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Effect of long term rice establishment methods on soil moisture depletion pattern in vertisol

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Abstract
The present investigation was carried out during 2016-17 at Hingnadih and Malpuri village, Dhamdha block, Durg district, Raipur. The soil of the experimental field was clay and clay loam in texture (Vertisol) localy knows as "kanhar". The experiment was laid out in Randomized block design with thirteen replications and three treatments. In this study, the effect of long term rice establishment methods on rice under rice based cropping system on soil moisture depletion pattern were evaluated in rice crop. In this study, three rice establishment methods (puddling, biasi and direct seeding rice) were laid in main treatment. The soil moisture was recorded at 7 days interval from flowering to harvesting of rice crop under various depths viz. 0-15, 15-30, 30-45 and 45-60 cm. As the day progressed, there was a decrease in the Moisture. Most moisture found in puddling condition. The soil moisture was increased with increase in soil depth. The most soil moisture were found in sub surface soil than surface soil. The Highest amount of soil moisture was found in puddling method of rice seeding than biasi and direct seeding method.

Keywords: Rice, puddling, biasi, soil moisture, depletion pattern

Introduction
Rice based cropping system is most vital for food security of the Indian sub-continent. Rice is most prominent crop in India and is the staple food of the people of the eastern and southern parts of the country and provides food security and livelihood for millions of people across the globe. *Oryza sativa* var. indica on the Indian side and *oryza sativa* var. japonica on the chinese and Japanese side. Rice is being grown in many regions of the world, mostly by conventional flooded rice cultivation system which provides 75% of the world rice supply. Rice grown by this system consumes about 80% of total agricultural water available in Asia and 75% of total available water resources in the world (Iqbal, 2014) [5]. Rice occupies an area 153 m ha land throughout the world. In India, out of the 43 m ha area under rice cultivation (Anonymous, 2013) [1].

Soil physical properties are indicators of the impact of soil and crop management practices. Furthermore, microbial populations in soil interact with each other, these interactions, in turn, affect major environmental processes, including biogeochemical cycling of nutrients, plant health, and soil quality. Rice requires soft puddles and water saturated soil condition while wheat requires well aggregated and well aerated soil with fine tilth. Long-term experiments on continuous rice (*Oryza sativa* L.) system have shown yield decline due to deterioration of soil physical condition and soil fertility (Sharma and Jain, 1997) [7]. The deteriorating soil physical conditions have been credited to tillage for rice–wheat system (Bajpai and Tripathi, 2000; Tripathi *et al.*, 2003) [3, 8].

Transplanting of paddy seedlings is common method of crop establishment in the irrigated rice systems of Asia. The preparation of land for transplanting paddy (puddling) consumes about 20-40% of the total water required for growing of crop and subsequently poses difficulties in seed bed preparation for succeeding wheat crop in rotation. It also promotes the formation of hard pan which effects rooting depth of next crop.

Introduction of dry direct seeding of rice seems to be promising to counter these constraints. Rice seeds can be sown in early rainy season after the onset of rainfall and established seedlings tolerate dry condition with firm root system, while transplanting cultivation needs the accumulation of water for puddling and transplanted rice suffers drought when the subsequent rainfall is not sufficient for growth. Dry direct seeded rice (DSR) differs from transplanted rice in terms of crop establishment as well as subsequent crop management

practices. The drilling/ dibbling of dry seeds in soil is called DSR but broadcast sowing after 30-35 day doing tillage called as biasi.

As world population is increasing so the demand for food is increasing and as such the need to open more lands for crop production arises. This research delves into investigating the effects of different soil management practices on soil chemical, biological and physical properties for long term sustainable aspect.

Materials and Methods

Farmer were selected from village- Hingnadih and Malpuri, Durg District under categories marginal, medium and resourceful farmer, on the basis of survey out of 45 farmers total 39 farmers selected for research purpose and samples were collected from selected farmers field. The tillage operations studied likewise: (a) Puddling (b) Direct seeding – drilling (c) Biasi (broadcasting) with three replication in randomized block design**.** Durg district was considered as strata and total two villages were selected using Simple Random Sampling without Replacement (SRSWOR). From selected village 39 farmers *viz.* large (>3ha), medium (1-3 ha) and small (<1ha)} were selected for sampling and other basic information about the farmers were collected. From each selected field standard procedure of sampling was followed and sampled fields were located as latitude longitude position using GPS. The soil samples were collected from 0-15 cm soil depth within each farmer field for physico-chemical and biological properties of soil. Data obtained from all observation were statistically analyzed by applying Randomized block design (RBD), (Gomez & Gomez, 1984).

Results and Discussion

Soil moisture depletion pattern

The soil moisture was recorded at 7 days interval from flowering to harvesting of rice crop under various depths viz. 0-15, 15-30, 30-45 and 45-60 cm and depletion pattern of soil moisture 35-38% was recorded (Figure 1 to 4 & Table 1). The maximum mean soil moisture was recorded at all the depths. The moisture content of soil varied at upper layer of soil depth due to various rice establishment methods. Variation of soil moisture content at lower depth of soil was minimum due to various rice establishment methods. In general, the soil moisture content under puddled condition was recorded higher at all the depths during crop growth. Higher amount of soil moisture was retained in puddling method of rice seeding than Biasi and direct seeding method. The direct seeded rice observed lower moisture content at the upper most layer of soil and the depletion of moisture content under this treatment was higher from lower soil depths as compared to others treatments. The soil moisture was increased with increase in soil depth. Puddled soil maintained higher moisture content; this may be related to the high retention capacity of puddled soil due to high micropores (Sharma *et al*. 1988, and Bajpai, 1994) [6, 2].

Table 1: Effect of rice establishment methods on soil moisture depletion pattern at different stage.

Table A: 0-15 cm depth soil moisture content (Qw %)

Rice establishment method	02 Nov	09 Nov	16 Nov	23 Nov	30 Nov	7 Dec
Direct seeding	27.90	26.78	25.21	24.49	22.73	21.09
Biasi	29.88	28.04	26.05	25.47	24.67	22.52
Puddling	31.70	29.41	27.16	26.33	25.53	23.56
CD at 5%	1.31	1.04	1.00	0.85	0.64	0.86

Table B: 15-30 cm depth soil moisture content (Qw %)

Rice establishment method	02 Nov	09 Nov	16 Nov	23 Nov	30 Nov	7 Dec
Direct seeding	31.36	30.52	29.96	27.48	26.38	22.75
Biasi	33.07	31.63	30.33	28.21	27.25	24.49
Puddling	35.71	33.60	31.75	29.33	28.24	25.92
CD at 5%	0.82	0.80	0.86	0.67	0.80	0.79

Table C: 30-45 cm depth soil moisture content (Qw %)

Rice establishment method	02 Nov	09 Nov	16 Nov	23 Nov	30 Nov	7 Dec
Direct seeding	36.77	34.09	32.88	31.32	30.92	27.43
Biasi	37.64	37.52	34.15	33.32	31.59	29.92
Puddling	39.25	38.86	35.22	34.52	33.97	30.66
CD at 5%	0.68	0.64	0.70	0.83	0.76	0.80

Table D: 45-60 cm depth soil moisture content (Qw %)

Rice establishment method	02 Nov	09 Nov	16 Nov	23 Nov	30 Nov	7 Dec
Direct seeding	38.36	37.93	35.48	32.76	30.64	28.96
Biasi	39.27	38.14	36.65	34.92	31.59	30.93
Puddling	40.04	39.09	37.79	35.22	33.63	31.30
CD at 5%	0.74	0.86	0.68	0.82	0.80	0.77

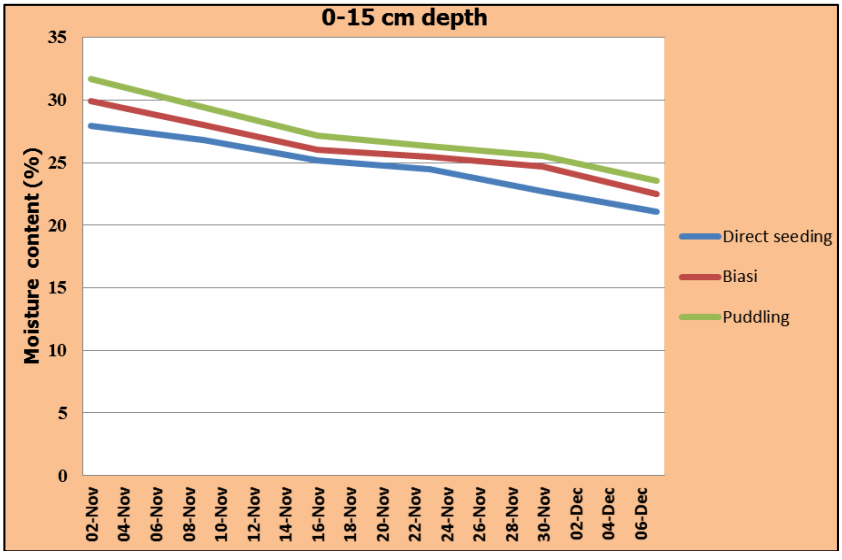

Fig 1: Influence of rice establishment methods on depletion pattern of soil moisture of at 0-15 cm soil depth

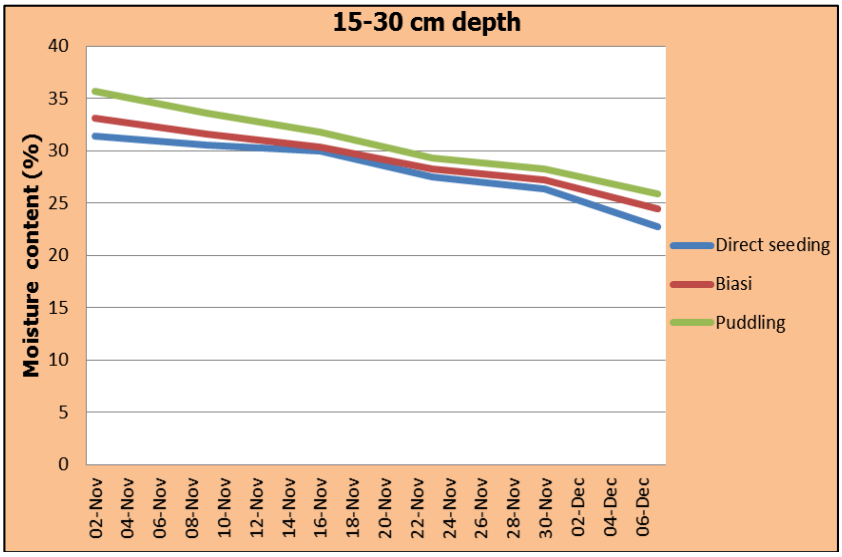

Fig 2: Influence of rice establishment methods on depletion pattern of soil moisture of at 15-30 cm soil depth

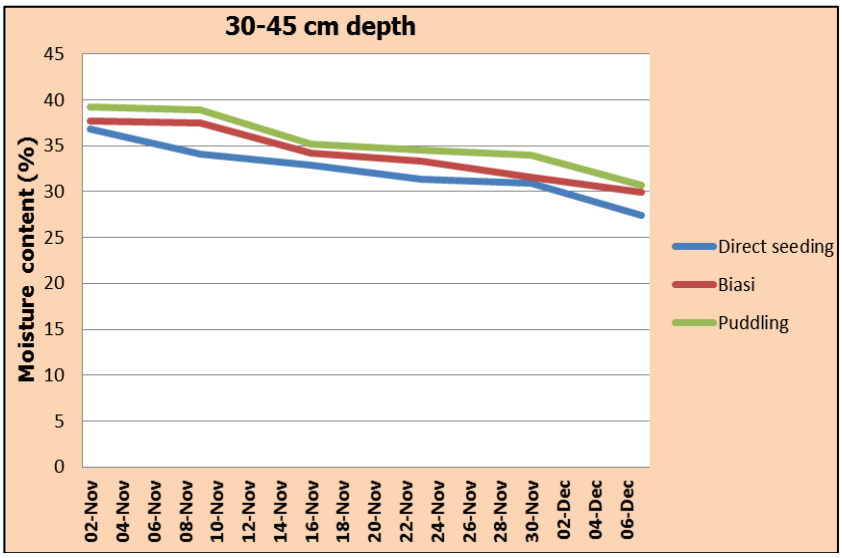

Fig 3: Influence of rice establishment methods on depletion pattern of soil moisture of at 30-45 cm soil depth

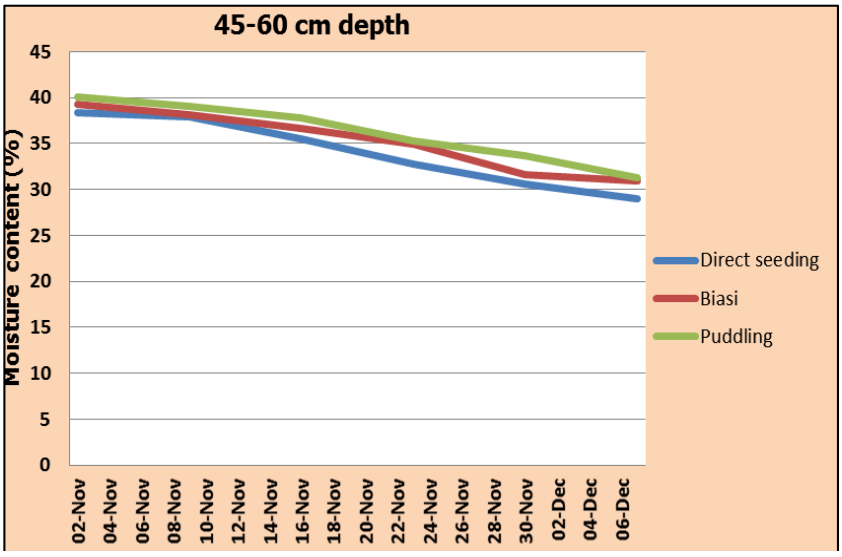

Fig 4: Influence of rice establishment methods on depletion pattern of soil moisture of at 45-60 cm soil depth

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