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Original Research Article

Effect of Foliar Spray of different Agro-Chemicals i.e. CPPU, Sea Weed Extract, Salicylic Acid and Traicantanol on Physiological Attributes of Mango Cv. Alphonso under Rainy Season of Konkan Conditions

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A B S T R A C T

Alphonso is considered as one of the choicest variety all over the world holding major share in export of fresh mangoes and mango pulp among the mango varieties from India. The light intensity during rainy days is less than light saturation point required for optimum photosynthesis of mango. This could be one of the reasons for less carbon assimilation leading to low productivity The experiment was executed in Randomized Block Design with thirteen treatments and two replications with an objective to increase in the photosynthetic activity during low light in rainfall conditions which will help to build up C:N ratio leading to early maturity of the shoots and thus to early flowering. These thirteen treatments consist of four agro-chemicals with three different concentrations namely CPPU (10, 20, 30 ppm), Salicylic acid (75, 100, 125 ppm), Sea weed extract (1, 3, 5 %), Traicontanol (10, 20, 30 ppm) and Control (No spray).In case of stomatal conductance rate, rate of photosynthesis and rate of transpiration were significantly increased by foliar application of CPPU 20 ppm. CPPU, Alginic acid, Salicylic acid and Traicontanol increased photochemical activities and physiological functioning in mango. The rate of photosynthesis can be increased by spraying of these chemicals in diffused light conditions in rainy season of Konkan agro-climatic condition.

Keywords

Mango, Low Light Intensity, CPPU, Alginic acid, Salicylic acid

Introduction

Mango is tasted by all corners of world and rightly known as ‘King of fruits’ owing to its nutritional richness, unique taste, pleasant aroma and its religious and medicinal importance. Konkan region on the west coast of Maharashtra is one of the largest mango growing belts which contribute nearly 10 per cent of total mango area in the country, occupying 0.180 million hectare area under mango cultivation (Anonymous, 2013). Alphonso is leading variety in Konkan region in terms of area and production; which is

locally called as 'Hapus'. It thrives and yields early under warm and humid climate of Konkan region. Alphonso is considered as one of the choicest variety because of its earliness, keeping quality, typical sugar acid blend, aroma, processing potential and thus holding major share in export of fresh mangoes and mango pulp among the mango varieties from India. Inspite of this, Alphonso has some inherited drawbacks. The less productivity is one of the major long standing constrains of Alphonso mango production in Konkan.

Konkan region receives 3000 to 4000 mm rainfall annually from June to September. Cloudy days during this period reduce the number of bright sunshine hours. The light intensity during rainy days is less than light saturation point required for optimum photosynthesis of mango (Burondkar *et al.*, 2012). This could be one of the reasons for less carbon assimilation leading to low productivity (Burondkar, 2015). However, in the recent years Konkan region is witnessing marked climatic aberrations during all the three seasons viz. monsoon, winter and summer season; such as abnormal rains, sudden fluctuations in the temperature, fog, cloudy days, etc. adversely affect the growth of mango trees causing morpho-physiological deviations.

Increase in the photosynthetic activity during low light in rainfall conditions will help to build up C:N ratio leading to early maturity of the shoots and thus to early flowering. Many of the researchers have worked on use of different agro-chemicals to improve physiological process in various crops and plants. Spraying of growth regulators increased physiological processes in various crops and showing ultimate effect on morphological attributes. But very few studies were conducted for increasing plant activities in different or low light intensities. Hence, the present study entitled was undertaken with the objectives to study the effect of different concentrations of N-2-(chloro-4-pyridyl)-N-phenyl urea (CPPU), Alginic acid, Salicylic acid, Tricontenol on morphological attributes and to find out the suitable treatment among these chemicals for improving physiological attributes of mango grafts Cv. Alphonso under rainy season of Konkan agro-climatic conditions

Materials and Methods

The experiment was conducted at Nursery of Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.) India. The experimental material used for the study was one year old 130 grafted mango plants of Alphonso variety having equal morphological parameters (No. of shoot, No. of leaves, height, etc.) and age.

The experiment consisted thirteen treatments and two replications with five grafts in each replication arranged at 1m x 1m distance of spacing on experimental plot under open sky. Four agro-chemicals each with three different concentrations were sprayed on plants according to treatments along with control using knapsack sprayer. Periodical physiological observations were recorded at initial stage, 24 hrs., 7 DAS, 14 DAS, 21 DAS and 28 DAS by using third or fourth mature leaf from apical end of plant and portable photosynthesis system (LICOR 6400xt, Loc. Inc. USA) model.

Results and Discussion

Foliar application of agro-chemicals showed non-significant differences in Stomatal conductance rate up to 7 days after spraying in all treatments, but it showed significant difference at 14 days after spraying. Average light intensity recorded in August month was

506.55 PDF which was recorded by using Quantam Sensor (LICOR, Loc. Inc. USA)

Stomatal conductance rate

In various physiological parameters, values of mean stomatal conductance rate, presented in Table 1 and Fig. 1, of all treatments recorded were 0.0397, 0.0285, 0.0376, 0.0401, 0.0380 and 0.0589 µmol $H_2O/m^2/Sec^1$ at 0, 7, 14, 21 and 28 days after spraying respectively. At 24 hours after spraying (0 DAS), the highest stomatal conductance rate was observed in treatment T_2 (0.0355 µmol H_2O $/m^2$ $/Sec^1$) (i.e. CPPU 20 ppm), whereas lowest stomatal conductance was observed in T_9 (0.0225 µmol H_2O $/m^2$ $/Sec^1$) (i.e. Sea weed extract 3 %). On 7^{th} DAS, highest stomatal conductance rate was observed in T_5 (0.0609 µmol H_2O $/m^2$ $/Sec^1$) (i.e. Salicylic Acid 100 ppm), while lowest stomatal conductance rate was found in T_{11} (0.0267 µmol H_2O $/m^2$ $/Sec^1$) (i.e. Traicontanol 20 ppm).At 14 DAS, highest stomatal conductance rate was observed in treatment T_1 (0.0678 µmol H_2O $/m^2$ $/Sec^1$) (i.e. CPPU 10 ppm), followed by T_2 and T_3 (i.e. CPPU 30 ppm), which were at par with each other. The lowest stomatal conductance rate was observed in treatment T_{11} (0.0251 µmol H_2O $/m^2$ $/Sec^1$) followed by T_{12} (i.e. Traicontanol 30 ppm), T_{10} (i.e. Traicontanol 10 ppm), T_{13} (i.e. Control), T_9, T_6 (i.e. Salicylic acid 125 ppm) and T_8 (i.e. Sea weed extract 3 %) which were at par with each other. At 21 DAS, maximum stomatal conductance rate was obtained in treatment T_2 (0.0514 µmol H_2O $/m^2$ $/Sec^1$) followed by T_1 and T_{10} which were at par with each other. The minimum stomatal conductance rate was obtained in treatment T_{12} (0.0294 µmol H_2O $/m^2$ $/Sec^1$) followed by T_6, T_{13}, T_{11}, T_4, T_5, T_7 and T_9 which were at par with each other. At 28 DAS, statistically highest stomatal conductance rate was recorded in treatment T_2 (0.0720 µmol H_2O $/m^2$ $/Sec^1$) followed T_1 which were at par with maximum value. The lowest stomatal conductance rate was recorded in treatment T_9 (0.0499 µmol H_2O $/m^2$ $/Sec^1$) followed by T_6, T_{11}, T_7, $T_{12,}$ T_4, T_3, T_{13} and T_{10} which was at par with each other.

CPPU, Salicylic acid and Sea weed extract significantly influenced stomatal conductance of plant for a particular period of time in low light intensity during experimental period by improving the water use efficiency of plant. Plant growth regulators in optimum concentration effectively stimulate signalling pathways in cells and effectively balance the ratio of endogenous hormones to exogenous hormones, working together in a coordinated fashion to control the growth. Present research observations are in line with Khot *et al.,* (2015) in Grapes and Malgorzata and Dobromilska (2013) in Tomato.

Rate of photosynthesis

In various physiological parameters, values of mean rate of photosynthesis, presented in Table 2 and Fig. 2, of all treatments recorded were 2.57, 2.87, 2.99, 3.23, 3.35 and 3.75 at initial and 0, 7, 14, 21, 28 DAS.

On 0 DAS, the maximum rate of photosynthesis was obtained in treatment T_2 (3.54 µmol CO_2 m^{-2} Sec^{-1}) followed by T_7 (3.45 µmol CO_2 m^{-2} Sec^{-1}). The minimum rate of photosynthesis was found in T_9 (2.20 µmol CO_2 m^{-2} Sec^{-1}) followed by T_6 (2.44). At 7 DAS, The maximum rate of photosynthesis was recorded by treatment T_2 (3.38 µmol CO_2 m^{-2} Sec^{-1}), while minimum rate of photosynthesis showed by T_6 (2.44 µmol CO_2 m^{-2} Sec^{-1}). At 14 DAS, the higher rate of photosynthesis was obtained in treatment T_9 (3.75 µmol CO_2 m^{-2} Sec^{-1}) followed by T_7, T_2, T_8, T_{11}, T_3, T_5, T_{13} and T_{12} which were at par with each other. The lowest rate of photosynthesis obtained in treatment T_6 (2.38 µmol CO_2 m^{-2} Sec^{-1})

followed by T_1 which was at par with lowest value. At 21 DAS, The rate of photosynthesis was significantly maximum in treatment T_2 (3.98 µmol CO_2 m^{-2} Sec^{-1}) followed by T_8, T_7 and T_3 which was at par with each other; while the minimum rate of photosynthesis was observed in treatment T_6 (2.81 µmol CO_2 m^{-2} Sec^{-1}) followed by T_5, T_{13}, T_{10}, $T_{11}$and T_9 which were at par with each other. At 28 DAS, the highest rate of photosynthesis observed in treatment T_2 (4.15 µmol CO_2 m^{-2} Sec^{-1}) followed by T_5, T_7,T_9, T_8, T_6, T_4 and T_{10} which were at par with each other. The lowest rate of photosynthesis was observed in treatment T_{13} (3.08 µmol CO_2 m^{-2} Sec^{-1}) followed by T_{11}, T_1, T_{12} and T_3 which were at par with each other.

Application of CPPU and Sea weed extract significantly increased the rate of photosynthesis. All concentrations of Sea weed extract and CPPU 20 ppm and onward increased photosynthetic efficiency of plants. Plants treated with CPPU, Sea weed extract and salicylic acid stimulated biochemical activity with the accumulation of compatible solute, maintain tissue water potential and enhance potency of anti-oxidant system which improve the integrity of cellular membrane, facilitate to sustain photosynthesis and general metabolism in plant (Farooq *et al.,* 2009) and treated with sea weed extract increases effectiveness of water use efficiency. Similar results were given by Yang – Gyu Ku *et al.,* (2008) CPPU in capsicum, Khot *et al.,* (2015) in Grape.

Rate of transpiration

In various physiological parameters, values of mean rate of transpiration, presented in Table 3 and Fig. 3, of all treatments recorded were 0.55, 0.59, 0.60, 0.60, 1.03 and 1.10 µmol H_2O m^{-2} Sec^{-1} at initial, 0, 7, 14, 21, 28 day after spraying respectively. After 24 hours of spraying, all treatments were showed non-significant difference but the rate of transpiration was increased then initial (before spraying). The maximum rate of transpiration was obtained in treatment T_{13} (0.78 µmol H_2O m^{-2} Sec^{-1}) followed by T_{10}.

The minimum rate of transpiration was found in T_3.At 7 DAS, all treatments were non-significant. In experiment, the maximum rate of transpiration was observed in grafts of treatment T_3 while minimum rate of transpiration showed in grafts of T_{11}.At 14 DAS, there were significant differences in the treatments. The higher rate of transpiration was obtained in treatment T_9 (0.84 µmol H_2O m^{-2} Sec^{-1}) followed by T_8 and T_{10} which were at par with each other. The lowest rate of transpiration was obtained in treatment T_3 (0.48 µmol H_2O m^{-2} Sec^{-1}) followed by T_2, T_6, T_4, T_1, T_{11}, T_{13}, T_5 and T_7 which were at par with each other. At 21 DAS, the rate of transpiration was significantly maximum in treatment T_2 (1.25 µmol H_2O m^{-2} Sec^{-1}) followed by T_{10}, T_8, T_3, T_4, T_5, T_6 and T_{11} which were at par with each other. The minimum rate of transpiration was observed in treatment T_1 (0.80 µmol H_2O m^{-2} Sec^{-1}) followed by T_7, T_{13}, T_{12}, T_9, T_6, T_{11}, T_5 and T_4 which were at par with each other. At 28 DAS, the highest rate of transpiration was observed in treatment T_8 (1.38 µmol H_2O m^{-2} Sec^{-1}) followed by T_5, T_7, T_9, T_2 and T_4 which were at par with each other. The lowest rate of transpiration was observed in treatment T_{13} (0.88 µmol H_2O m^{-2} Sec^{-1}) followed by T_{12} and T_{11}, T_1, $T_6$and T_3 which were at par with each other.

The Salicylic acid and sea weed extract significantly increased rate of transpiration. Salicylic acid helps to overcome from stress conditions and enhance water use efficiency leads to better stomatal conductance and attributed to increase in rate of transpiration increased by application of salicylic acid and other agro-chemicals.

Table.1 Effect of Foliar spray of different agro-chemicals on stomatal conductance rate

Treatments	Stomatal conductance rate (µmol H_2O m^{-2} Sec^{-1})					
	Initial	0 DAS	7 DAS	14 DAS	21 DAS	28 DAS
T_1 - CPPU @ 10 ppm	0.0483	0.0344	0.0355	0.0678	0.0479	0.0648
T_2 - CPPU @ 20 ppm	0.0492	0.0355	0.0372	0.0541	0.0514	0.0720
T_3 - CPPU @ 30 ppm	0.0471	0.0238	0.0478	0.0538	0.0406	0.0583
T_4 - Salicylic acid @ 75 ppm	0.0448	0.0294	0.0505	0.0474	0.0354	0.0581
T_5 - Salicylic acid @ 100 ppm	0.0428	0.0297	0.0609	0.0461	0.0354	0.0658
T_6 - Salicylic acid @ 125 ppm	0.0400	0.0269	0.0326	0.0353	0.0310	0.0500
T_7 - Sea weed extract @ 1 %	0.0373	0.0319	0.0377	0.0415	0.0358	0.0556
T_8 - Sea weed extract @ 3 %	0.0330	0.0253	0.0322	0.0372	0.0392	0.0596
T_9 - Sea weed extract @ 5 %	0.0336	0.0225	0.0277	0.0305	0.0387	0.0499
T_{10} - Traicontanol @ 10 ppm	0.0312	0.0303	0.0341	0.0268	0.0445	0.0596
T_{11} - Traicontanol @ 20 ppm	0.0355	0.0275	0.0267	0.0251	0.0335	0.0544
T_{12} - Traicontanol @ 30 ppm	0.0421	0.0236	0.0281	0.0264	0.0294	0.0578
T_{13} - Control (No Spray)	0.0315	0.0296	0.0373	0.0291	0.0314	0.0592
Mean	0.0397	0.0285	0.0376	0.0401	0.0380	0.0589
S.E.	NS	NS	NS	0.0051	0.0032	0.0037
C.D.	NS	NS	NS	0.0148	0.0095	0.0107

Table.2 Effect of foliar spray of different agro-chemicals on rate of photosynthesis

Treatments	Rate of photosynthesis (µmol CO_2 m^{-2} Sec^{-1})					
	Initial	0 DAS	7 DAS	14 DAS	21 DAS	28 DAS
T_1 - CPPU @ 10 ppm	2.47	2.77	2.95	2.85	3.09	3.43
T_2 - CPPU @ 20 ppm	3.13	3.55	3.39	3.60	3.98	4.15
T_3 - CPPU @ 30 ppm	2.99	2.85	3.29	3.36	3.75	3.68
T_4 - Salicylic acid @ 75 ppm	2.59	2.92	3.19	3.04	3.22	3.95
T_5 - Salicylic acid @ 100 ppm	2.97	3.04	3.08	3.31	3.05	4.14
T_6 - Salicylic acid @ 125 ppm	2.37	2.45	2.45	2.38	2.82	3.96
T_7 - Sea weed extract @ 1 %	2.61	3.46	3.25	3.62	3.78	4.12
T_8 - Sea weed extract @ 3 %	2.27	2.58	2.70	3.44	3.94	3.90
T_9 - Sea weed extract @ 5 %	2.15	2.21	2.94	3.76	3.24	4.10
T_{10} - Traicontanol @ 10 ppm	2.23	2.76	2.85	3.05	3.12	3.72
T_{11} - Traicontanol @ 20 ppm	2.64	2.89	2.91	3.43	3.22	3.11
T_{12} - Traicontanol @ 30 ppm	2.17	2.68	3.06	3.12	3.30	3.48
T_{13} - Control (No Spray)	2.90	3.19	2.90	3.15	3.05	3.08
Mean	2.58	2.87	3.00	3.24	3.35	3.75
S.E.	NS	NS	NS	0.22	0.16	0.21
C.D.	NS	NS	NS	0.64	0.46	0.62

Table.3 Effect foliar sprays of different agro-chemicals on rate of transpiration

Treatments	Rate of transpiration (µmol H_2O m^{-2} Sec^{-1})					
	Initial	0 DAS	7 DAS	14 DAS	21 DAS	28 DAS
T_1 - CPPU @ 10 ppm	0.49	0.47	0.51	0.55	0.80	1.03
T_2 - CPPU @ 20 ppm	0.59	0.48	0.54	0.51	1.25	1.18
T_3 - CPPU @ 30 ppm	0.65	0.40	0.88	0.48	1.17	1.09
T_4 - Salicylic acid @ 75 ppm	0.69	0.50	0.84	0.53	1.06	1.16
T_5 - Salicylic acid @ 100 ppm	0.62	0.57	0.83	0.60	1.04	1.28
T_6 - Salicylic acid @ 125 ppm	0.48	0.60	0.50	0.51	1.02	1.06
T_7 - Sea weed extract @ 1 %	0.58	0.71	0.56	0.63	0.85	1.20
T_8 - Sea weed extract @ 3 %	0.59	0.59	0.55	0.76	1.17	1.38
T_9 - Sea weed extract @ 5 %	0.50	0.52	0.49	0.84	1.00	1.20
T_{10} - Traicontanol @ 10 ppm	0.53	0.77	0.57	0.69	1.20	1.12
T_{11} - Traicontanol @ 20 ppm	0.69	0.71	0.44	0.56	1.02	0.93
T_{12} - Traicontanol @ 30 ppm	0.41	0.65	0.51	0.67	0.99	0.89
T_{13} - Control (No Spray)	0.42	0.78	0.68	0.58	0.89	0.88
Mean	0.56	0.60	0.61	0.61	1.03	1.11
S.E.	NS	NS	0.06	0.05	0.08	0.08
C.D.	NS	NS	0.19	0.16	0.23	0.22

Fig.1 Effect of foliar spray of different agro-chemicals on stomatal conductance rate

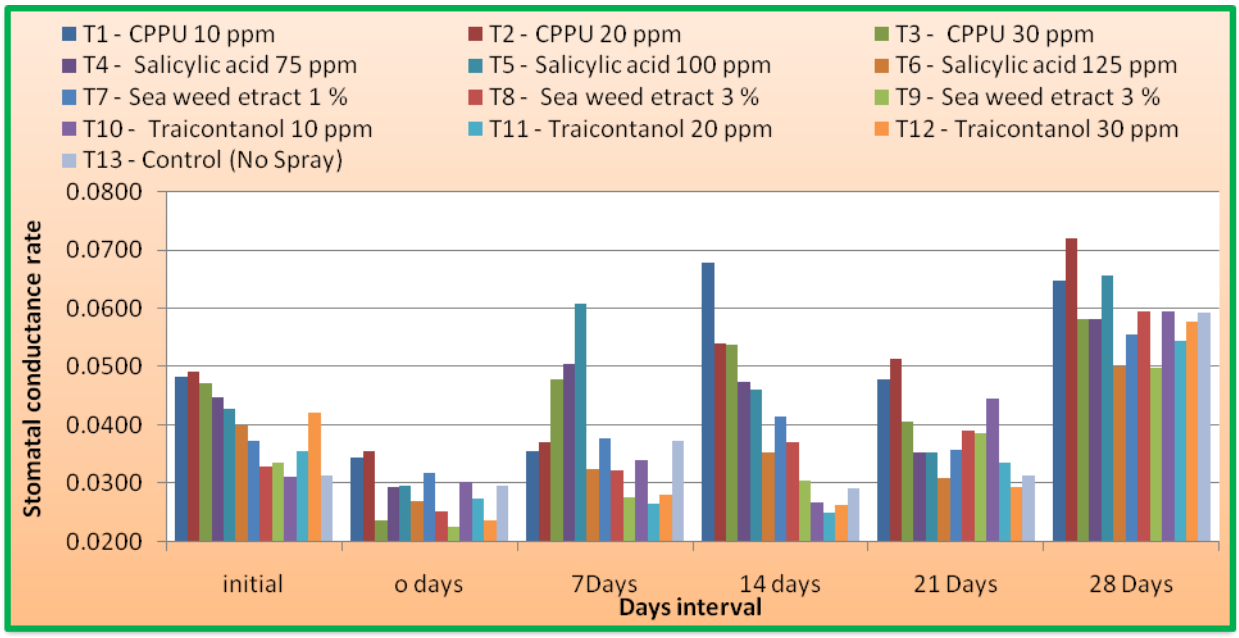


Fig.2 Effect of foliar spray of different agro-chemicals on rate of photosynthesis

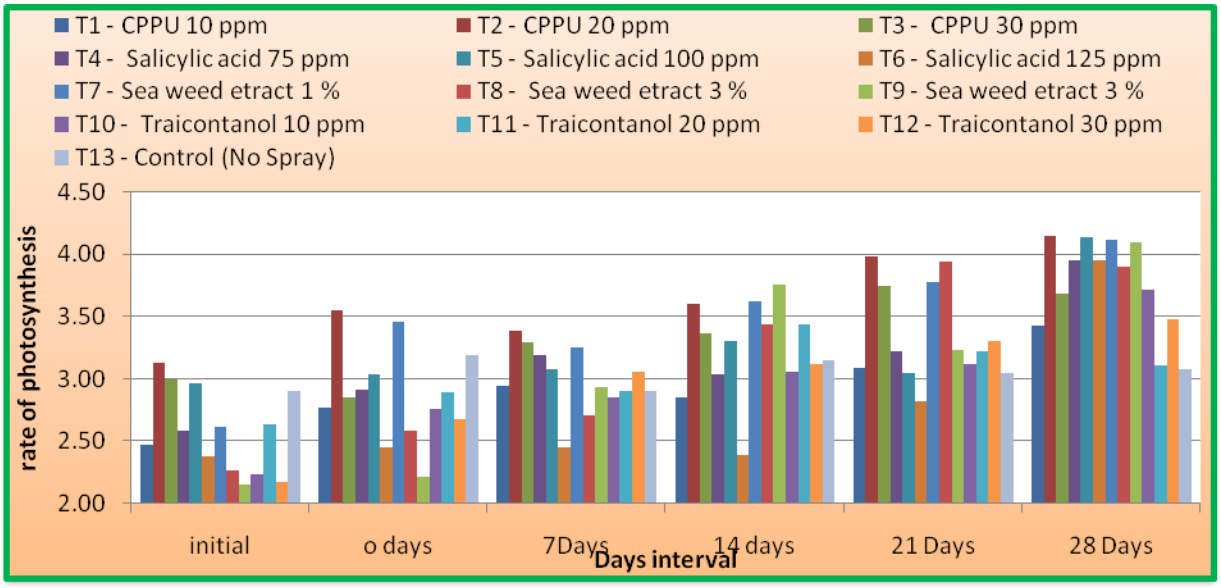
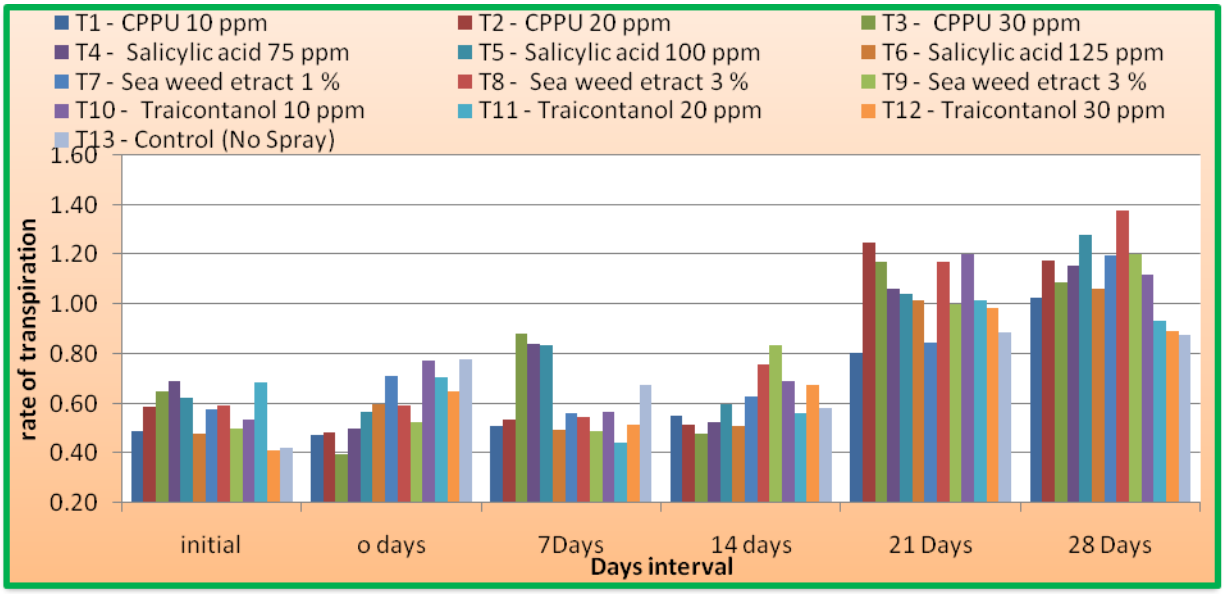


Fig.3 Effect of foliar spray of different agro-chemicals on rate of transpiration



The similar results were obtained by Afshari *et al.,* (2013) in Cowpea, Malgorzata and Dobromilska(2014) in Tomato.

During this investigation, the agro-chemical CPPU reported positive results with respect to increase in growth of plant in diffused light condition in rainy season of Konkan agro-climatic condition. In case of physiological parameters i.e. stomatal conductance rate, rate of photosynthesis and rate of transpiration was significantly increased by foliar application of CPPU 20 ppm. From the present investigation it could be concluded that the agro-chemicals used namely N-2-(chloro-4-pyridyl)-N-phenyl urea (CPPU), Alginic acid, Salicylic acid and Traicontanol increased photochemical activities and

physiological functioning in mango. The rate of photosynthesis can be increased by spraying of these chemicals in diffused light conditions in rainy season of Konkan agro-climatic condition. But these agro-chemicals may be more effective in higher concentration or in combination thus, there is scope for further research regarding effect of higher concentration and combination of these chemicals on growth of mango plants.

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