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Plant height and Root mass density of rice at different depth as influenced by tillage with nutrient management practices in rice-linseed cropping system

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Abstract
Experiment was conducted during *kharif* 2018 and 2019 at Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya Raipur (C.G.). In rice crop, treatments comprised with nine tillage with nutrient management practices *i.e.* T_1: Conventional tillage (CT)-Transplanted rice (TPR) 100% RDF, T_2: CT-TPR 100% recommended dose of fertilizer (RDF) + 2 t FYM, T_3: CT-TPR 100% RDF (75% inorg + 25% FYM), T_4: CT-Direct seeded rice (DSR) 100% RDF, T_5: CT-DSR 100% RDF + 2 t FYM, T_6: CT-DSR 100% RDF (75% inorg + 25% FYM), T_7: Zero tillage (ZT)-DSR 100% RDF, T_8: ZT-DSR 100% RDF + 2 t FYM and T_9: ZT-DSR 100% RDF (75% inorg + 25% FYM) were laid out in randomized block design with three replications. Rice variety Rajeshwari-1 was taken as test crop. The RDF for rice crop was 100:60:40 N, P_2O_5 and K_2O kg ha^{-1} respectively. During *kharif* 2018 and 2019 in rice, treatment T_2: CT-TPR with 100% RDF + 2 t FYM produced significantly the highest plant height and root density.

Keywords: Plant height, root density, transplanted rice, direct seeded rice

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crop, which plays a key role for food security. India is the second largest producer and consumer of rice in the world. In India, rice is grown on an area of 43.99 lakh ha with a production of 109.69 lakh tones and productivity of 2494 kg ha^{-1} (Anonymous, 2017a) [2]. In Chhattisgarh, rice based cropping system is vegue where rice is grown on 38.1 lakh ha with a production of 80.4 lakh tones having productivity of 2101 kg ha^{-1} (Anonymous, 2017b) [3]. The rice in Chhattisgarh is mainly grown by transplanting under puddled field and direct seeding through seed drill and broadcasting of seeds on unpuddled field and their after beushening. The growing of second crops after rice is a concern due to field preparation, proper crop establishment method, shortage of moisture especially at upper soil layer and poor germination, hence, coverage of acreage as second crop is nearly 38 percent, which is very low considering natural resources especially rainfall of the state.

During *rabi* season, chickpea, lathyrus and pea among pulses, mustard and linseed among oilseeds are popularly grown in the state. The linseed or flax (*Linum usitatissimum* L.) is one of the oldest crop, grown in almost all countries of the world for oil, fibre and seed purposes. Linseed is unique among oilseeds for its technical grade vegetable oil producing ability and fibre (good quality having high strength and durability) production. The linseed crop occupies an area of 325.22 thousand ha in the country yielding out 184.25 thousand tones having an average productivity of 567 kg ha^{-1} (Anonymous, 2017a) [2]. Chhattisgarh is one of the important linseed growing state of India, where linseed is being cultivated over 29.90 thousand hectares with a production of 10.30 thousand tones with productivity of 344 kg ha^{-1} (Anonymous, 2017b) [3]. Linseed is mostly grown as *utera* (relay) during *rabi* season (Agrawal *et al*., 2014) [1]. The important linseed growing districts of Chhattisgarh are Rajnandgaon, Durg, Bilaspur, Kabirdham, Raipur, Dhamtari, Surguja, Kanker and Raigarh. Besides, an important oilseed crop, its average productivity in India as well as in Chhattisgarh is very low in comparison to other countries of the world because of various factors like narrow genetic base, raising of crop by the resource poor farmers in marginal and sub-marginal areas, non-availability of high yielding varieties having resistance to biotic and abiotic stresses, etc. (Patial *et al*., 2014) [7].

Conventional agriculture system is an energy intensive farming system which invariably appeared to be excessive and inappropriate due to burning /removal of crop residue and poor nutrient replenishment through inadequate fertilizer use and depletion of organic matter, soil moisture and other nutrients which results to soil degradation and productivity losses (Sharma *et al.*, 2012) [9]. However, technologies are needed to reduce energy, labour and water application and environmental pollution and improvement in soil physical, chemical and biological properties. Potential solution includes a shift from conventional agriculture system to conservation agriculture (CA) system. The CA system is based on three linked principles-minimum soil disturbance, soil surface cover at all times with crop residues retention and diversified crop rotation (Hobbs *et al.*, 2008) [4]. CA based technologies are site-specific and required to be refined under a specific agro-climatic condition to optimize the performance. However, agro climate cropping system based for obtaining the advantage of CA.

Tillage is the basic and most important requirement of crop production. The efficiency of input use, *viz.* water, fertilizers, herbicides and others resources depends on tillage and crop establishment practices. Under the conventional agricultural systems involving intensive tillage, clean cultivation, monocropping, unbalanced fertilizer use and irrational use of irrigation water, there is gradual decline in soil organic matter through accelerated oxidation and burning of crop residues, causing pollution and loss of valuable plant nutrients. The management of crop residues and soil organic matter is of primary importance in maintaining soil fertility and productivity. After harvesting of crops, significant crop residues are left in the field. The farmers resort to buring of the crop residues to have a good seedbed and employ excessive tillage, resulting in high energy and cost of cultivation, accelerated soil erosion and compactness of sub-soil (Regmi, 1997) [8].

Materials and Methods

Experimental site and Geographical situation

The present investigation was carried out at Research-cum-Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) India. It is situated in central parts of Chhattisgarh. The experimental site was situated at 21º16′ N latitude and 81º36′ E Longitude with altitude of 298.56 m above mean sea level. The topography of the experimental site was uniform**.**

Weather conditions during the crop growing period

The rice crop received a rainfall of 224.61 mm and 152.25 mm during *kharif* season of 2018 and 2019, respectively. The maximum temperature varied from 33.66 °C in 1st week of July to 25.31 °C in 1st week of August during *kharif* 2018 and 36.80 °C in 4th week of June to 28.00 °C in 1st week of August during *kharif* 2019, whereas, minimum temperature varies from 25.31°C in 1st week of August to 25.73°C in 1st week of July during *kharif* 2018 and 24.21 °C in 4th week of September to 27.47 °C in 4th week of July during *kharif* 2019, respectively. The maximum relative humidity throughout the crop season varied between 95.86 to 63.43 per cent in the morning and 22.36 to 84.43 per cent in the evening hours during *kharif* 2018 and 94.00 to 78.00 per cent in the morning and 52.86 to 86.86 per cent in the evening hours during *kharif* 2019. The open pan evaporation mean values ranged from 1.03 to 10.26 mm day^{-1} and 1.66 to 5.59 mm day^{-1} respectively during *kharif* 2018 and 2019, respectively. The bright sunshine during these years varied from 0.20 to 9.23 hours day^{-1} and 0.39to 8.19 hours day^{-1} during *kharif* 2018 &2019, respectively. The average wind velocity for different weeks varied from 0.77 to 9.03 km hr^{-1} and 2.13 to 10.97 km hr^{-1} during *kharif* 2018 and 2019, respectively.

Characteristics of the soil

The soil of the experimental field was clay-loam in texture (*Vertisols*) locally known as "*Kanhar*". The soil was neutral in reaction. The soil was low in available nitrogen, medium in available phosphorus and high in available potassium

Plant height

For recording plant height five plants were marked from the randomly selected central rows of the plot and the height was measured from a base up to the tip of the longest leaf of the plant at 30 days interval up to the harvest.

Roots analyses

The root mass density was measured at maximum vegetative stage in three different soil depths (0-15, 15-30 and 30-45 cm) with auger-like root sampler 15 cm (6 inch) in diameter and 22.5 cm (9 inch) in length.

$$\text{Root mass density (mg cm}^{-3}) = \frac{\text{Mass of root}}{\text{Total volume of soil}}$$

Results and Discussion

Plant height (cm)

Plant height of rice observed at 30, 60 and 90 DAS/T and at harvest influenced significantly due to various treatments combinations of tillage with nutrient.

Management practices during both the years and on mean basis (Table 1).

At 30 DAS/T, significantly the highest plant height was measured under the treatment of T_2: CT-TPR with 100% RDF + 2 t FYM, which was at par to those, where rice was transplanted *i.e*. T_1: CT-TPR with 100% RDF and T_3: CT-TPR with 100% RDF (75% inorg + 25% FYM) during both the years and on mean basis. These treatments found to be significantly superior than other treatments of nutrient combinations with CT-DSR or ZT-DSR during both the years and on mean basis. The lowest plant height was observed under the treatment of T_9: ZT-DSR with 100% RDF (75% inorg + 25% FYM). Almost similar trend in plant height was observed at 60 and 90 DAS/T and at harvest stage of the crop during both the years and on mean basis.

Irrespective of the treatments, mean of two years data reflected that crop attained (27.82%) height between sowing to 30 DAS/T, (41.61%) between 30 to 60 DAS/T, (26.41%) between 60 to 90 DAS/T and (2.28%) between 90 DAS/T to harvest. In general, transplanted rice gave higher plant height from of 30 DAS/T because rice under transplanted condition remained in nursery for 25 days and then transferred to main field. However, transplanted crop was older than direct seeded crop and also was taller than direct seeded rice at different stages of crop growth as also reported by Sridhara (2008) [10]. Moreover, the application of 100% RDF + 2 t FYM maintained superiority in increasing plant height, irrespective of the tillage practices or seeding method adopted in rice. Maqsood (1998) [6] also reported higher plant height in transplanted rice as compared with direct seeding. The addition of FYM, might have reduced nutrient losses and increases the availability of nutrient which enhanced the plant height of rice at all the stages of rice (Jan and Noor, 2007) [5].

Table 1: Plant height of rice at different intervals as influenced by tillage with nutrient management practices in rice-linseed cropping system

	Treatment	Plant height (cm)											
		30 DAS/T			60 DAS/T			90 DAS/T			At harvest		
		2018	2019	Mean	2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
T_1:	CT-TPR with 100% RDF	29.96	30.94	30.45	70.70	73.88	72.29	96.98	107.92	102.45	101.0	108.3	104.6
T_2:	CT-TPR with 100% RDF + 2 t FYM	30.09	32.65	31.37	74.55	75.67	75.11	100.43	109.30	104.86	103.1	111.4	107.3
T_3:	CT-TPR with 100% RDF (75% inorg + 25% FYM)	29.81	30.61	30.21	70.49	72.58	71.53	96.65	108.71	102.68	99.9	107.9	103.9
T_4:	CT-DSR with 100% RDF	25.29	29.65	27.47	67.90	69.67	68.79	91.31	94.67	92.99	91.7	96.9	94.3
T_5:	CT-DSR with 100% RDF + 2 t FYM	25.50	30.76	28.13	68.15	71.83	69.99	94.42	96.83	95.63	94.1	98.7	96.4
T_6:	CT-DSR with 100% RDF (75% inorg + 25% FYM)	25.18	29.32	27.25	67.51	69.29	68.40	91.10	94.01	92.55	90.2	96.3	93.3
T_7:	ZT-DSR with 100% RDF	24.02	26.84	25.43	64.05	68.35	66.20	90.01	92.71	91.36	88.1	93.1	90.6
T_8:	ZT-DSR with 100% RDF + 2 t FYM	24.86	26.43	25.65	66.90	68.72	67.81	90.41	93.02	91.71	89.3	94.8	92.1
T_9:	ZT-DSR with 100% RDF (75% inorg + 25% FYM)	23.60	25.30	24.45	63.11	66.40	64.75	85.66	91.03	88.34	87.9	92.1	90.0
	SEm±	0.97	1.17	0.70	1.87	1.89	1.39	2.45	2.95	2.06	2.36	2.19	1.88
	CD (p=0.05)	2.88	3.48	2.07	5.56	5.62	4.14	7.29	8.75	6.13	7.02	6.51	5.59

Root mass density

The root mass density of rice was measured at 60 DAS in different soil depth which varied significantly due to tillage with nutrient management practices in rice (Table 2).

During both the years and on mean data basis, at 0-15 cm depth, the highest root mass density of (5.45, 5.61 and 5.53 mg cm^{-3}) was recorded under the treatment of T_8: ZT-DSR 100% RDF + 2 t FYM, which was at par to the treatment of T_9: ZT-DSR 100% RDF (75% inorg + 25% FYM). While, it was the lowest in the treatment of T_1: CT-TPR 100% RDF. Further increase in depth at 15-30 and 30-45 cm, the highest root mass density was observed under T_5: CT-DSR 100% RDF + 2 t FYM. This treatment being at par with the treatment of T_6: CT-DSR 100% RDF (75% inorga + 25% FYM) during both the years and on mean basis. The lowest root mass density was observed in the treatment of T_7: ZT-DSR 100% RDF in these depths on both the years.

In 0-15 cm depth, the roots density was higher under the treatment of T_9: ZT-DSR 100% RDF + 2 t FYM than the T_1: CT-TPR 100% RDF, but reverse was true in case of subsurface (15-30 cm) and deep soils (30-45 cm). It is quite expected that under ZT, soil was not disturbed and then most of the root remained in top of soil between 0-15 cm depth, while, in other tillage practices field were ploughed and root mass density was more in deeper depths. The root mass density was drastically reduced downward under ZT, which was associated with the less pore space due to compaction and increased soil bulk density in deeper zone. Root proliferation or extensibility was probably obstructed by the dense or compact layer of the soil profile.

Table 2: Root mass density of rice at different depth as influenced by tillage with nutrient management practices in rice-linseed cropping system

	Treatment	Root mass density (mg cm^{-3})								
		0-15 cm			15-30 cm			30-45 cm		
		2018	2019	Mean	2018	2019	Mean	2018	2019	Mean
T_1:	Rice CT-TPR 100% RDF	4.75	4.91	4.83	1.17	1.26	1.22	0.59	0.63	0.61
T_2:	Rice CT-TPR 100% RDF + 2 t FYM	4.88	4.95	4.92	1.29	1.42	1.36	0.67	0.71	0.69
T_3:	Rice CT-TPR 100% RDF (75% inorg + 25% FYM)	4.83	4.97	4.90	1.23	1.34	1.29	0.63	0.68	0.66
T_4:	Rice CT-DSR 100% RDF	5.05	5.12	5.09	1.73	1.84	1.78	0.72	0.75	0.74
T_5:	Rice CT-DSR 100% RDF + 2 t FYM	5.24	5.31	5.28	1.88	1.97	1.93	0.82	0.87	0.85
T_6:	Rice CT-DSR 100% RDF (75% inorg + 25% FYM)	5.16	5.36	5.26	1.84	1.87	1.85	0.78	0.86	0.82
T_7:	Rice ZT-DSR 100% RDF	5.36	5.42	5.39	0.86	0.89	0.87	0.39	0.47	0.43
T_8:	Rice ZT-DSR 100% RDF + 2 t FYM	5.45	5.61	5.53	0.95	0.99	0.97	0.47	0.54	0.51
T_9:	Rice ZT-DSR 100% RDF (75% inorg + 25% FYM)	5.41	5.53	5.47	0.91	0.95	0.93	0.44	0.47	0.46
	SEm±	0.02	0.03	0.02	0.02	0.02	0.02	0.01	0.02	0.01
	CD (p=0.05)	0.06	0.10	0.06	0.06	0.07	0.05	0.03	0.07	0.04

Reference

1. Agrawal AP, Minz M, Neelofar S. Screening of linseed genotypes against bud fly in Chhattisgarh. *In*: National Seminar on Strategic Interventions to enhance Oilseeds production in India. Feb 2014;19-21:152-153.
2. Anonymous. Ministry of Agriculture and Farmers Welfare, Govt. of India 2017a.
3. Anonymous. Ministry of Agriculture and Farmers Welfare, Govt. of India 2017b.
4. Hobbs P, Sayre K, Gupta R. The role of conservation agriculture in sustainable agriculture. Philosophical Transactions of the Royal Society B 2008;36(3):543-555.
5. Jan A, Noor M. Response of wheat to farm yard manure and nitrogen under rainfed conditions. African J Crop Science 2007;8:37-40.
6. Maqsood T. Effects of high temperature and CO_2 concentration on spikelet sterility in indica rice. Field Crops Res 1998;51:213-219.
7. Patial R, Paul S, Sharma D. Studies on genetic variability for yield improvement in linseed. In: National Seminar on Strategic Interventions to Enhance Oilseeds Production in India, Feb 2014;19(2):85-88.
8. Regmi AP. Long term soil fertility experiment in the rice-wheat system, Nepal. In. Hobbs and Rajbhandari (Ed.). Proceedings of the rice-wheat research, end of project workshop, 1-3 October, Kathmandu, Nepal. Mexico, D. F. NARC-CIMMYT-RWCIGP 1997, 63-66.
9. Sharma MP, Gupta S, Sharma SK, Vyas AK. Effect of

tillage and crop sequences on arbuscular mycorrhizal symbiosis and soil enzyme activities in soybean (*Glycine max*) Rhizosphere. Indian J. Agr. Sci 2012;82(1):25-30.
10. Sridhara CJ. Effect of genotypes, planting geometry and methods of establishment and micronutrient application on growth and of aerobic rice. Ph.D. Thesis, University of Agricultural Sciences, Bangalore 2008.