J. Soils and Crops 31 (2) 355-359, December 2021

ISSN 0971-2836 (Print)
ISSN 2582-2756 (Online)

SCREENING OF WHITE AND PIGMENTED RICE CULTIVARS FOR BIOCHEMICAL AND YIELD AND YIELD CONTRIBUTING CHARACTERS

Krunal N. Bele[1], Gautam R. Shamkuwar[2], Rajesh D. Deotale[3] and Aditi. S. Deshmukh[4]

ABSTRACT

An investigation was carried out during *kharif* season of 2020-2021 at research farm of ARS Sakoli, Dist. Bhandara (MH) in Randomized Block Design (RBD) with eleven treatments which included five white rice cultivars *viz.*, PDKV Tilak, Sakoli-9, PKV HMT, PDKV Kisan and SKL-3-1-41-8-33-15 and six pigmented rice cultivars *viz.*, SKLRR-1, Kormagreen, Raktashali, Kalibati, Chakhao Poireiton and Black Rice Early and were replicated thrice. Cultivar SKL-3-1-41-8-33-15 recorded higher total chlorophyll content, highest weight of grains panicle^{-1}, higher 1000 grain weight and highest harvest index when compared with other cultivars studied. Hence, cultivar SKL-3-1-41-8-33-15 can be recommended for cultivation.

(Key words: Rice, biochemical, yield and yield contributing characters)

INTRODUCTION

Rice (*Oryza sativa* L.) is the seed of the monocot plants. It can be a short, medium or long grain size. It is cultivated in 116 countries globally by 144 million farm families in around 160 million ha producing 480 million tons milled rice (Singh, 2018). The total area under rice cultivation in India was 44.6 million hectares producing 108.08 million tons with the productivity of 2.47 t ha^{-1} in 2016. The total area under rice in Maharashtra state is 15.57 lakh hectare with an annual rice production of 36.54 lakh tons (52.95 lakh tons rough rice) and the average productivity is 2.35 t ha^{-1} (3.4 t ha^{-1} rough rice) (Anonymous, 2016a). Eastern Vidarbha zone is the major rice producing area of Maharashtra. Nearly 8.16 lakh hectare area of Vidarbha (contributes 52.41 % of the state area) was under rice crop with production of 24.39 lakh tons rough rice (16.83 lakh tons milled rice) (Anonymous 2016a). Indonesia is the third richest country for its pigmented rice source (7.2%), after China (6.2%), Sri Lanka (8.6%), India (5.1%), Philippine (4.3%), Bangladesh (4.1%), and other countries such as Malaysia, Thailand and Myanmar with only minor percentage (Shinta *et al.*, 2014).

Throughout the world and in India people prefer white rice for consumption as food. However, pigmented rice is not yet known as the primary food and as a herb for people. There are many countries and states diverting production towards pigmented rice over traditional white rice. Eastern Vidharbha Zone in Maharashtra is also diverted to some extent to the production of pigmented rice like black, red, green rice which fetches higher market price because of high nutritional content. Various research studies indicated higher nutritional benefits of pigmented rice cultivars as compared to white rice cultivars but they are low grain yielder.

MATERIALS AND METHODS

A field experiment was conducted at research farm ARS, Sakoli, during 2020-21 in RBD with three replications and eleven treatments (cultivars included five white rice cultivars *viz.*, PDKV Tilak, Sakoli-9, PKV-HMT, PDKV Kisan and SKL-3-1-41-8-33-15 and six pigmented rice cultivars *viz.*, SKLRR-1, Kormagreen, Raktashali, Kalibati, Chakhao Poireiton and Black Rice Early). Observations on total chlorophyll content were recorded at 60 DAT. Total number of grains panicle^{-1}, spikelet fertility, weight of grains panicle^{-1}, number of panicles m^{-2}, panicle length, 1000 grain weight, grain type, harvest index and grain yield kg ha^{-1} were recorded at harvest. Data were statistically analyzed as per method suggested by Panse and Sukhatme (1967).

Total chlorophyll content of oven dried leaves was estimated by colorimetric method as suggested by Bruinsma (1982).The third leaf from top was selected for estimation of total chlorophyll content. 10 ml of 80% acetone was added in 500 mg of dry leaf material and homogeneous paste was prepared using mortal and pastel. Extract was collected using Whatman filter paper no. 40 and green extract was gradually obtained by adding 80 % acetone to make up volume of 50 ml. Optical density of the extract was measured on double photo cell colorimeter by using red filter.

$$\text{Total Chlorophyll} = \frac{D652 \times 1000}{34.5} \times \frac{V}{1000 \times W}$$

1 & 4. P.G. Students, Botany Section, College of Agriculture, Nagpur
2. Senior Rice Breeder, Agriculture research station, Sakoli
3. Ex. Professor, Botany Section, College of agriculture, Nagpur

Where,

D = Optical density

V= Final volume of 80% acetone in ml

W = Dry weight of sample taken (g)

Sum of all the filled and unfilled grains were counted of the panicle of main tiller of randomly selected plants and represented as total number of grains panicle^{-1}. Spikelet fertility was calculated as the ratio of filled grains panicle^{-1} to the total number of grains panicle^{-1} and expressed as per cent.

$$\text{Spikelet fertility (\%)} = \frac{\text{Filled grains panicle}^{-1}}{\text{Total number of grains panicle}^{-1}} \times 100$$

Weight of grains panicle^{-1} was calculated by removing all the filled grains from panicles of randomly selected plants and recorded weight on electronic balance and mean value panicle^{-1} was calculated. Total number of panicles was counted in square meter area at maturity in each cultivar of each replication and mean value was calculated. Panicle length was measured in centimeters at the time of plant maturity from the base of panicle to the tip of last spikelet in each cultivar of each replication and mean value calculated. A random sample of 1000 grain was counted manually from each cultivar and replication and weighed on electronic balance and expressed in gram and represented as 1000 grain weight. The decorticated kernel length and width of ten rice samples from each cultivar were measured in millimeter by use of dial micrometer and mean values calculated. Then length breadth ratio (L/B ratio) obtained was classified as (Long slender, medium slender, medium, medium bold and bold according to Ramiah (1969) and represented as grain type. One square meter area from each net plot was harvested separately from each cultivar and replication. The harvested produce was threshed using manual labour and grains were separated. The cleaned grains of each one square meter area were dried in hot sun for two days and then weight of grains was recorded. By multiplying hectare factor with grain weight of one square meter area, grain yield kg ha^{-1} was calculated. Harvest index refers to the co-efficient of effectiveness. It is defined as the percentage of economic yield to biological yield, and it is calculated by the formula (Donald and Hamblin 1976) as follow,

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg)}}{\text{Biological yield (kg)}} \times 100$$

RESULTS AND DISCUSSION

Total chlorophyll content (mg g^{-1})

The data pertaining to total chlorophyll content of rice cultivars are presented in Table 1 indicates that mean total chlorophyll content of rice cultivars at 60 DAT was 1.68 mg g^{-1}. Three white rice cultivars and three pigmented rice cultivars recorded significantly higher total chlorophyll content. Significantly highest total chlorophyll content was recorded in pigmented rice cultivar Kormagreen (2.21 mg g^{-1}) followed by white rice cultivar SKL-3-1-41-8-33-15 (2.03 mg g^{-1}), Sakoli-9 (1.89 mg g^{-1}), PDKV Kisan (1.87 mg g^{-1}), Kalibati (1.84 mg g^{-1}) and SKLRR-1 (1.80 mg g^{-1}). However, significantly lowest total chlorophyll content was recorded in three pigmented rice cultivars *viz.*, Black Rice Early (0.92 mg g^{-1}) followed by Raktashali (1.14 mg g^{-1}) and Chakhao Poireiton (1.54 mg g^{-1}). Remaining all the rice cultivars were found at par with the general mean.

Chlorophyll is the most important factor for photosynthesis process. It plays vital importance in grain filling. In the present investigation high yielding genotypes also showed higher chlorophyll content in rice cultivars. Swain *et al.* (2017) reported mean of 2.03 mg g^{-1} total chlorophyll content of rice varieties and at later stage the range was 1.6 to 2.5 mg g^{-1}. The present results obtained at 60 DAT are also supported by Vanisri *et al.* (2017). They reported the range of total chlorophyll from 3.42 in Tulsi to 6.56 mg g^{-1} in Rasi amongst 21 rice cultivars studied.

Total number of grains panicle^{-1}

The data in respect to total number of grains panicle^{-1} of white and pigmented rice cultivars are presented in Table 1 indicates that mean total number of grains panicle^{-1} of rice cultivars was 103.80. Significant differences were found in respect to total number of grains panicle^{-1} of white and pigmented rice cultivars. Significantly highest total number of grains panicle^{-1} was recorded in white rice cultivar PDKV Tilak (125.48). However, numerically higher total number of grains panicle^{-1} were recorded in PKV-HMT (120.58), SKLRR-1 (120.45), PDKV Kisan (110.31) and Sakoli-9 (108.37). Significantly less total number of grains panicle^{-1} was recorded in pigmented rice cultivar Black Rice Early (78.36). However, rest of rice cultivars showed at par total number of grains panicle^{-1} with the general mean.

In present investigation total number of grains panicle^{-1} of white and pigmented rice cultivars were found in the range of 78.36 to 125.48. Present results are in accordance with the results reported by Swain *et al.* (2017) and they reported range of number of grains panicle^{-1} from 72.7 to 107.4.

Spikelet fertility (%)

The data pertaining to spikelet fertility of rice cultivars are presented in Table 1 shows that mean spikelet fertility of rice cultivars was 82.76 %. Numerically higher spikelet fertility was recorded in pigmented rice cultivar SKLRR-1 (86.43 %) followed by white rice cultivars PKV-HMT (85.51 %) and PDKV Kisan (83.79 %). The pigmented rice cultivar Black Rice Early showed lowest spikelet fertility (80.50 %). All the rice cultivars exhibited at par spikelet fertility (%) with the general mean.

In present investigation spikelet fertility of rice cultivars ranged from 80.50 to 86.43 %. The present results are in accordance with the results reported by Malarvizhi *et al.* (2010), who reported spikelet fertility in the range of 86.2 to 93.35 % in different rice cultivars and hybrids studied.

Swain *et al.* (2017) also reported more than 84% spikelet fertility in rice cultivars.

Weight of grains panicle^{-1} (g)

The data in respect to weight of grains panicle^{-1} (g) of white and pigmented rice cultivars are presented in Table 1 indicates that mean weight of grains panicle^{-1} (g) of rice cultivars was 1.58 g. Significantly highest weight of grains panicle^{-1} was recorded in white rice cultivar SKL-3-1-41-8-33-15 (2.21 g) followed by pigmented rice cultivar Kalibati (2.04 g). Whereas, significantly lowest weight of grains panicle^{-1} was recorded in pigmented rice cultivar Black Rice early (1.13 g) followed by Raktashali (1.18 g). Rest of all rice cultivars were exhibited at par weight of grains panicle^{-1} with the general mean.

In present study mean weight of grains panicle^{-1} of rice cultivars was 1.58 g and ranged from 1.13 g to 2.21 g. High yielding early duration dwarf white rice cultivar SKL-3-1-41-8-33-15 had 2.21 g weight of grains panicle^{-1}. Results are in accordance with the results reported by Efisue *et al* (2014). They studied 26 rice cultivars and reported mean weight of grains panicle^{-1} of 2.80 and range from 1.73 to 4.17 g.

Number of panicles m^{-2}

The data pertaining to number of panicles m^{-2} of white and pigmented rice cultivars are presented in Table 1 indicates that mean number of panicles m^{-2} of rice cultivars was 225.94. Highest number of panicles m^{-2} was recorded in late duration white rice cultivars PDKV Tilak (269) followed by PDKV Kisan (259.33), Black Rice Early (257.33) and SKLRR-1 (254.32). Significantly lowest number of panicles m^{-2} was recorded in pigmented rice cultivars Chakhao Poireiton (161.67) followed by Kalibati (165.67). Rest of all rice cultivars were exhibited at par number of panicles m^{-2} with the general mean.

In present study number of panicles m^{-2} was in the range of 161.67 to 269. Presents results are in accordance with the results reported by Ali *et al.* (2007). They reported that number of panicles m^{-2} ranged from 141 to 327.

Panicle length (cm)

The data in respect to panicle length of white and pigmented rice cultivars are presented in Table 12 shows that mean panicle length of rice cultivars was 26.50 cm. Significantly highest panicle length was recorded in pigmented rice cultivar Kormagreen (29.97 cm). Lowest panicle length was recorded in white rice cultivars PKV-HMT (23.53 cm) followed by PDKV Kisan (23.75 cm). However, rest of the rice cultivars were found at par with the general mean for panicle length.

In present investigation panicle length of white and pigmented rice cultivars ranged from 23.53 to 29.97 cm. The present results are in agreement with the results reported by Padole *et al.* (2018), where panicle length of 35 white and 1 pigmented rice cultivar was ranged from 16.55 cm to 26.06 cm.

1000 grain weight (g)

The data in respect to 1000 grain weight (g) of white and pigmented rice cultivars are presented in Table 1 indicates that mean 1000 grain weight of rice cultivars was 18.93 g. Significant difference was observed among the rice cultivars. Significantly higher 1000 grain weight was recorded in pigmented rice cultivars Kalibati (27.72 g) followed by Chakhao Poireiton (25.74 g) and white rice cultivar SKL-3-1-41-8-33-15 (25.44 g). Whereas, significantly lower 1000 grain weight was recorded in three white rice cultivars and two pigmented rice cultivars. The white rice cultivar PDKV Tilak (13.51 g) recorded significantly lowest 1000 grain weight than the general mean followed by PKV-HMT (14.17 g). Rest of the rice cultivars were at par with the general mean.

In present investigation 1000 grain weight (g) of white and pigmented rice cultivars ranged from 13.51 g to 27.72 g. Higher 1000 grain weight of Kalibati (27.72 g), Chakhao Poireiton (25.74 g) and SKL-3-1-41-8-33-15 (25.44 g) might be due to short bold, long slender and long slender grain type respectively. However, lower 1000 grain weight of PDKV Tilak (13.51 g) and PKV-HMT (14.17 g) might be due to short slender grain type. The present results are supported by Padole *et al*. (2018). They reported range of 12.4 g to 26.9 g 1000 grain weight among the 35 white rice cultivars and 1 pigmented rice cultivar. Ponnapan *et al.* (2017) studied four different pigmented rice varieties and reported that 1000 grain weight (g) was highest in white rice (22.5 g) and least in black rice (17.50 g).

Grain type

The data in respect to grain type of rice cultivars are presented in Table 1. Differences were observed in all the white and pigmented rice cultivars under study. High yielding white rice cultivar SKL-3-1-41-8-33-15 showed long slender (LS) grain type. Pigmented rice cultivars Chakhao Poireiton and Black rice early also exhibited long slender (LS) grain type. The white rice cultivar Sakoli-9 and pigmented rice cultivar Raktashali showed medium slender (MS) grain type. Two pigmented rice cultivars *viz.*, Kormagreen and Kalibati showed short bold (SB) grain type. Three white rice cultivars namely, PDKV Tilak, PKV-HMT and PDKV Kisan along with one pigmented rice cultivar SKLRR-1 exhibited short slender (SS) grain type. Padole *et al.* (2018) reported that fifteen rice cultivars (SYE-1, RTN-5, KJT-184, KJT-4, PKV-HMT, PKV-GANESH, PDKV-KISAN, SYE-4, SKL-10, SKL-RR1, YSR, Shriram, Kesar, PKV-Khamang, Kalanamak) were grouped as short slender grain, ten cultivars as medium slender grain (Chhattisgarh Zinc Rice-1, SKL-30-39, MTU-1001, SKL-9, RPN, Swarna sub-1, White Luchai-112, PKV-Makarand, Chinoor, Heeranaki), eight cultivars as long slender grain (SKL-6, MTU-1010, IR-64, Shyamla, RP-4-14, DRR DHAN-45, SKL-8, SKL-7) and two cultivars as short bold (SB) grain group (SYE-2001 and SYE-5).

Harvest index (%)

The data in respect to harvest index (%) of rice cultivars are presented in Table 1 shows that mean harvest index of rice cultivars was (39.81 %). Numerically highest harvest index was recorded in white rice cultivar SKL-3-1-41-8-33-15 (48.08 %). Whereas, significantly lowest harvest

Table 1. Total chlorophyll content (mg g^{-1}), number of grains $panicle^{-1}$ (g), spikelet fertility (%), weight of grains $panicle^{-1}$(g), number of panicle m^{-2}, panicle length (cm), 1000 grain weight (g), grain type, Harvest Index (%) and grain yield kg ha^{-1} in white and pigmented rice cultivars

Genotypes	Chlorophyll content (mg g^{-1}) at 60 DAS	Number of grains $panicle^{-1}$	Spikelet fertility(%)	Weight of grains $panicle^{-1}$ (g)	Number of panicle m^{-2}	Panicle length(cm)	1000 grain weight (g)	Grain type	Harvest index (%)	Grain yield (kg ha^{-1})
PDKV Tilak	1.59	125.48	82.40	1.32	269.00	26.62	13.51	SS	40.01	3627
Sakoli-9	1.89	108.37	80.74	1.73	236.33	25.96	20.03	MS	43.45	4140
PKV HMT	1.60	120.58	85.51	1.45	226.33	23.53	14.17	SS	38.96	3320
PDKV Kisan	1.87	110.31	83.79	1.48	259.33	23.75	15.56	SS	42.60	3773
SKL-3-1-41-8-33-15	2.03	102.78	82.06	2.21	214.00	26.87	25.44	LS	48.08	4597
SKLRR-1	1.80	120.45	86.43	1.51	254.33	25.75	14.52	SS	45.58	3853
Kormagreen	2.21	105.55	82.00	1.56	204.67	29.97	17.20	SB	30.85	3068
Rakthashali	1.14	94.33	83.46	1.18	236.67	25.31	14.21	MS	38.19	2683
Kalibati	1.84	90.50	81.12	2.04	165.67	27.66	27.72	SB	30.59	3382
Chakhao Poireiton	1.54	85.10	82.32	1.81	161.67	28.49	25.74	LS	40.93	2944
Black rice early	0.92	78.36	80.50	1.13	257.33	27.60	20.17	LS	38.68	2981
Mean	1.68	103.80	82.76	1.58	225.94	26.50	18.93	—	39.81	3488
SE (m) ±	0.04	6.40	1.28	0.11	15.01	1.12	0.71	—	2.84	231.19
CD at 5%	0.11	18.88	3.79	0.31	44.27	3.33	2.10	—	8.40	682.03

index was recorded in pigmented rice cultivars Kalibati (30.59 %) followed by Kormagreen (30.85 %). Rest of the rice cultivars were found to be at par to the general mean.

In present investigation harvest index (%) of rice cultivars was ranged from 30.59 to 48.08%. The presents results are supported by Ashrafuzzaman *et al.* (2008). They reported range of harvest index (%) from 31.51 to 34.94.

Grain yield kg ha^{-1}

The data in respect to grain yield kg ha^{-1} of rice cultivars are presented in Table 1 indicates that mean grain yield of rice cultivars was 3488 kg ha^{-1}. Grain yield differences were statistically significant. Grain yield ranged from 2683 to 4597 kg ha^{-1}. Significantly highest grain yield kg ha^{-1} was recorded in white rice cultivar SKL-3-1-41-8-33-15 (4597 kg ha^{-1}). White rice cultivar Sakoli-9 (4140 kg ha^{-1}) and pigmented rice cultivar SKLRR-1 (3853 kg ha^{-1}) stood second and third respectively in terms of grain yield kg ha^{-1}. However, significantly lowest grain yield kg ha^{-1} was recorded in pigmented rice cultivar Raktashali (2683 kg ha^{-1}). While rest of the rice cultivars were at par with the general mean.

In present investigation grain yield ranged from 2683 to 4597 kg ha^{-1}. The highest grain yield of early duration white rice cultivar SKL-3-1-41-8-33-15 might be due to significantly higher total chlorophyll content (2.03 mg g^{-1}), significantly highest weight of grains panicle^{-1} (2.21 g), higher 1000 grain weight (25.44 g) and highest harvest index (48.08%). While, white rice cultivar Sakoli-9 ranked second in grain yield kg ha^{-1} (4140 kg ha^{-1}) might be due to significantly higher total chlorophyll content (1.89 mg g^{-1}) at 60 DAT, higher weight of grains panicle^{-1} (1.73 g), optimum number of panicles m^{-2} (236.33) and optimum 1000 grain weight (20.03 g). Likewise pigmented red rice cultivar SKLRR-1 stood third in grain yield kg ha^{-1} (3853 kg ha^{-1}) might be due to significantly higher total chlorophyll content (1.80 mg g^{-1}), highest spikelet fertility (86.43 %) and higher number of panicles m^{-2} (254.33). The results obtained in present study are in accordance with results reported by Shende *et al.* (2017) and Sharma *et al.* (2018). Shende *et al.* (2017) reported range of grain yield from 3569 to 4526 kg ha^{-1} when screened 4 rice varieties at multilocation. Sharma *et al.* (2018) reported that highest grain yield (4939.0 kg ha^{-1}) was recorded with crop transplanted on 26th June. The lowest grain yield (4673.8 kg ha^{-1}) was recorded with 11th July.

REFERENCES

Ali, R. I., T, H. Awan., Z. Manzoor, M. M. Ashraf, M. E. Safdar and M. Ahmad, 2007. Screening of rice varieties suitable for direct seeding in Panjab. J. Amin. Pl. Sci. **17**(1-2): 24-26.

Anonymous, 2016[a]. MSSD, Pune, 2016-17 second advance estimates.

Ashrafuzzaman, M., M. R. Islam, S. M. Shahidullah and M. M. Hanafi, 2009. Evaluation of six aromatic rice varieties for yield and yield contributing characters Int. J. Agric. Biol. 11: 616-620.

Bruinsma, J. 1982. A comment on the spectrophotometric determination of chlorophlyll Bio-Chem., Bio-Phy. Acta. **52**: 576- 578.

Donald, C.M. and J. Hamblin, 1976. Growth and development in physiology of crop plants. 2nd Ed. Scientific publishers Jodhapur. 198-199.

Efisue A. A., C. Bianca, Umunna and J. A. Orluchukwu, 2014. Effects of yield components on yield potential of some lowland rice in coastal region of Southern Nigeria. J. Plant Breed. Crop Sci. **6**(9): 119-127.

Malarwizhi, D., K.Thyagarajan, C. Vijayalakshmi and S. Manonmani, 2010. Genetic analysis to assess the physiological efficiency of parental lines in rice. Electronic J. Plant Breeding. **1**(2): 100- 113.

Padole, B. H., W. P. Badole, G. R. Shamkuwar, 2018. 2nd Int. Conf. on Recent Devp. In Sci. Humanities & Mang.18.

Panse, V. G. and P. V. Sukhatme, 1967. Statistical methods for agricultural workers. Pp. 381. ICAR, New Delhi.

Ponnappan, S., A. Thangavel and O. Sahu, 2017. Milling and physical characteristics of pigmented rice varieties. Int. J. Food chem. **1** (1) : 24-29

Ramaiah K., 1969, Rice Research in India, ICAR, Grain Classification, pp. 629.

Sharma, N., N. S. Murty, P. Mall and S. B. Bhardwaj, 2018. An analysis on the yield and yield contributing characters of rice in tarai region of Uttarakhand. Int. J. Chem. Stu. **6**(3): 42-47.

Shende, P. V., G. R. Shamkuwar, B. N. Chaudari and R. F. Raut, 2017. PDKV Tilak: The high yielding, short slender and good cooking quality rice variety. Int. J. Res. In Biosci. Agri. & Tech. **1**(5): 29-38.

Shinta, S. Indriyani and E. Arisoesilaningsih, 2014. Morphological variation of six pigmented rice local varieties grown in organic rice field in Sengguruh village, Kepanjen District, Malang Regency, J. Trop. Life. Sci. **4**(2):149-150.

Singh, B. N. 2018. Global Rice cultivation and Cultivars. Stadium Press LLC, Houstom-USA pp. 1-591.

Swain, R. K., A. K. Padhiary, S. Behera, S. P. Mishra, M. Jena, S. C. Swain and S. K. Rout, 2017. Morpho physiological traits of some rice varieties in response to shallow water depth. Int. J. Curr. Microbiol. App. Sci. **6**(11): 3950-3957.

Vanisri, S., M. Sreedhar, L. Jeevan, A. Pavani, A. Chaturvedi, M. Aparna, D. Pavan Kumar, T. Sunitha, K. Aruna, V. G. N. Tripura Venkata, Ch. Surendra Raj and R. Jagadeeswar, 2017. Evaluation of rice genotypes for chlorophyll content and scavenging enzyme activity under the influence of mannitol stress towards drought tolerance. Int. J. Curr. Microbiol. App. Sci. **6**(12):2907-2917.

Rec. on 12.06.2021 & Acc. on 27.06.2021