.

Table 3. Wheat yields and water productivity in conventionally leveling and laser leveling treatments.

Parameters	Conventional levelling	Laser Levelling
Levelling index (cm)	>1.5	<1.5
Irrigation depth (cm) Paddy Wheat	 110-115 30-35	 90-95 20-25
Pumping requirement		

(hr/ha/irrigation) Paddy Wheat	25-27 15-17	20-22 9-11
Water productivity (Kg/m^3) Paddy Wheat	 0.37 1.50	 0.47 2.44
Profit over conventional (Rs/ha) 1^{st} year 2^{nd} year onwards	 - -	 1000-1200 4000-5000

Results obtained based upon three years observations in these experiments are presented and discussed in this paper.