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Comparative Evaluation of Photosynthetic Efficiency among Leaf Orientation of Castor (*Ricinus communis*) and Redgram (*Cajanus cajan*)

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A B S T R A C T

In castor (*Ricinus communis*), top leaf adjacent to spike (flag leaf) was observed with higher photosynthetic rate (19.17 µ mol/m^2 /Sec) followed by middle leaf (13.81) and bottom leaf (13.82) and young leaf (6.32). This showed the translocation of source to the sink. Transpiration rate is in the range of 5.57 m mol/m^2 /Sec. Stomatal conductance also not much varied with top, middle, bottom and young leaf. Redgram (*Cajanus cajan*) was reported with a Photosynthetic rate was same as castor (19.86). Transpiration rate (6.48) and stomatal conductance of 0.53 mol /sec which is slightly lesser than castor. Young leaf expressed very less physiological activity photosynthesis of 1.79, Transpiration rate of 1.43 and very less stomatal conductance (0.08) than top leaf and lower leaf.

Introduction

Pigeonpea is the second important pulse crop of India and recognized of a valuable source of proteins for the vegetarians in their daily diet. In India Pigeonpea is sown in an area of 4.09 million hectares with a production of 3.27 million tonnes. It is known that Pigeonpea thrives well under drought prone condition. In India, castor is cultivated in an area of 8.4 lakh ha under both irrigated and rainfed conditions.

Castor has the potential for its use in bioenergy and industrial feed stock due to its high oil content and has the adaptability to grow under drought and saline conditions (Severino *et al.,* 2012). India is the first country in the world to exploit hybrid vigour of castor crop on commercial scale (Ramchandran and Rao, 2012). Drought is deleterious for plant growth, yield and mineral nutrition. (Garg *et al.,* 2004) and is one of the largest limiting factors in agriculture (Reddy *et al.,* 2004). Seed yield is most affected by drought occurring in the flowering and early pod development stages. Genotypic differences in drought resistance are associated with maintenance of dry matter partitioning into leaves during and dry matter production following drought periods (Reddy *et al.,* 2004). In this experiment two drought tolerant climate smart crops of redgram and castor has been studied for its physiology namely photosynthetic rate, stomatal conductance and Transpiration rate. Difference over in different leaf position of both the crops is recorded.

Materials and Methods

Castor (YRCH1) and Redgram (Co (Rg)8 was taken sowing on 26.6.2020. Photosynthetic rate, Transpiration

rate and stomatal conductance was measured in the leaves adjacent to the spike (flag leaf), top leaf, middle leaf, bottom leaf and young leaf in castor and redgram on 90 DAS (26.9.20) which is the critical phase for both the crops using IRGA Lci -T.

Data was recorded to know the drought tolerance of castor and redgram. While taking reading; castor was with spike and redgram is in vegetative stage. This is recorded to know the photosynthetic rate and stomatal conductance of castor and redgram.

Results and Discussion

Redgram

In Redgram, Photosynthetic rate was same as castor (19.86 µ mol/m^2 /Sec). Transpiration rate (6.48 m mol/m^2 /Sec) and stomatal conductance of 0.53 mol /sec which is slightly lesser than castor. Young leaf expressed very less physiological activity photosynthesis of 1.79 µ mol/m^2 /Sec, Transpiration rate of 1.43 m mol/m^2 /Sec and very less stomatal conductance (0.08 mol /sec) than top leaf and lower leaf.

Castor

In castor, top leaf adjacent to spike (flag leaf) was observed with higher photosynthetic rate (19.17) followed by middle leaf (13.81) and bottom leaf (13.82) and young leaf (6.32). This showed the translocation of source to the sink. Transpiration rate is in the range of 5.57. Stomatal conductance also not much varied with top, middle, bottom and young leaf. The regression equation between photosynthesis has significant positive relation with Transpiration rate Tr (r^2 = 0.7326) and stomatal conductance gs (r^2 =0.689429). The regression equation between Transpiration rate and Stomatal conductance is (r^2 =0.744053).

Sowmya *et al.,* (2016) reported that the regression equation between gs (Stomatal conductance) has significant positive relation with Tr (Transpiration rate) (r^2 = 0.9773) whereas WUE has significant negative relation with gs (r^2 = 0.8972) and Tr (r^2 = 0.9128) revealing that the WUE of castor is mainly dictated by Tr and which in turn by gs and not Pn.

Both the crops raised in the same date of sowing was observed with same photosynthetic rate, transpiration rate and stomatal conductance. Photosynthetic rate of redgram was also as same as castor (19.86 µ mol/m^2 /Sec).

Transpiration rate (6.48 m mol/m^2 /Sec) and stomatal conductance of 0.53 mol/sec which is slightly lesser than castor. Young leaf expressed very less physiological activity photosynthesis of 1.79, Transpiration rate of 1.43 and very less stomatal conductance (0.08) than top leaf and lower leaf.

Table.1 Photosynthetic rate, Transpiration rate and Stomatal Conductance of different leaf position in Redgram

Plant	Top Leaf			Lower Leaf			Young Leaf		
	Photosynthetic rate µ mol/m^2 /Sec	Transpiration rate m mol/m^2 /Sec	Stomatal Conductance mol /sec	Photosynthetic rate µ mol/m^2 /Sec	Transpiration rate m mol/m^2 /Sec	Stomatal Conductance mol /sec	Photosynthetic rate µ mol/m^2 /Sec	Transpiration rate mol/m^2 /Sec	Stomatal Conductance mol /sec
1.	20.90	6.09	0.50	19.08	6.13	0.70	0.20	1.05	0.03
2.	23.19	6.50	0.45	16.99	4.79	0.30	1.30	2.33	0.17
3.	15.50	6.86	0.63	18.89	7.51	0.52	3.86	0.92	0.03
Average	19.86	6.48	0.53	18.32	6.14	0.51	1.79	1.43	0.08

Table.2 Photosynthetic rate, Transpiration rate and Stomatal Conductance of different leaf position in Castor

Castor												
Plant	Top Leaf			Middle Leaf			Bottom Leaf			Young leaf		
	Photosynthetic rate µ mol/m^2 /Sec	Transpiration rate m mol/m^2 /Sec	Stomatal Conductance mol /sec	Photosynthetic rate µ mol/m^2 /Sec	Transpiration rate m mol/m^2 /Sec	Stomatal Conductance mol /sec	Photosynthetic rate µ mol/m^2 /Sec	Transpiration rate m mol/m^2 /Sec	Stomatal Conductance mol /sec	Photosynthetic rate µ mol/m^2 /Sec	Transpiration rate m mol/m^2 /Sec	Stomatal Conductance mol /sec
1.	21.56	4.83	0.72	14.7	5.05	0.63	17.79	6.32	0.8	3.44	4.08	0.19
2.	23.06	6.05	0.67	18.36	5.59	0.75	10.87	5.25	0.8	3.49	3.95	0.27
3.	19.3	5.98	0.65	9.51	5.18	0.65	12.81	5.15	0.58	11.18	4.97	0.53
4.	12.79	5.2	0.55	12.69	5.42	0.89	13.83	5.8	0.79	7.17	5.13	0.36
Average	19.1775	5.515	0.6475	13.815	5.31	0.73	13.825	5.63	0.7425	6.32	4.5325	0.3375

In castor, Flag leaf (adjacent to the spike) was recorded with more photosynthetic rate (19.17 µ mol/m2 /Sec), stomatal conductance and transpiration rate. Young leaf was recorded with very less photosynthetic rate (6.3 µ mol/m2 /Sec).

Author Contribution

K. Kalaichelvi: Investigation, formal analysis, writing—original draft. D. Sambasiva Rao: Validation, methodology, writing—reviewing. J. Prabhaharan:—Formal analysis, writing—review and editing. R. Durai Singh: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval: Not applicable.

Consent to Participate: Not applicable.

Consent to Publish: Not applicable.

Conflict of Interest: The authors declare no competing interests.

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