www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(6): 741-745

www.thepharmajournal.com
Received: 16-04-2019
Accepted: 18-05-2019

Govindaraj T
PG Scholar, Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

P Murali Arthanari
Associate Professor (Agronomy), Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

GA Dheebakaran
Assistant Professor (Agronomy) Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

C Bharathi
Assistant Professor (Soil Science), Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Correspondence
P Murali Arthanari
Associate Professor (Agronomy), Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India

Effect of elevated temperature and moisture stress on growth and development of Horse purslane (*Trianthema portulacastrum* L.)

Govindaraj T, P Murali Arthanari, GA Dheebakaran and C Bharathi

Abstract
Experiment was carried out at Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore, during October 2018 – March, 2019 to understand horse purslane response to elevated temperature in order to manage them during under future climate scenarios. The experiment was carried out under pot culture mode in Climate Control Chamber with six treatments by Factorial completely randomized design. Each treatment was the combination of one temperature and one moisture level. Three temperature levels *viz.*, ambient (0 °C), elevated +2 °C and elevated +4 °C three moisture and levels *viz*., supply of moisture at 100 per cent, 140 per cent and 60 per cent ET of previous day. Horse purslane has high reproduction and efficient seed dispersal mechanisms on +2 °C elevated temperature and excess moisture when compared to ambient temperature and elevated +4 °C. Even under drought condition the treatment of elevated temperature performing better than the ambient temperature. From this experimentation, it is concluded that *Trianthema portulacastrum* will grow vigorously and efficiently utilise the resources even under elevated temperature and moisture stress condition in the cropped field.

Keywords: Elevated temperature, moisture stress**,** horse purslane, growth and development

1. Introduction
Climate is changing for several decades of years, but recent changes had received wider attention because of radical shifts in natural and human activities. Anthropogenic activities of humans contribute largely to global warming by affecting the amounts of greenhouse gases (GHGs) and aerosols (small particles). Assessment of the effects of global climate change factors [particularly of elevated carbon dioxide (CO_2) concentrations and rising temperature] on agriculture and farming practices is important to anticipate and adapt practices that maximize agricultural production in future climate scenarios (Mc Donald *et al*., 2009) [2].The Atmospheric CO_2 concentration have risen from about 280 ppm (pre-industrial period) to today's about 390 ppm and it is expected that by the end of 21st century, it will reach to the levels of 600-700 ppm, if the same trend prevails. Climate models projected that the global earth surface temperature is likely to rise in a range of 1.1 to 6.4 °C during the 21st century due to the rising CO_2 concentration (IPCC, 2014) [5].

Weeds are complex in nature and have significant negative effects on agriculture, forestry, rangelands, public health, and many human activities. Unlike outbreaks of pests and diseases, which may be random and irregular, weeds are relatively constant and pose severe problems in crop production (Amit Kumar *et al*., 2017) [1]. The atmospheric CO_2, temperature, and water or nutrient availability are important abiotic variables that directly affect weed physiology and growth and development. Weeds respond quickly to resource changes and have a greater likelihood to adapt and flourish in various types of habitats due to their greater genetic diversity and physiological plasticity compared with the crops. Change in available resources in the environment, will leads to greater response of weeds particularly, horse pursulane and reflect on the growth and performance compared to the crops. (Kristian Peters *et al*., 2014) [6]. The atmospheric CO_2, rainfall and temperature changes will affect weed species existence and adoptability within weed and crop communities. Further, it leads to adopt more agronomic practices to curtail furthermore weed growth and proliferation. (Gulshan Mahajan *et al*., 2012) [4].

Trianthema portulacastrum popularly known as horse purslane is an annual indigenous plant of South Africa which was widely distributed in South East and West Asia, Africa and Tropical America.

It is one of the problematic terrestrial weed by virtue of its competitiveness as a C4 species, It belongs to the aizoaceae family and is a much branched, fast growing, prostrate, succulent annual herb with ovate green leaves (Saeed *et al*., 2010) [8]. It has exclusively vegetative growth for a short time period of 35-40 days after emergence and then both vegetative growth and reproductive growth continue simultaneously (Tanveer *et al*.,2013) [10]. The *Trianthema portulacastrum* sufficient moisture condition will adopt easily and produce more growth under elevated temperature as supported by the earlier studies. (Ziska *et al*., 1997) [12].

An increase in temperature from 25 °C to 35 °C increased germination percentage from 65 to 85%. After 35 °C, germination started to decrease and was reduced to 71.25 % at 45 °C. In *T. portulacastrum*, maximum germination (90%) was observed at 35 °C (Balyan & Bhan, 1986) [3].In this context, the study was conducted with an objective of performance of horse purslane on elevated temperature and different level of moisture stress condition.

Materials and methods

The study was conducted as pot culture in climate control chamber of Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore, during October 2018 – March, 2019 to estimate the growth and development of Horse purslane (*Trianthema portulacastrum*) under elevated temperature and moisture stress.

The experiment was located at latitude of 11°N, longitude of 77°E and mean altitude is 426.7 m above mean sea level and Coimbatore comes under Western agro climate zone of Tamil Nadu**.** Coimbatore is climatically categorized as Semi-Arid Tropic (SAT) climate with an average annual rainfall of 696 mm distributed in 46 rainy days. The long period average annual mean maximum and minimum temperatures are 31.7 °C and 21.3 °C respectively. The normal annual mean relative humidity is 84.8 per cent during morning 07.22 hours LMT and 49.3 per cent during evening 14.22 hours LMT. The average mean bright sunshine hour is 7 per day and solar radiation is 311.4 cal/cm2/day. The experiment was laid out in a Factorial Completely Randomized Design (CRD) with two replications. Each treatment was a combination of one temperature and one moisture level. The temperature levels were varied as ambient (0 °C), elevated two degree (+2 °C), elevated four degree (+4 °C). The moisture levels were supply of moisture at 100 per cent of evaporation (M100), 60 per cent of evaporation (M60) and 140 per cent (M140) of evaporation occurred previous day. The treatment detailed in Table 1.

Table 1: Treatments details

Treatment	Treatment combination	
	Temperature	Moisture
T1	Ambient temperature + M 100 %ET	
T2	Ambient temperature + M 140 %ET	
T3	Ambient temperature + M 60 %ET	
T4	+ 2 °C elevated + M 100 %ET	
T5	+ 2 °C elevated + M 140 %ET	
T6	+ 2 °C elevated + M 60 %ET	
T7	+ 4 °C elevated + M 100 %ET	
T8	+ 4 °C elevated + M 140 %ET	
T9	+ 4 °C elevated + M 60 %ET	

Irrigation with good water was done to the pots on the basis of pan evaporation reading as per treatment schedule. The loss of water through evaporation was calculated every day and equal water was poured in the pots for 100 per cent moisture level. In 60 per cent moisture stress treatment, quantity of water equal to 60 per cent of open pan evaporation was poured and 140 per cent of pan evaporation was excess moisture. The calculation method was as followed

The calculation method was as followed

Area of the pot- 0.040 m^2	1 cubic meter is equal to 1000 litres
1 mm of water in one m^2 is equal to 1 litre	1 mm of water in 0.040m^2 is 40 ml
If the pan evaporation is 5 mm then water required for 100 per cent is 200 ml, for 140 per cent is 280 ml and 60 per cent is 120 ml.	

Results and discussion

The data was recorded on at 15 Days after Sowing (DAS), 30 DAS, 45 DAS for plant height (cm), and 60 DAS for number of fruiting branches, number of flowers and number of seeds and 20 DAS, 40 DAS, 60 DAS for the effects of different treatments on weed dry weight (gram).

The mean values recorded at 15 DAS, 30 DAS, and 45 DAS were ranged (plant height 1.8 to 8.2 cm, 7.6 to 19.1 cm and 17.3 to 32.9 cm). It was observed that, the treatment +4 °C with M 140% ET had significantly higher plant height (8.2 cm, 19.1 cm and 32.9 cm), followed by +4 °C with M 100% ET and plant height was 5.3 cm than other treatments, On, 30 DAS the treatment with +2 °C with M 140% ET plant height was 16.4 cm than the other treatments, during 45 DAS the treatment +2 °C with M 140% ET plant height was 27.7 cm than the other treatments. Whereas, the plant height of *Trianthema portulacastrum* was significantly lower (1.8 cm.7.6 cm and 17.3 cm) with ambient temperature with M 60% ET during 15, 30 and 45 DAS. The C4 pathway of horse purslane helped the weed to utilise the moisture and temperature more efficiently even during stress and produced higher growth.

The data total dry matter production per plant observed mean values at 20, 40 and 60 DAS were ranged (total dry matter per plant 0.033 gram to 0.53 gram, 2.25 gram to 8.2 gram and 3.62 gram to 13.60 gram). It was observed that, the dry matter production (0.53 gram to 13.60 gram) were significantly higher in the treatment +4 °C with M 140% ET followed by the treatment +4 °C with M 100% ET and the dry weight was 0.53 gram than other treatments, on 40 DAS the treatment +2 °C with M 140% ET 7.40 g dry weight was recorded than the other treatments, whereas, on 60 DAS the treatment +2 °C with M 140% ET dry weight was 11.82 gram than the other treatments. Significantly lower dry weight of *Trianthema portulacastrum* was observed (0.03 gram, 2.25 gram and 3.62 gram) in treatment of ambient with M 60% ET on 20 DAS, 40 DAS and 60 DAS. This might be due to enhanced physiological activity of the *Trianthema* will leads better translocation and more production of dry matters.

The mean values of number of fruiting branches, number of flower and number of seeds per plant at 45 DAS were ranged from 5 to 15, 23 to 74 and 160 to 524.5. It was observed that, the, number of flower and number of seeds *Trianthema portulacastrum* plant were significantly higher in the treatment +2 °C with M 140% ET followed by +2 °C with M100% ET than other treatments. The number of fruiting branches, number of flower and number of seeds per plant significantly lower in treatment +4 °C with M 60% ET

followed by ambient temperature with M 60 % ET.

The results obtained for the effects of different temperature and moisture stress combinations on *Trianthema portulacastrum* seed production were depicted in figure 3. The results inferred that the seeds production capacity of the *Trianthema portulacastrum* were positively influenced by increasing temperature up to 2 °C and negatively influenced by increasing temperature up to 4 °C. The data observed at 45 planting/Cutting (DAS/C) for the effects of different treatments on *Trianthema portulacastrum* plant height (cm), number of branch and leaf area (sq.cm) T4 (+4 °C with M100) had significantly higher plant height number of branches and leaf area than all other treatments. The growth of *Trianthema portulacastrum* was significantly lower in ambient temperature treatment (+0 °C with M100) and (+0 °C with M60) (Ajit kumar mandal *et al*. 2017) [7].

Temperature and moisture has significantly influenced the seed production in *Trianthema portulacastrum*. Though the vegetative phase responded positively towards stress but the reproductive phase was severely affected when weed subjected to the combination of elevated temperature and moisture stress. (Ugalechumi *et al*., 2018) [11].

Table 2: Effect of elevated temperature and moisture stress on horse purslane height (cm)

Treatment number	Temperature	Moisture						
	T	M	15 DAS		30 DAS		45 DAS	
T1	Ambient	100% ET	2.9		12.0		21.1	
T2	Ambient	140% ET	3.2		15.8		25.6	
T3	Ambient	60% ET	1.8		7.6		17.3	
T4	+2 °C	100% ET	3.5		14.8		25.1	
T5	+2 °C	140% ET	3.4		16.4		27.7	
T6	+2 °C	60% ET	2.5		9.5		20.9	
T7	+4 °C	100% ET	5.3		12.9		26.0	
T8	+4 °C	140% ET	8.2		19.1		32.9	
T9	+4 °C	60% ET	4.9		8.9		23.1	
Mean			3.9		13.0		24.4	
			SED	CD(0.05)	SED	CD(0.05)	SED	CD(0.05)
T			0.26	0.60	0.31	0.70	0.48	1.09
M			0.26	0.60	0.31	0.70	0.48	1.09
T*M			0.46	1.03	0.53	1.21	0.83	1.88

Table 3: Effect of elevated temperature and moisture stress on horse purslane yield components

Treatment	Temp.	Moisture	Number of fruiting branches		Number of flowers		Total seeds	
	T	M						
T1	Ambient	100% ET	8		41		289	
T2	Ambient	140% ET	9		49		355.5	
T3	Ambient	60% ET	5		33		234	
T4	+2 °C	100% ET	13		57		405.5	
T5	+2 °C	140% ET	15		74		524.5	
T6	+2 °C	60% ET	8		44		313	
T7	+4 °C	100% ET	6		35		245	
T8	+4 °C	140% ET	7		43		295	
T9	+4 °C	60% ET	5		23		160.5	
Mean			8.0		44.0		313.5	
			SED	CD(0.05)	SED	CD(0.05)	SED	CD(0.05)
T			0.75	1.69	0.66	1.50	3.29	7.44
M			0.75	1.69	0.66	1.50	3.29	7.44
T*M			NS	NS	1.15	2.61	5.70	12.89

Table 4: Effect of elevated temperature and moisture stress on horse purslane dry matter production

Treatment	Temp.	Moisture						
	T	M	20 DAS		40 DAS		60 DAS	
T1	Ambient	100% ET	0.04		3.34		5.73	
T2	Ambient	140% ET	0.08		4.69		6.45	
T3	Ambient	60% ET	0.03		2.25		3.62	
T4	+2 °C	100% ET	0.06		4.63		7.96	
T5	+2 °C	140% ET	0.10		7.40		11.82	
T6	+2 °C	60% ET	0.05		3.33		6.09	
T7	+4 °C	100% ET	0.07		5.40		8.40	
T8	+4 °C	140% ET	0.53		8.20		13.60	
T9	+4 °C	60% ET	0.04		4.30		7.20	
Mean			0.11		4.84		7.9	
			SED	CD(0.05)	SED	CD(0.05)	SED	CD(0.05)
T			0.01	0.02	0.12	0.27	0.10	0.23
M			0.01	0.02	0.12	0.27	0.10	0.23
T*M			0.01	0.03	0.21	0.47	0.18	0.40

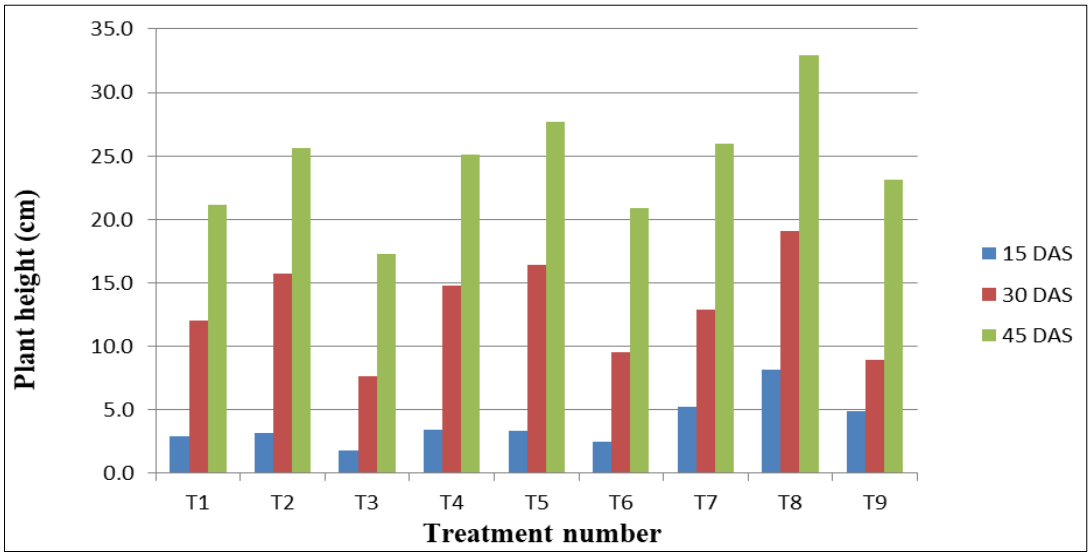

Fig 1: Effects of elevated temperature and moisture stress on horse purslane weed height (cm)

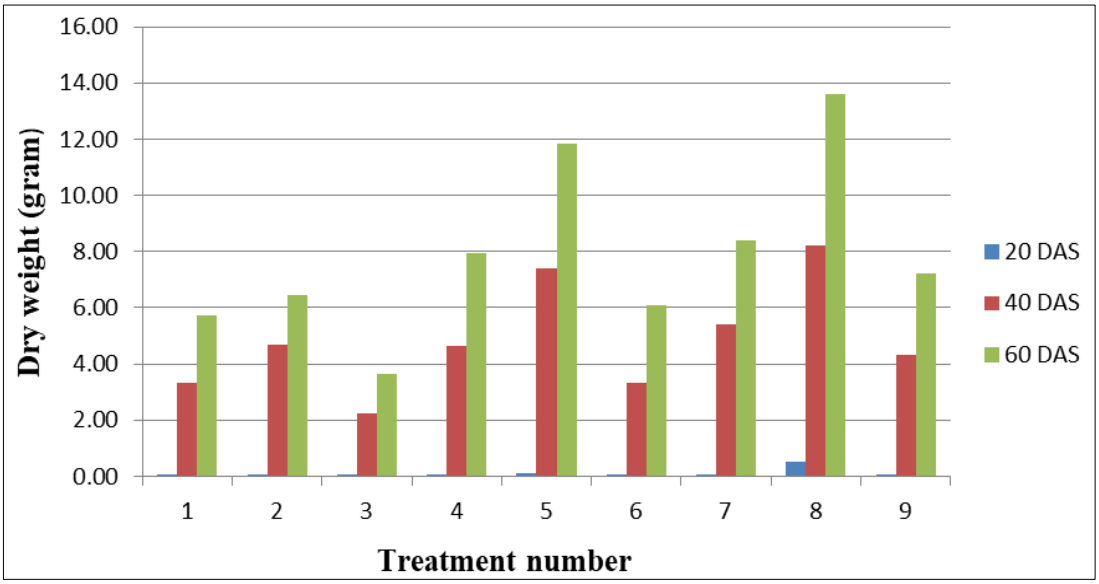

Fig 2: Effect of elevated temperature and moisture stress on horse purslane dry matter production

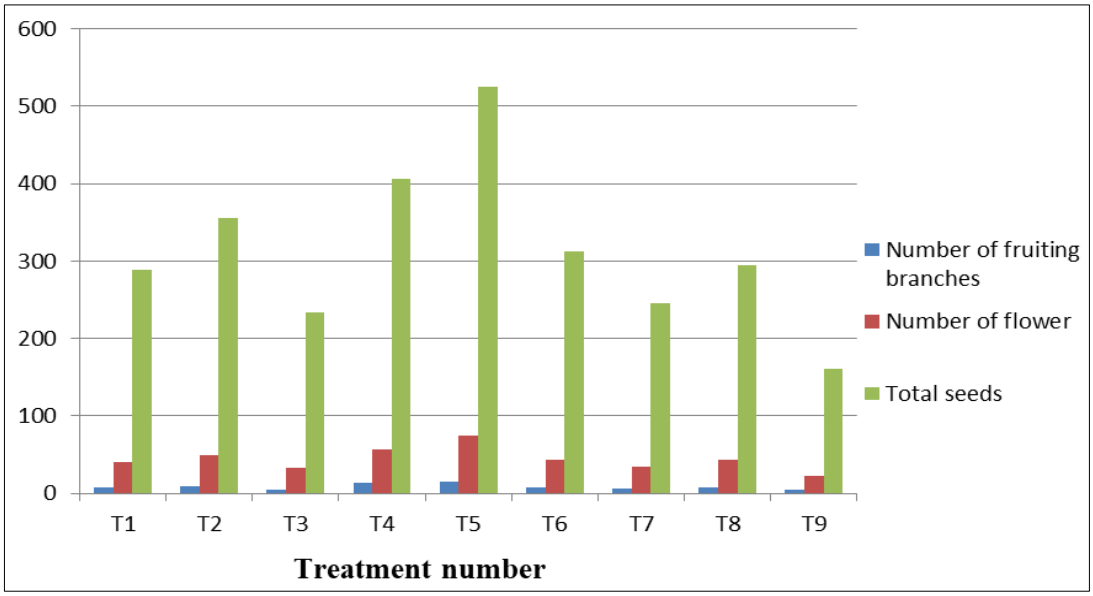

Fig 3: Effect of elevated temperature and moisture stress on horse purslane yield components

Conclusion

The most vibrant and fast growing weed *Trianthema portulacastrum* had higher very good capacity to produce more growth and development under elevated temperature, with sufficient moisture. Hence, it was concluded that in future elevated temperature conditions with less moisture conditions horse purslane weed will grow luxuriantly and very well compete with the cropped environment.

References

1. Amit Kumar, Mukesh Kumar. Climate Change's Impacts on Weeds and Herbicide Efficacy: A Review Int. J Curr. Microbiol. App. Sci. 2017; 6(9):2846-2853.
2. Andrew McDonald, Susan Riha, Antonio DiTommaso, Arthur DeGaetano. Climate change and the geography of weed damage: Analysis of U.S. maize systems suggests the potential for significant range transformations, Agriculture, Ecosystems and Environment, 2009, 130-140.
3. Balyan RS, Bhan VM. Emergence, Growth, and Reproduction of Horse Purslane (*Trianthema portulacastrum*) as Influenced by Environmental Conditions, Weed Science. 1986; 34:516-519.
4. Gulshan Mahajan, Samunder Singh, Bhagirath Singh Chauhan. Impact of climate change on weeds in the rice–wheat cropping system, Current Science. 2012; 102:9.
5. IPCC. (Intergovernmental panel on climate change) Climate change 2013 the physical science basis, 2013. (<http://www.ipcc.ch/report/ar5/wg1/>, March 2014).
6. Kristian Peters, Laura Breitsameter, Bärbel Gerowitt. Impact of climate change on weeds in agriculture: a review, Agron. Sustain. Dev. 2014; 34:707-721.
7. Mandal AK, Dheebakaran G, Banik M, Kumar A, Kumar V. Impact of climate change on adaptation capacity of Horse purslane (*Trianthema portulacastrum*). The Pharma Innovation Journal. 2017; 6(11):414-418.
8. Saeed M. Interference of horse purslane (*Trianthema portulacastrum* L.) with maize (*Zea mays* L.) at different densities. Pakistan Journal of Botany. 2010; 42(1):173-179.
9. Singh RP, Ramesh Singh K, Singh MK. Impact of Climate and Carbon Dioxide Change on Weeds and their Management-A Review, Indian J Weed Sci. 2011; 43(1-2):1-11.
10. Tanveer A, Mumtaz K, Javaid MM, Chaudhry MN, Balal RM, Khaliq A. Effect of ecological factors on germination of horse purslane (*Trianthema portulacastrum*). Viçosa; Planta daninha. 2013; 31:3.
11. Ugalechumi K, Geethalakshmi V, Panneerselvam S, Chinnusamy C, Jeyakumar P, Chinnamuthu CR. Impact of climate change on phenology of horse pursulane (*Trianthema portulacastrum*). The Pharma Innovation Journal. 2018; 7(7):184-187.
12. Ziska LH, Bunce JA. Influence of increasing carbon dioxide concentration on the photosynthetic and growth stimulation of selected C4 crops and weeds, Photosynthesis Research. 1997; 54:199-208.