International Journal of Plant & Soil Science

Volume 36, Issue 5, Page 323-328, 2024; Article no.IJPSS.114754
ISSN: 2320-7035

Physiological Efficiency of Weeds in Rice Fallow Fields

K.Kalaichelvi [a++*]

[a] Agricultural College and Research Institute, Madurai – 625104, India.

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/IJPSS/2024/v36i54530

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/114754

Original Research Article

Received: 19/01/2024
Accepted: 23/03/2024
Published: 28/03/2024

ABSTRACT

Photosynthetic rate, Transpiration rate and Stomatal Conductance is measured in different weeds during July'2020 in rice fallows using IRGA- Photosynthesis system model Lci- T. We have chosen all the weeds at flowering to maturity phase and observed the data. Among the weeds analysed *Parthenium hysterophorus* has recorded very high Photosynthetic rate (µ $molm^{-2}$ Sec^{-1})and there was difference with stage also, Flowering stage (165.28) has recorded a higher photosynthetic rate followed by vegetative (123.2) and maturity phase (118.72) and found that transpiration rate also followed the same trend. Even this has recorded more than the C4 crop photosynthetic rate for example *Trianthema portulacastrum* which has recorded a photosynthetic rate of 21.98, which was the next highest photosynthetic rate among the weeds recorded and as well as over C4 crops too. Among the grasses *Paspalum* sp., *Echinochloa colona* (7.81µ $molm^{-2}$ Sec^{-1})) and *Cynodon dactylon* (4.2µ $molm^{-2}$ Sec^{-1})) has recorded higher photosynthetic rate. *Cyperus* and *Cyanodon*has recorded with lesser stomatal conductance and transpiration rate but has recorded higher photosynthetic rate which can thrive better in rainfeds also. *Echinochloa* has more transpiration rate and stomatal conductance among grasses and this might be due to their water loving nature. *Boerhavia diffusa*, *Euphorbia hirta* and *Ruella tuberosa* are recorded with lesser stomatal conductance. On critically analysing the weeds, it was observed that some weeds like Parthenium are reported with higher photosynthetic rate with lesser transpiration rate and stomatal conductance over better

---

[++] *Assistant Professor (Agronomy);*
**Corresponding author: E-mail: kalaichelvi.k@tnau.ac.in;*

photosynthetic efficiency crop like maize and also this has resulted in the better withstanding ability to the water stress. Correlation analysis showed that photosynthesis and Transpiration rate are positively correlated but weak (r=0.28) and the regression equation is (Y=4.98+4.32(x)), photosynthetic rate and stomatal conductance are also positively correlated but weak (r=0.20) and the regression equation is Y= 20.36+17.04(X). Transpiration and Stomatal Conductance is positively and strongly correlated (r=0.57) and regression equation is Y=3.92+2.51(x).

Keywords: Major weeds; physiological efficiency; documentation.

1. INTRODUCTION

Adaptation of weeds to adverse climate is with high plasticity and even succeeds their generation against the efforts forced by man to control these plants. Rising carbon dioxide (CO_2) concentrations and associated changes in global temperature and precipitation are major concerns for future weed management and crop production Aruna Varanasi et al. [1]. Weed cause 36% yield loss in groundnut, 31% in Soybean, 25% in maize and sorghum and 19% in wheat Gharde et al. [2]. Physiological efficiency of the weeds changes among species and environment in which it grows. For instance Caroline Hernke Thie et al. [3] found that Alexander grass (*Urochloa plantaginea*) relies on the superior control of stomatal opening and high water use efficiency. Hairy beggarticks (*Bidens pilosa*) efficiency in competition lies on its ability to remove water from soil to levels when the other surrounding plant species would undergo stress. We wish to document the physiological efficiency of the weeds available in current fallows without any crop competition. All the physiological parameters like photosynthetic rate, transpiration rate and stomatal conductance are documented using Infrared Gas Analyzer (IRGA) model LCi T. By assessing this we can identify the most efficient weed and we can take measures to manage this weed and its spread especially invasive weeds. We have categorised the weeds in to Grasses, Sedges and Broad-Leaved weeds and as well as their photosynthetic pathway C3, C4 and C3- C4. It is necessary to know the photosynthetic rate of the weeds to design our weed management practices. We can identify the noxious weed to control and better weed for domestication.

2. MATERIALS AND METHODS

We have chosen all the weeds at flowering to maturity phase and observed the data. Among the weeds analysed Parthenium hysterophorus has recorded very high Photosynthetic rate (µ molm-2 Sec-1)and there was difference with stage also, Flowering stage (165.28) has recorded a higher photosynthetic rate followed by vegetative (123.2) and maturity phase (118.72) and found that transpiration rate also followed the same trend. All the physiological parameters like photosynthetic rate, transpiration rate and stomatal conductance are documented using Infrared Gas Analyzer (IRGA) model LCi T and this was recorded in the rice fallow fields of D block, Agricultural College and Research Institute, Madurai. The stage of the weed also recorded mostly we have taken at the flowering stage of the available weeds and as well as some field crops for comparison. During the observation, the moisture remains same and we have observed the data between 10.30-12.30 am on 31.7.2020 as we have confirmed with the 3 plants for a single species at the same stage. The instrument is precise and easy to record.

3. RESULTS AND DISCUSSION

Among the weeds analysed *Parthenium hysterophorus* has recorded very high Photosynthetic rate and there was difference with stage also, Flowering stage (165.28µ $molm^{-2}$ Sec^{-1})) has recorded a higher photosynthetic rate followed by vegetative (123.2µ $molm^{-2}$ Sec^{-1})) and maturity phase (118.72µ $molm^{-2}$ Sec^{-1})) and found that transpiration rate also followed the same trend. At maturity the *Sorghum arundinaceum* presents higher values of transpiration rate, stomatal conductance and non-photochemical quenching coefficient was reported by Deborah Amorim Martins et al. [4]. Even this Parthenium has recorded more than the C4 crop photosynthetic rate for example *Trianthema portulacastrum* has recorded a photosynthetic rate of 21.98µ $molm^{-2}$ Sec^{-1}, which was the next highest photsynthetic rate. Among the grasses *Paspalum* sp., *Echinochloa colona* (7.81µ $molm^{-2}$ Sec^{-1})) and *Cynodon dactylon* (4.2µ $molm^{-2}$ Sec^{-1})) has recorded higher photosynthetic rate. *Cyperus* and *Cyanodon* has recorded with lesser stomatal conductance and transpiration rate has recorded higher

Table 1. Photosynthetic efficiency of weeds

Grasses

Sl.No	Name of the weed	Stage of the weed	Photosynthetic rate μ molm^{-2} Sec^{-1}	Transpiration rate m mol m^{-2} Sec^{-1}	Stomatal Conductance mol sec^{-1}
1.	*Paspalum sp.*	Seed formation	10.08	5.67	0.18
2.	*Echinochloa colona*	Seed formation	7.81	5.71	0.13
3.	*Cynodon dactylon*	Well mat	4.69	2.36	0.03
4.	*Cynodon dactylon*	Well mat	4.20	1.19	0.02
5.	*Brachiaria reptans*	Flowering	3.04	3.26	0.07
7.	*Cenchrus ciliaris*	Flowering	3.32	1.18	0.03
8.	*Chloris barbata*	Flowering	6.49	1.68	0.14

Sedges

Sl.No	Name of the weed	Stage of the weed	Photosynthetic rate μ molm^{-2} Sec^{-1}	Transpiration rate m mol m^{-2} Sec^{-1}	Stomatal Conductance mol sec^{-1}
1.	*Cyperus iria*	Flowering	6.13	2.21	0.04
2.	*Cyperus esculentus*	Flowering	2.45	2.04	0.05

Broad leaved weeds

Sl.No	Name of the weed	Stage of the weed	Photosynthetic rate μ molm^{-2} Sec^{-1}	Transpiration rate m mol m^{-2} Sec^{-1}	Stomatal Conductance mol sec^{-1}
1.	*Parthenium hysterophorus*	Flowering	165.28	7.05	0.23
2.	*Parthenium hysterophorus*	Matured	118.72	2.98	0.05
3.	*Parthenium*	Vegetative	123.2	6.43	0.16
5.	*Trianthema portulacastrum*	Seed formation	21.8	7.4	0.26
6.	*Corchorus olitorius*	Flowering	11.18	8.13	0.60
7.	*Cleome chelidoni*	Flowering	15.26	10.49	0.33
8.	*Passiflora foetida*	Small twine	65.71	7.5	2.6
		Flowering	9.68	3.45	0.10
9.	*Sida cordifolia*	Flowering	13.47	9.6	0.50
10	*Convolvulus arvensis*	Flowering	11.41	4.84	0.21
11.	*Hibiscus vitifolius*	flowering	5.95	2.64	0.04
12.	*Heliotropium indicum*	Seed formation	5.55	5.48	0.11
13.	*Chrozaphora rottleri*	Seed formation	3.53	4.99	0.09
14.	*Malvastrum coromandelianum*	Flowering	2.60	6.55	0.47
15.	*Ruella tuberosa*	Flowering	2.37	0.4	0.01
16.	*Boerhavia diffusa*	Flowering	2.03	1.81	0.08
17.	*Tridax procumbens*	Flowering	2.06	2.43	0.13
18.	*Euphorbia hirta*	Seed formation	1.47	1.28	0.03
19.	*Commelina benghalensis*	Flowering	3.48	3.28	0.18
20.	*Eclipta alba*	Flowering	8.27	3.88	0.15
21.	*Acalypha indica*	Flowering	4.81	2.10	0.13

photosynthetic rate which can thrive better in rainfeds also. Alexander grass (*Urochloa plantaginea*) presented better stomatal control ability to avoid water loss and at the same time high efficiency in the use of the available CO_2, being able to maintain high photosynthetic rates even with greater periods of stomatal closure, which results in higher WUE Aspiazú et al. [5]; Caroline Hernke Thiel et al. [6]. Some common annual weeds growing with crops transpires about four times more water than a crop plant and use up to three times as much water to produce a pound of dry matter as do the crops [7]. *Echinochloa* has more transpiration rate and stomatal conductance among grasses and this might be due to their water loving nature. *Boerhavia diffusa*, *Euphorbia hirta* and *Ruella tuberosa* are recorded with lesser stomatal conductance.

On averaging the photosynthetic efficiency of weeds it was observed that some C3 like *Passiflorafoetida* also with better photosynthetic efficiency over C4 weed and crops. HoweverParthenium has recorded a very high photosynthetic rate which is of C3- C4 intermediate Photorespiration is thought to be reduced through a CO_2 concentrating mechanism by limited C4-type of photosynthesis in the C3-C4 intermediate Flaveria species Gedupudi Rajendrudu, [8]. Rising temperature, elevated CO_2 and changing rainfall pattern are the important aspects of changing climate with pronounced impacts on agriculture ecosystems in general and weed species specifically Dinesh Jinger et al. [9].

3.1 Correlation and Regression

Correlation analysis showed that photosynthesis and Transpiration rate are positively correlated but weak (r=0.28) and the regression equation is (Y=4.98+4.32(x)), photosynthetic rate and stomatal conductance are also positively correlated but weak (r=0.20) and the regression equation is Y= 20.36+17.04(X). Transpiration and Stomatal Conductance is positively and strongly correlated (r=0.57) and regression equation is Y=3.92+2.51(x).

Crops

Crop	Stage	Photosynthetic rate μ molm^{-2} Sec^{-1}	Transpiration rate m mol m^{-2} Sec^{-1}	Stomatal conductance mol sec^{-1}
Maize	Cob formation Stage	12.92	6.82	0.16
Cumbu Napier Hybrid grass	At harvest stage	20.85	4.27	0.21
Cowpea	Vegetative	8.27	3.88	0.15

C3 weeds

Sl.No	Name of the weed	Stage of the weed	Photosynthetic rate μ molm^{-2} Sec^{-1}	Transpiration rate m mol m^{-2} Sec^{-1}	Stomatal Conductance mol sec^{-1}
1.	*Corchorus olitorius*	Flowering	11.18	8.13	0.60
2.	*Passiflora foetida*	Small twine	65.71	7.5	2.60
3.	*Sida cordifolia*	Flowering	13.47	9.6	0.50
4.	*Hibiscus vitifolius*	flowering	5.95	2.64	0.04
5.	*Heliotropium indicum*	Seed formation	5.55	5.48	0.11
6.	*Chrozaphorarottleri*	Seed formation	3.53	4.99	0.09
7.	*Malvastrum coromandelianum*	flowering	2.60	6.55	0.47
8.	*Ruella tuberosa*	Flowering	2.37	0.4	0.01
9.	*Tridax procumbens*	Flowering	2.06	2.43	0.13
10.	*Convolvulus arvensis*	Flowering	11.41	4.84	0.21
Mean			**12.383**	**5.256**	**0.476**

C4 weeds

Sl.No	Name of the weed	Stage of the weed	Photosynthetic rate μ molm^{-2} Sec^{-1}	Transpiration rate m mol m^{-2} Sec^{-1}	Stomatal Conductance mol sec^{-1}
1.	*Paspalum sp.*	Seed formation	10.08	5.67	0.18
2.	*Echinochloa colona*	Seed formation	7.81	5.71	0.13
3.	*Cynodon dactylon*	Well mat	4.69	2.36	0.03
4.	*Cynodon dactylon*	Well spreaded	4.20	1.19	0.02
5.	*Brachiaria reptans*	Flowering	3.04	3.26	0.07
6.	*Cenchrus ciliaris*	Flowering	3.32	1.18	0.03
7.	*Cyperus iria*	Flowering	6.13	2.21	0.04
8.	*Trianthema portulacastrum*	Seed formation	21.8	7.4	0.26
9.	*Boerhavia diffusa*	Flowering	2.03	1.81	0.08
10.	*Euphorbia hirta*	seed formation	1.47	1.28	0.03
11.	*Cleome chelidoni*	Flowering	15.26	10.49	0.33
Mean			**7.26**	**3.87**	**0.11**

C3-C4 intermediate weed

Sl.No	Name of the weed	Stage of the weed	Photosynthetic rate μ molm^{-2} Sec^{-1}	Transpiration rate m mol m^{-2} Sec^{-1}	Stomatal Conductance mol sec^{-1}
1.	*Parthenium hysterophorus*	Flowering	165.28	7.05	0.23
2	*Parthenium hysterophorus*	Vegetative	123.2	6.43	0.16
3.	*Parthenium hysterophorus*	Matured	118.7	2.98	0.05
Mean			**135.73**	**5.49**	**0.15**

Table 2. Correlation and regression analysis

Variables	Photosynthetic rate with Transpiration rate	Photosynthetic rate with stomatal conductance	Transpiration with Stomatal Conductance
Correlation	r=0.28	r=0.20	r=0.57
Regression equation	Y=4.98+4.32(x)	Y= 20.36+17.04(X)	Y=3.92+2.51(x)
r^2	0.07	0.20	0.46

4. CONCLUSION

Parthenium hysterophorus has recorded very high photosynthetic rate and there was difference with stage also, Flowering stage (165.28) has recorded a higher photosynthetic rate(μ mol/m^2 /Sec) followed by vegetative (123.2) and maturity phase (118.72) and found that transpiration rate also followed the same trend. Even this has recorded more than the C4 crop photosynthetic rate for example *Trianthema portulacastrum* which has recorded a photosynthetic rate of 21.98, which was the next highest photosynthetic rate among the weeds recorded and as well as over C4 crops too. Among the grasses *Paspalum* sp., *Echinochloa colona* (7.81μ molm^{-2} Sec^{-1}) and *Cynodon dactylon*(4.2μ molm^{-2} Sec^{-1}) has recorded higher photosynthetic rate. *Cyperus* and *Cyanodon* has recorded with lesser stomatal conductance and transpiration rate but has recorded higher photosynthetic rate which can thrive better in rainfeds also. *Echinochloa* has more transpiration rate and stomatal conductance among grasses and this might be due to their water loving nature.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Aruna Varanasi, Vara Prasad PV, Mithila Jugulam, Chapter three - impact of climate change factors on weeds and herbicide efficacy, Editor(s): Donald L. Sparks,

Advances in Agronomy, Academic Press. 2016;135:107-146.
2. Gharde Y. Singh PK, Dubey RP, Gupta PK. Assessment of yield and economic losses in agriculture due to weeds in India. Crop Prot. 2018;107:12-18.
3. Caroline Hernke Thie, Felipe Adelio de David, Leandro Galon, Sidnei Deuner, Cesar Tiago Forte, Gismael Francisco Perin, Paula Rochelly de David, Altemir José Mossi, André Andres, Germani Concenço. Physiology of Weeds in Intraspecific Competition Journal of Agricultural Science. 2018;10(6):334-340.
4. Deborah Amorim Martins, Adriano Jakelaitis, Isabella Sichierski Cardoso, Alan Carlos Costa, Juliana de Fátima Sales. Growth and physiological characteristics of the weed false johnsongrass (*Sorghum arundinaceum* (Desv.) Stapf Rev. Ceres 2016;63(1):16-24.
5. Aspiazú I, Sediyama T, Ribeiro Jr JI, Silva AA, Concenço G, Ferreira EA, Araujo WF. Water use efficiency of cassava plants under competition conditions. Planta Daninha, 2010;28(4): 699-703. https://doi.org/10.1590/S0100-83582010000400001
6. Caroline HernkeThiel , Felipe Adelio de David , Leandro Galon , SidneiDeuner , Cesar Tiago Forte , Gismael Francisco Perin , Paula Rochelly de David , Altemir José Mossi , André Andres, Germani Concenço, Physiology of weeds in intraspecific competition. Journal of Agricultural Science. 2018;10(6):334-340.
7. Hussein FawzyAbouziena, Hamed Mohamed El-Saeid, AboBakr Ahmed El-Said Amin. Water loss by weeds: A review. International Journal of Chem Tech Research. 2015;7(1):323-336.
8. Gedupudi Rajendrudu, Jasty Prasad SR, Ramadas VS. C3-C4 intermediate species in Alternanthera (*Amaranthaceae*). Plant Physiol. 1986;80:409-414.
9. Dinesh Jinger, Ramanjit Kaur, Navneet Kaur, Anchal Das, Weed dynamics under changing climatic scenario: A review. Int. J.Curr. Microbiol. App. Sci. 2017;6(3): 2376-2388.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/114754