



## **Comparison of Biophysical Parameters in D-DSR and TPR**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The study explained comparison of the biophysical parameters with in the two rice cultures. Study was conducted in the farmers field at Jogulamba Gadwal District of Telangana under same management practices. The biophysical parameters were recorded during the crop growth stages like Vegetative, Maximum Tillering, Panicle initiation, Flowering and Maturity. The data was analyzed by using the two-sample t test with equal variances revealed that there were no significant differences was observed in the dry matter produced, SPAD and LAI values of the two rice cultures at Vegetative, Maximum Tillering, Panicle initiation, Flowering and Maturity of the crop growth. The significant difference was found in the plant height at Maximum Tillering, Panicle initiation and Flowering. The total number of tillers were also significant at flowering Due to the pest infestation in the TPR reported the highest number of tillers when compared with D-DSR, the number of tillers at harvest were also less due to unproductive tillers damaged by pest in TPR than D-DSR.

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## 1. INTRODUCTION

Food security has become a fundamental issue due to the rapid increase in world population and higher demand for food. Rice is a key staple food consumed by more than half of the world's population [1]. As a consequence, rice production systems must boost production to meet global food demand [2]. A sustainable increase in rice production is challenged by rural to urban labour migration, agricultural land conversion, pests and diseases, the high cost of labour and inputs, abiotic stresses such as drought, submergence, cold and heat, and competition for water resources [3]. The diversity of rice growing environments (irrigated, rainfed lowland, upland and deep-water) results in different levels of natural resource availability (i.e., water and soil fertility) and different levels of exposure to yield-limiting and yield-reducing factors. This leads to different management approaches to create favourable rice-growing under same management practices. Transplanting (TP) and direct seeding (DS) are two common methods of rice establishment [1]. TP is more common in irrigated and rainfed lowland ecosystems [4] where there is sufficient water. In TP, seeds are normally germinated in the nursery for 2–3 weeks before they are manually or mechanically transplanted into the main fields (IRRI, 2007a; Sangeetha and Baskar, 2015). In DS, seeds are sown on the soil surface, and this can be practised in rainfed, deep-water, and irrigated systems [5]. Sowing can be done manually (hand broadcasting the seeds) or mechanically (using a drum seeder or seed drill, for example). DS rice matures up to seven to ten days faster than TP rice [5,6,7] due to the lack of transplanting shock (Yoshida, 1981). DS can be further classified into wet direct seeding (WDS) or dry direct seeding (DDS). WDS requires seeds that are pre-germinated for 24–48 h before broadcasting or drilling seeds into the mud with a drum seeder. In DDS, un-germinated seeds are sown (broadcasted, drilled or dibbled) on dry, prepared soil that is ploughed or harrowed afterwards (IRRI, 2007b; Singh et al., [4]). DDS is practised traditionally in rainfed ecosystems in most Asian countries but is gaining importance in irrigated areas where water is becoming scarce [8].

The choice of establishment method is influenced by environmental and socio-economic factors. Areas with low wages (high labour

supply) and sufficient irrigation water typically favour TP because of higher yields due to better weed control [1,9]. In contrast, DS is prevalent in labour- and water-scarce regions [8]. In addition to rainfall distribution, the position of the field in the top sequence also contributes to spatial variations in adoption of crop establishment method [10]. DS has been spreading in tropical rice areas of Asia replacing TP, the more traditional way of crop establishment [10]. In addition to labour- and water- savings, DS reduces methane emissions in rice, reduces the cost of cultivation, and allows timely planting of a subsequent crop, and hence is expected to further expand as labour and water costs increase in future, and improved varieties and crop management practices become available making DS more attractive to farmers [8,11].

## 2. MATERIALS AND METHODS

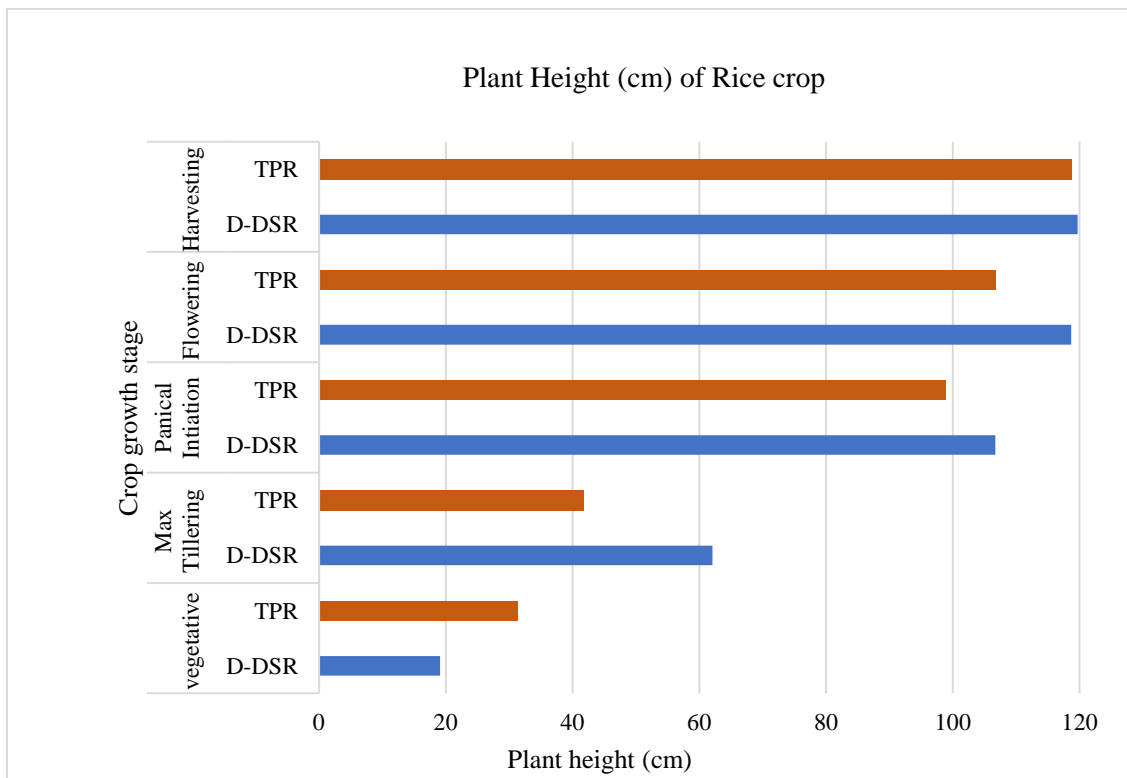
The farmer's field was selected in Nauroji camp village of Jogulamba Gadwal District in Telangana. Area of 2 ha under each cultivation practice was selected and the readings were collected from the each five randomly tagged plants. The number of hills  $m^{-2}$ , number of tillers  $m^{-2}$ , biomass of the plants was recorded by drying them in the hot air oven for a period of 24 hrs until the readings were similar. The LAI (Leaf Area Index) was measured with the help of CI-203 Handheld Laser Leaf Area Meter. The SPAD was by chlorophyll 502 meter. The yield was also recorded from the ten points of the different farmers fields were recorded.

### 2.1 Statistical Analysis

Paired two sample T test was performed in order to record the changes in the two cultures with equal management practices. The number of points that are monitored in the two cultures are equal.

## 3. RESULTS

Plant height, a growth parameter that was mainly governed by many factors such as space nutrients, light and water. Plant height was significantly influenced by plant to plant spacing in D-DSR than in TPR. Plant height increased continuously from tillering stage to harvest. In two rice culture there was significant difference was recorded in plant height at maximum tillering, panicle initiation and flowering stages of the crop growth Fig. 1.



**Fig. 1. Plant height of rice crop at each crop growth stage in D-DSR and TPR**

The tillers in rice were mainly useful in production of panicles and also grain yield, production of tillers was mainly influenced by plant density, pest incidence and other management practices. The Number of tillers  $m^{-2}$  was recorded in two rice culture there was significant difference in the rice cultures at flowering and at harvest due the incidence of gall midge during crop growth where the total number of tillers production is increased this led to production of unproductive tillers by formation of onion shoots. At harvest stage the productive tillers were reduced due to the pest incidence in the TPR Fig. 2.

The dry matter production in crop indicates plant growth and also yield of crop. Data in both cultures were non-significant at all the stages of crop growth. The dry matter production in D-DSR was more in the earlier stages of growth, but there was reduction in the panicle initiation and flowering Fig. 3.

The LAI was measured both manually and mechanically, LAI was highest in D-DSR and there was no significant difference among the rice cultures. LAI for D-DSR was greater because of a greater number of tillers per  $m^2$

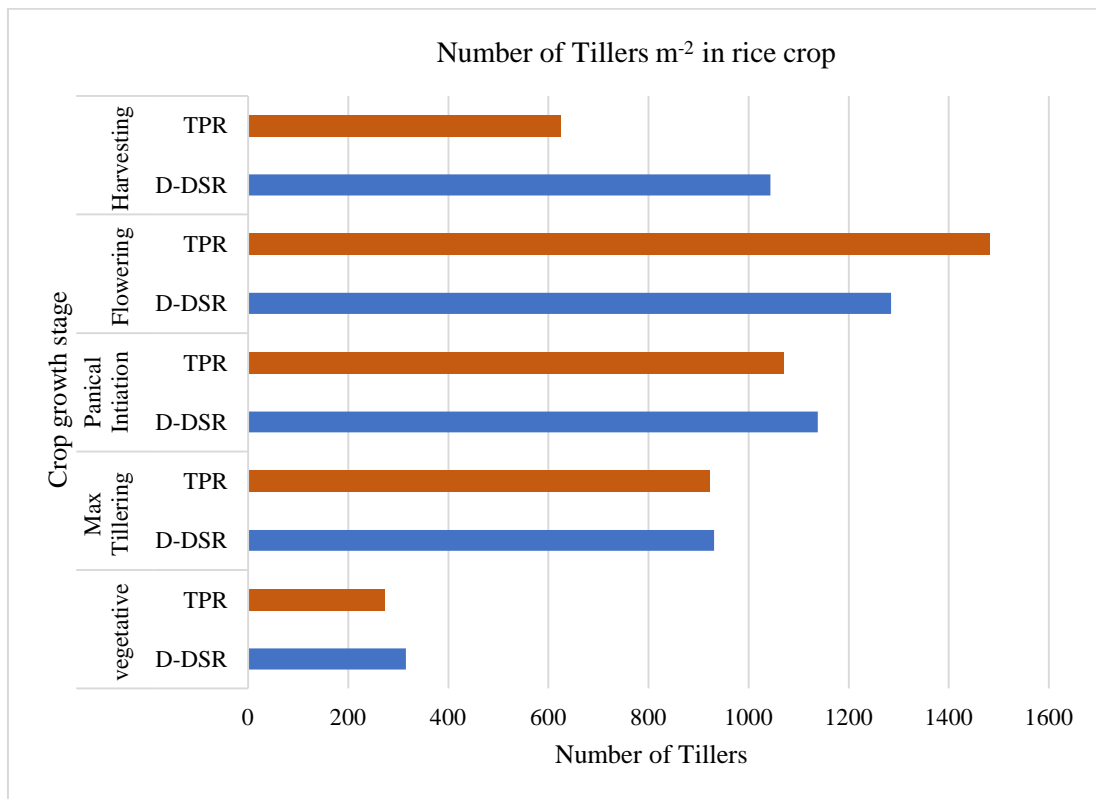
when compared with TPR, more leaves were produced in DSR, at later stages the TPR recorded more LAI Fig. 4.

The chlorophyll content was recorded by the SPAD meter. The chlorophyll content was good indicator of the healthy crop, there was no significant differences in the rice cultures. The more amount of chlorophyll content was recorded in the TPR when compared with the D-DSR Fig. 5.

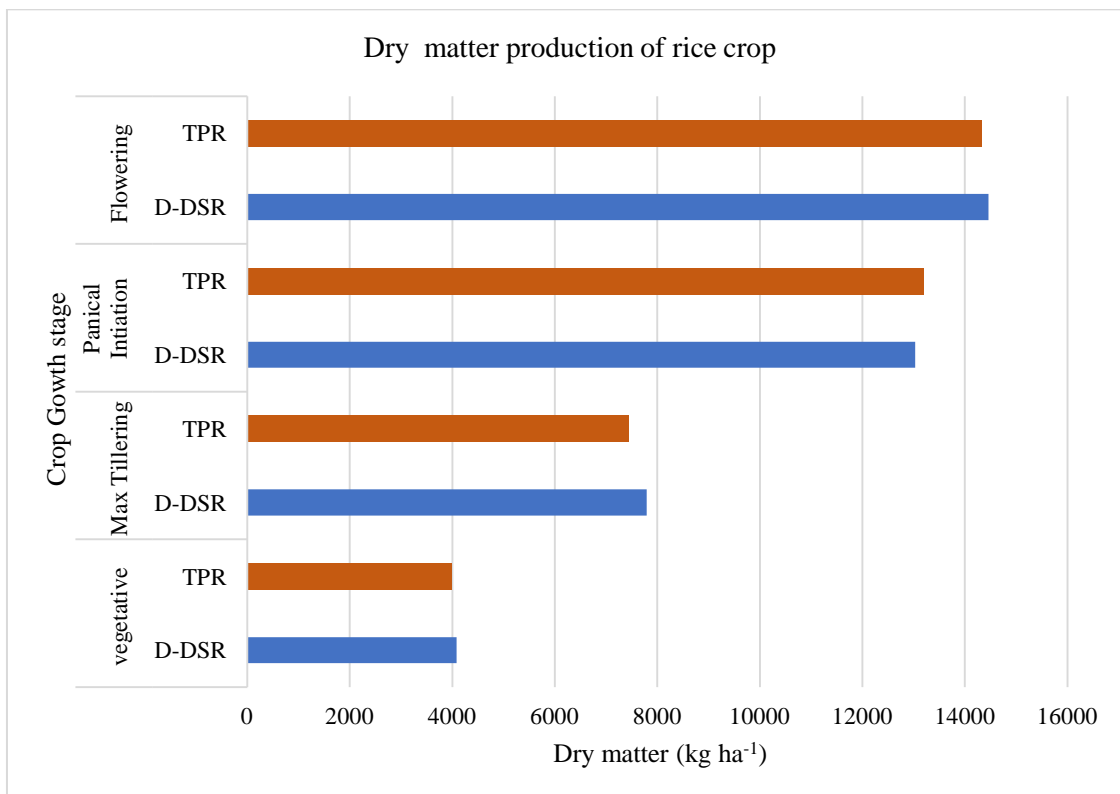
The comparison of all the biophysical parameter's that were compared among the two cultures with two sample T test with equal variance was given in the Table 1.

### 3.1 Yield Variability Analysis

The average yield of D-DSR recorded was 5.3 t  $ha^{-1}$  and transplanted rice was 5.1 t  $ha^{-1}$ . Variability was observed in rice yields under transplanted conditions due to damage caused by gall midge. Reduction in the yield was mainly due to production of unproductive tillers caused by the pest. Mohan, et al., [12], also reported that late transplanting of the paddy will be affected by gall midge Fig. 6.



**Fig. 2. Number of Tillers m<sup>2</sup> during each crop growth stage in D-DSR and TPR**



**Fig. 3. Dry matter production (kg ha<sup>-1</sup>) during each crop growth stage in D-DSR and TPR**

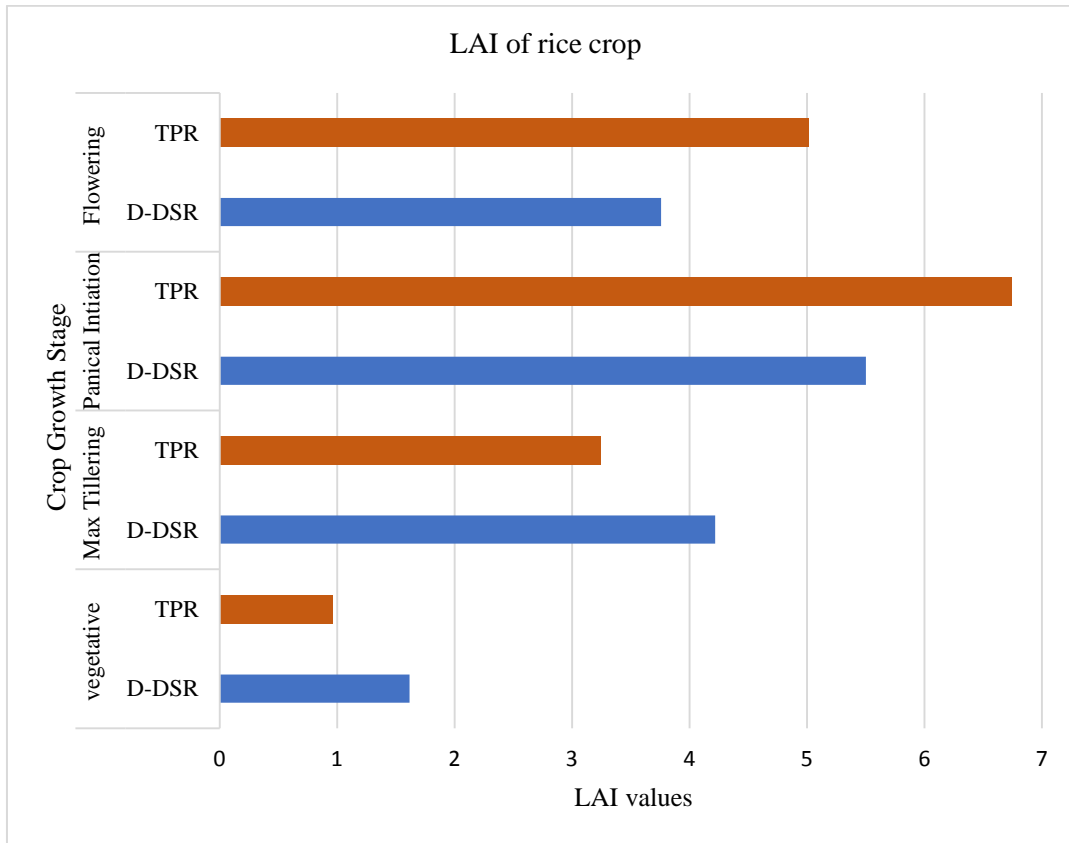


Fig. 4. LAI during each crop growth stage in D-DSR and TPR

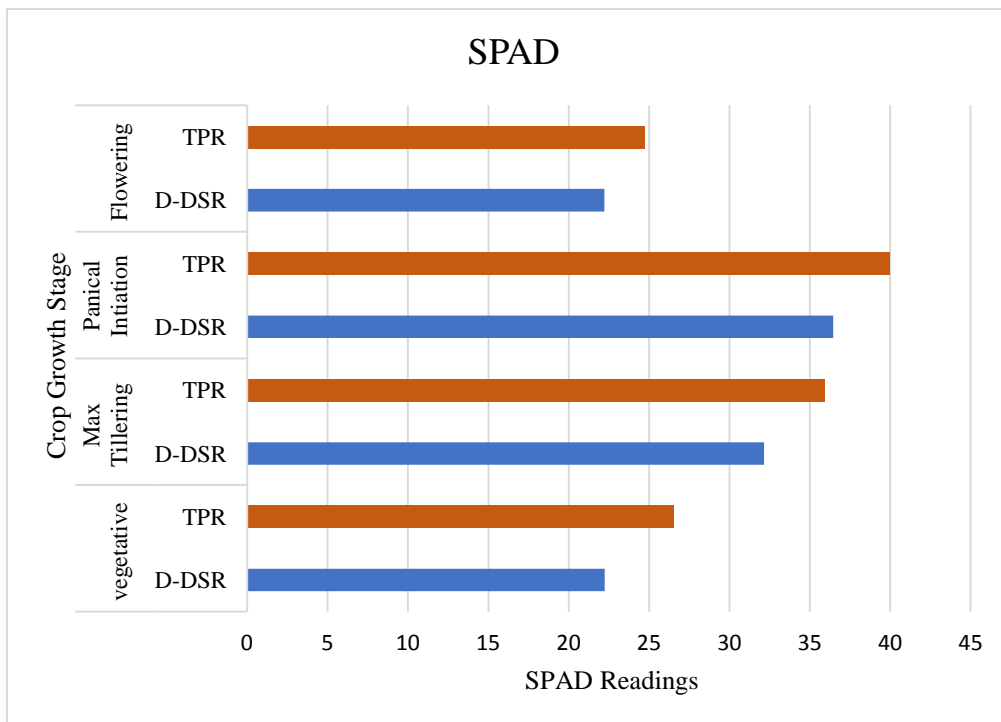


Fig. 5. SPAD values during each crop growth stage in D-DSR and TPR

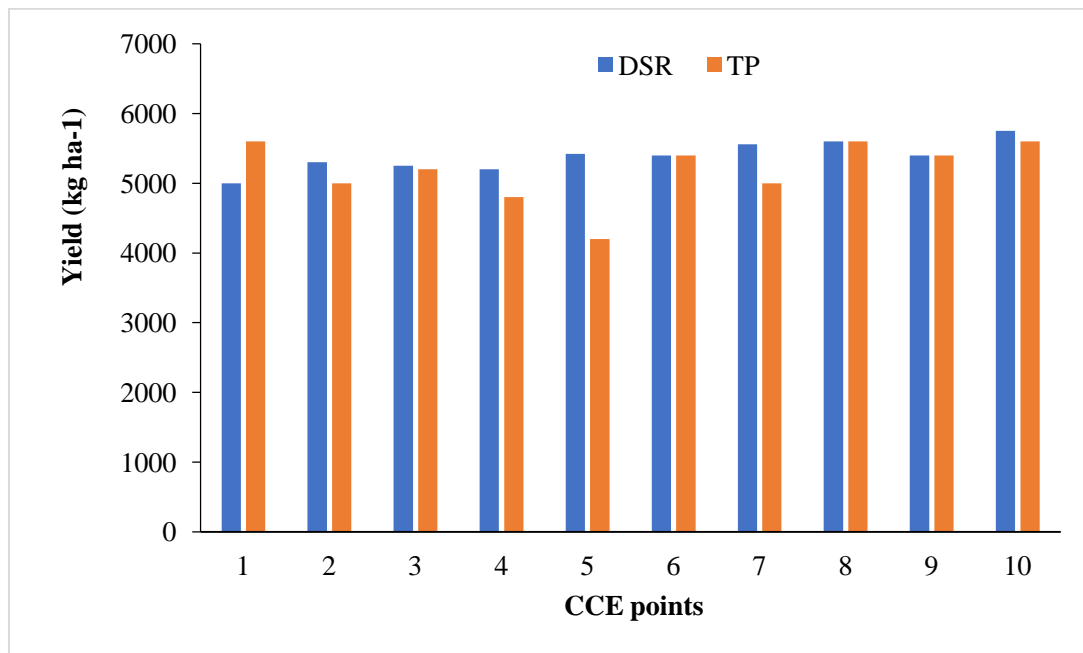


Fig. 6. Yield variability in two rice ecosystems during *kharif*, 2020

Table 1. Comparison table of biophysical parameters in the two-rice cultures

Biophysical parameter	Vegetative	Max Tillering	Panicle Initiation	Flowering	Harvesting
Plant height	-16.53	3.25*	5.21*	11.80*	-2.41
No of tillers	-4.87	-2.40	-0.078	3.76*	7.16*
SPAD readings	-3.42	-12.00	-3.84	-9.65	-
LAI	-2.47	-7.23	-7.48	-5.60	-
Bio mass	-5.27	-0.10	-5.22	-1.77	-

*T* statistics value at 0.05 % LOS is 2.10. (\*) significant difference between the two ecosystems

#### 4. DISCUSSION

The average plant height in D-DSR was 119.7 cm when compared with TPR it was 118.9 cm this was mainly due to crowding effect in D-DSR sowing was done in solid rows where plants tend to compete with each other for light. The plants grow taller due to the more amount of plant population in D-DSR  $m^{-2}$  when compared with the TPR according to Hussain et al., [13], Gathala et al., [14] and Sidhu et al., (2014), [15-19].

The Number of tillers  $m^{-2}$  was recorded in two rice culture there was significant difference in the rice cultures at flowering and at harvest due the incidence of gall midge at those stages of crop growth where the total number of tillers production is increased this led to production of unproductive tillers by formation of onion shoots. At harvest stage the productive tillers were reduced due to the pest incidence in the TPR.

The results in accordance with Mohan et al., 2015. The total number of tillers produced in D-DSR was greater when compared with the TPR because total plant population in D-DSR was greater than TPR, but number of tillers produced per plant is less in case of DSR Gill et al., [20], Gangwar et al., [21], Ishfaq et al., [22].

LAI for D-DSR was greater because of a greater number of tillers per  $m^2$  when compared with TPR, more leaves were produced in DSR, at later stages the TPR recorded more LAI due to incidence of pest that led to production of more tillers per hill Arjun et al., [11].

The SPAD values are more in TPR when compared to the DSR this was mainly due to deficiency in the micronutrients in DSR. Iron was one of the most limiting factors in DSR rice which leads to reduced synthesis of the chlorophyll content (Hongyan et al., 2018).

The yield variability in the both cultures was same but there was no variability in the two systems. DSR performed best under a mild water stress condition, matching or exceeding TPR yield [23]. The direct seeding of rice is known as a labour- and water-saving cultivation technique. The major environmental concern is the availability of the fresh water for the crop production. The per capita water availability was decreasing every year this makes the major threat to the water scarcity and the rice is one of the crops that consumes more water than other crops [24,25]. The production of methane gas which is one of the greenhouse gaseous that is majorly produced from the transplanted rice by adopting to the DSR the emissions can be reduced.

## 5. CONCLUSIONS

DSR is the alternative methods of crop establishment to transplanting rice. Rice crop requires most of the amount of water when compared to all the others. There was no significant difference was found among the two rice cultures regarding their biophysical parameters under the same management practices. So DSR is one of the best methods of which saves water. The emission of the green house gaseous can also be reduced.

## DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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