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Polyamines (Spermine, Spermidine and Putrescine) and Triacontanol on Physiological Behaviour on Mango cv. Alphonso under Rainy Season of West Coast (Konkan) of Maharashtra

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A B S T R A C T

Mango is a favourite fruit of almost everyone on the earth. It is full of vitamins and minerals and is of great taste. It is also the national fruit of India. It has gained worldwide popularity starting from ancient times. One of the major reason for low productivity of Alphonso in Konkan region is low rate of physiological process during monsoon season, due to low diffused sun light intensity. The present investigation entitled "Effect of Polyamines (Spermine, Spermidine and Putrescine) and Triacontanol on physiological behaviour of mango cv. Alphonso under rainy season of Konkan area" was conducted and laid out in randomized block design with thirteen treatments. Treatment details: T_1 (Triacontanol 10 ppm), T_2 (Triacontanol 15 ppm), T_3 (Triacontanol 20 ppm), T_4 (Spermine 150 ppm), T_5 (Spermine 450 ppm), T_6 (Spermine 700 ppm), T_7 (Spermidine 200 ppm), T_8 (Spermidine 600 ppm), T_9 (Spermidine 1000 ppm), T_{10} (Putrescine 100 ppm), T_{11} (Putrescine 250 ppm), T_{12} (Putrescine 450 ppm) and T_{13} (control). Thus, from present investigation it could be concluded that rate of photosynthesis increased by foliar application of Putrescine shown better effect under diffused sun light intensity conditions.

Introduction

Mango (*Mangifera indica* L.) is the oldest and choicest fruit of the world. It is considered as 'National fruit of India' and rightly known as 'King of fruits' owing to its nutritional richness, unique taste, pleasant aroma and its religious and medicinal importance. Mango is believed to be originated to South East Asia, Indo Burma region, in the foot hills of the Himalayas (Mukherjee, 1951). Due to its good qualities and high medicinal values, it is enjoyed by masses and classes from each corner of the World. It has an intimate association with cultural, religious, aesthetic and economical life of Indians since time immemorial (Chattopadhyay, 1976).

In Konkan region on the west coast of Maharashtra is one of the largest mango growing belt which contributes nearly 10 per cent of total mango area in the country,

occupying 0.180 million hectare area under mango cultivation. In Konkan, about 90 per cent area of mango is covered by the single cultivar "Alphonso", which is locally called as 'Hapus'. It thrives and yields best under warm and humid climate of Konkan region.

Konkan region receives 3000 to 4000 mm rainfall annually from June to September. Cloudy days during this period reduces the number of sunshine hours which adversely affect the rate of photosynthesis available to the mango crop, this is one the reason for low productivity. This problem of less sunshine hours available to mango crop, which leads to low physiological processes indirectly leads to either stunted over lanky i.e. etiolated growth of mango grafts. However, recently the climatic changes such as abnormal rains, sudden fluctuations in the temperature, fog etc. adversely affect the mango trees directly by causing morpho-physiological damage to the mango orchard.

One of the major reason for low productivity of Alphonso in Konkan is low rate of physiological process during monsoon season, due to low diffused light intensity. Many of the researches worked on use of different chemicals to improve physiological process in various horticultural crops. Spaying of Triacontanol and different polyamines increased physiological processes in various fruit crops.

Recent studies entitled that can be overcome by spraying of Triacontanol and poly amines (Spermine, Spermidine and Putrescine) increase the physiological process. Polyamines are considered to be a class of growth regulators in plants. In higher plants, PAs are mainly present in their free form. Spermine, Spermidine and Putrescine are the main polyamines in plants and they are involved in the regulation of diverse physiological processes, such as flower bud development with maintaining of C:N ratio, organogenesis, embryogenesis, fruit maturation and physiological attributes and development. They are also involved in responses to biotic and abiotic stresses. Exogenous application of Triacontanol were accelerate the process of flower bud differentiation and high contents in apical buds were beneficial for the initiation and maintenance of flower bud differentiation.

Materials and Methods

The experiment was conducted in Nursery number-10, Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S.) India. The experimental material for the study consisted of thirteen (13) treatments. 100 mango Cv. Alphonso grafts having equal morphological parameters and age. Applied with mixed soil with farm yard manure and fertilizers. The experiment consisted thirteen treatments and arranged at 1m x 1m distance of spacing on experimental plot under open conditions. Four agro-chemicals (Spermine, Spermidine, Putrescine and Triacontanol) each with three different concentrations were sprayed on plants according to treatments along with control using with sprayer. Periodical physiological observations were recorded at 24 hrs., 7 DAS and 30 DAS by using third or fourth mature leaf from apical end of plant and physiological parameters are measured with Portable Photosynthesis System (LICOR 6400xt, Loc. Inc. USA) model.

Results and Discussion

Application of agro-chemicals (Spermine, Spermidine, Putrescine and Triacontanol) are influenced positively under diffused light conditions which increases the rate of all the physiological parameters of mango Cv. Alphonso.

Rate of Transpiration

Data regarding transpiration rate was presented in Table 1 and Fig.1. Significant difference in respect of transpiration rate were obtained at all stages i.e. 24 hrs and 7 days, except 30 DAS. Mean transpiration rate of value of all treatments recorded were 0.204, 0.274 and 0.193 at 24 Hrs, 7 and 30 DAS respectively.

At 24 Hrs after spraying, significantly highest transpiration rate was recorded in T8 (0.273) (i.e. spermidine @ 600 ppm), followed by T12 (0.272) (i.e. Putrescine @ 450 ppm) and T7 (0.264) (i.e. Spermine @ 200 ppm) which was at par with each other. The lowest transpiration rate was recorded in treatment T5 (0.134) (i.e. Spermine @ 450 ppm), followed by T9 (0.142) (i.e. spermidine @ 1000 ppm) and T6 (0.168) (i.e. Spermine @ 700 ppm) which were at par with each other.

At 7 DAS, significantly highest transpiration rate was recorded in treatments T11 (0.323) (i.e. Putrescine @ 250 ppm), followed by T12 (0.323) (i.e. Putrescine @ 450 ppm) and T7 (0.322) (i.e. spermidine @ 200 ppm) which was at par with each other. The lowest transpiration rate was recorded in treatment T3 (0.215) (i.e. Triacontanol @ 20 ppm, followed by T4 (0.223) (i.e. Spermine @150 ppm) and T1 (0.226) (i.e. Triacontanol @ 10 ppm) which was at par with each other.

At 30 DAS, numerically highest transpiration rate was recorded in T12 (0.279) (i.e. Putrescine @ 450 ppm) and T10 (0.236) (i.e. putrescine @ 100 ppm) while the lowest transpiration rate was recorded in T6 (0.105) (i.e. Spermine @ 700 ppm) and T3 (0.145) (i.e. Triacontanol @ 20 ppm). Polyamines and Triacontanol application could cause an increase in the intensity of transpiration in the leaves with increase in the photosynthesis rate. Similar results are recorded in present investigation are in agreement with the findings of Wu *et al.*, (2010) putrescine in citrus. Muhammad Shahbaz *et al.*, (2013) triacontanol in canola (*Brassica napus* L.). The lower values obtained for transpiration could be attributed to the rainy season when relative humidity is always very high above (80%) in Konkan region.

Stomatal Conductance Rate

Data regarding stomatal conductance rate are presented in Table 2 and Fig.2. Significant differences in respect of Stomatal conductance rate were obtained at all stages i.e. 24 Hrs, 7 and except 30 days after spraying (DAS). Value of mean stomatal conductance rate of value of all treatments recorded were 0.052, 0.059 and 0.061 at 24 Hrs, 7 and 30 DAS respectively.

At 24 Hrs after spraying, significantly highest stomatal conductance rate was recorded in treatments T10 (0.069) (i.e. Putrescine @ 100 ppm), followed by T2 (0.062) (i.e. Triacontanol @ 15 ppm) and T3 (0.061) (i.e. Triacontanol @ 20 ppm) which were at par with each other. The lowest stomatal conductance rate were recorded in treatment T8 (0.038) (i.e. spermidine @ 600 ppm), followed by T4 (0.042) (i.e. Spermine @ 150 ppm) and T5 (0.044) (i.e. Spermine @ 450 ppm) which were at par with each other.

At 7 DAS, significantly highest stomatal conductance rate was recorded in treatments T10 (0.079), (i.e. Putrescine @ 100 ppm), followed by T1 (0.070) (i.e. Triacontanol @ 10 ppm) and T2 (0.070) (i.e. Triacontanol @ 15 ppm) which were at par with each other.

Table.1 Transpiration (mol H_2Om^{-2} Sec^{-1}) rate of Mango Cv. Alphonso.

Treatments	Rate of transpiration (mol H_2Om^{-2} Sec^{-1})		
	Days after spraying		
	24 Hrs	7 days	30 days
T1- Triacontanol @ 10 ppm	0.180	0.226	0.153
T2-Triacontanol @ 15 ppm	0.193	0.311	0.180
T3-Triacontanol @ 20 ppm	0.212	0.215	0.145
T4-Spermine @ 150 ppm	0.227	0.223	0.149
T5-Spermine @ 450 ppm	0.134	0.269	0.207
T6-Spermine @ 700 ppm	0.168	0.255	0.105
T7-Spermidine @ 200 ppm	0.264	0.322	0.206
T8-Spermidine @ 600 ppm	0.273	0.304	0.227
T9-Spermidine @1000 ppm	0.142	0.248	0.196
T10-Putrescine @ 100 ppm	0.225	0.273	0.236
T11-Putrescine @ 250 ppm	0.179	0.336	0.226
T12-Putrescine @ 450 ppm	0.272	0.323	0.279
T13 –Control	0.188	0.259	0.203
Mean	**0.204**	**0.274**	**0.193**
S.Em±	0.028	0.027	0.041
C.D. at 5%	0.082	0.080	NS

Table.2 Stomatal conductance (µ mol H_2Om^{-2} Sec^{-1}) of Mango Cv. Alphonso as influenced by Different Treatments

Treatments	Rate of Stomatal conductance (µ mol H_2Om^{-2} Sec^{-1})		
	Days after spraying		
	24 Hrs	7 days	30 days
T1- Triacontanol @ 10 ppm	0.056	0.070	0.070
T2-Triacontanol @ 15 ppm	0.062	0.070	0.069
T3-Triacontanol @ 20 ppm	0.061	0.068	0.065
T4-Spermine @ 150 ppm	0.042	0.048	0.043
T5-Spermine @ 450 ppm	0.044	0.062	0.063
T6-Spermine @ 700 ppm	0.051	0.060	0.064
T7-Spermidine @ 200 ppm	0.061	0.056	0.059
T8-Spermidine @ 600 ppm	0.038	0.049	0.056
T9-Spermidine @1000 ppm	0.046	0.063	0.064
T10-Putrescine @ 100 ppm	0.069	0.079	0.073
T11-Putrescine @ 250 ppm	0.054	0.047	0.063
T12-Putrescine @ 450 ppm	0.053	0.050	0.054
T13 –Control	0.045	0.041	0.046
Mean	0.052	0.059	0.061
S.Em±	0.004	0.005	0.006
C.D. at 5%	0.0012	0.0015	NS

Table.3 Photosynthesis (µ mol CO_2 m^2 Sec^1) rate of Mango Cv. Alphonso as influenced by Different Treatments

Treatments	Rate of photosynthesis (µ mol CO_2 m^2 Sec^{-1})		
	Days after spraying		
	24 Hrs	7 days	30 days
T1- Triacontanol @ 10 ppm	3.23	3.28	7.09
T2-Triacontanol @ 15 ppm	3.40	4.17	7.08
T3-Triacontanol @ 20 ppm	4.08	4.01	6.78
T4-Spermine @ 150 ppm	3.39	3.27	6.80
T5-Spermine @ 450 ppm	4.25	4.52	6.78
T6-Spermine @ 700 ppm	3.40	3.20	7.26
T7-Spermidine @ 200 ppm	3.96	4.88	7.37
T8-Spermidine @ 600 ppm	3.91	5.29	8.04
T9-Spermidine @1000 ppm	3.21	4.39	8.13
T10-Putrescine @ 100 ppm	4.49	5.86	8.53
T11-Putrescine @ 250 ppm	3.86	3.97	7.73
T12-Putrescine @ 450 ppm	3.34	4.50	8.28
T13 –Control	2.93	3.70	4.94
Mean	3.65	4.23	7.29
S.Em±	0.23	0.42	0.71
C.D. at 5%	0.68	1.22	NS

Fig.1 Stomatal conductance (µ mol H2Om-2 Sec-1) of Mango Cv. Alphonso

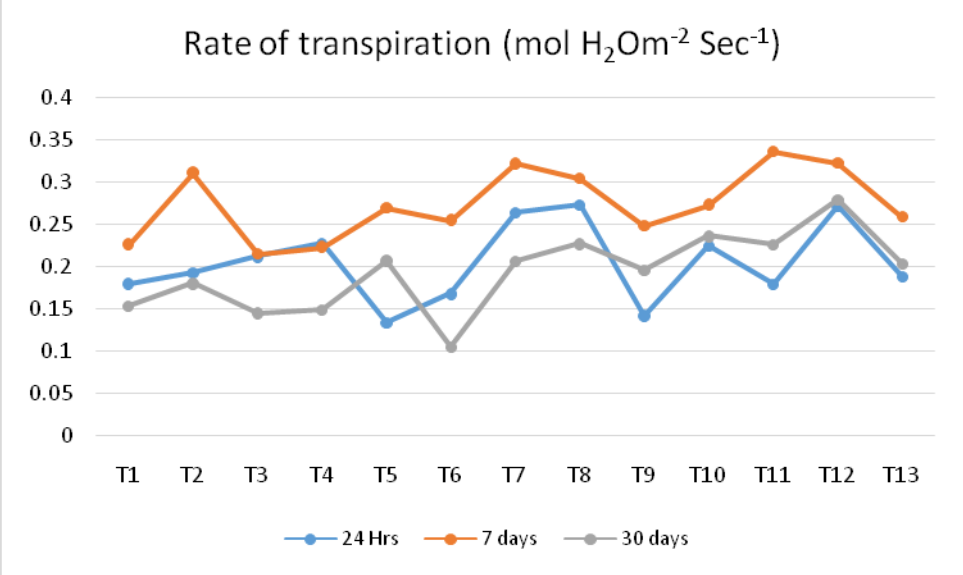


Fig.2 Effect of Polyamines and Triacontanol on rate of stomatal conductance of mango Cv. Alphonso

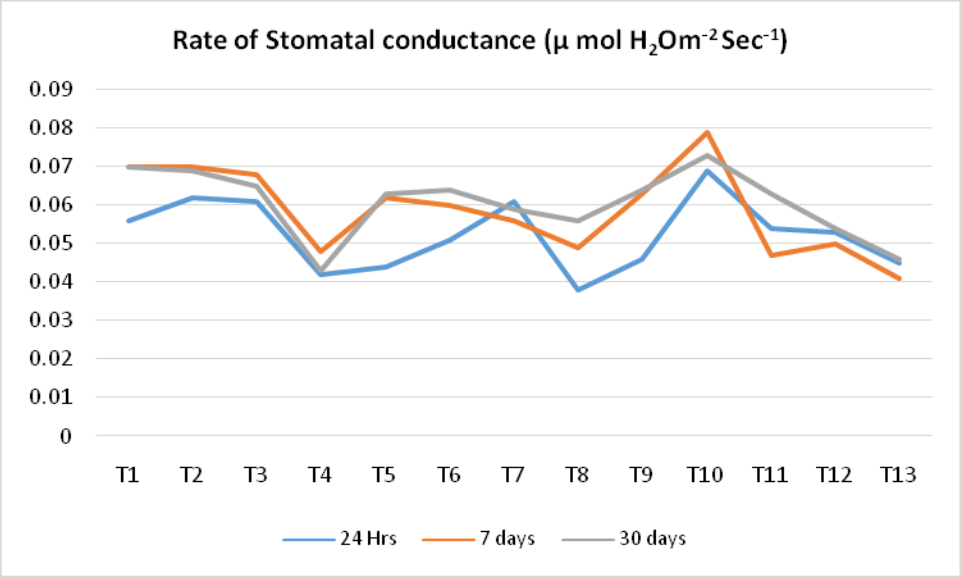
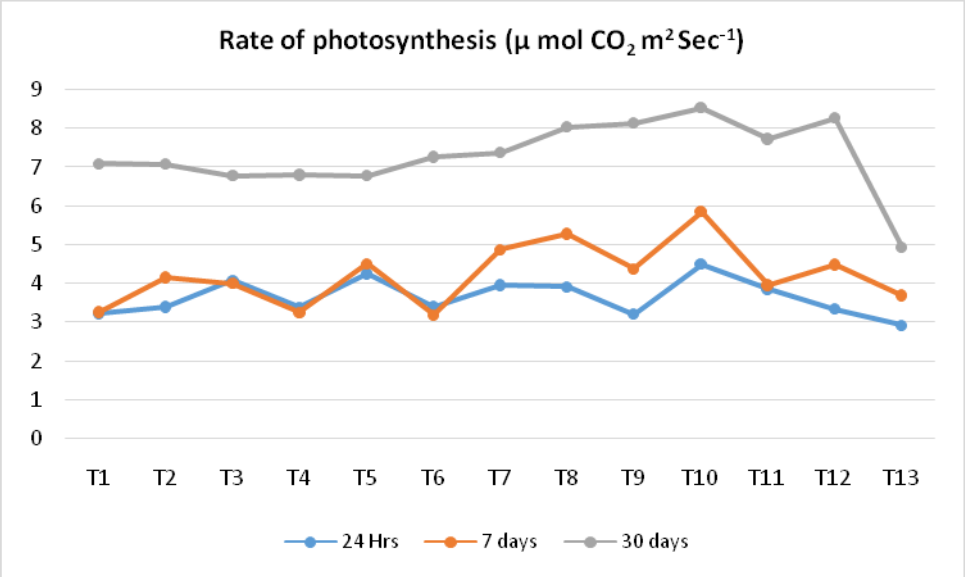


Fig.3 Effect of Polyamines and Triacontanol on Photosynthesis rate of mango Cv. Alphonso



The lowest stomatal conductance rate were recorded in treatment T13 (0.041) (i.e. control) followed by T11 (0.047) (i.e. putrescine @ 250 ppm) and T4 (0.048) (i.e. Spermine @ 150 ppm) which were at par with each other. At 30 DAS, numerically highest stomatal conductance rate was recorded in T10 (0.073) (i.e. Putrescine @ 100 ppm) and T1 (0.070) (i.e. Triacontanol @ 10 ppm), while the lowest stomatal conductance rate was recorded in T4 (0.043) (i.e. Spermine @ 150 ppm) and T13 (0.046) (i.e. control).

Application of Triacontanol and polyamines could also cause an increase in the intensity of stomatal conductance in the leaves with

increase in photosynthesis. The results recorded in present investigation are in agreement with the finding of Sharma *et al.,* (2002) in almond, Wang Tian *et al.,* (2008) in *Cucumis sativus*, Qiang-Sheng Wu *et al.,* (2010) putrescine in citrus, and Khandaker *et al.,* (2013) in Bougainvillea plants. The lower values obtained for stomatal conductance could be attributed to the rainy season when relative humidity is always very high above (80%) in Konkan region.

Photosynthesis Rate

Data regarding photosynthesis rate are presented in Table 3 and Fig.3. Significant differences in respect of photosynthesis rate were obtained at stages i.e. 24 Hrs, 7 and except 30 days after spraying (DAS). Values of mean photosynthesis rate of all treatments recorded were 3.65, 4.23 and 7.29 at 24 Hrs, 7 and 30 DAS, respectively.

At 24 Hrs, after spraying, the photosynthesis rate was recorded significantly highest in treatments T10 (4.49) (i.e. Putrescine @ 100 ppm), T5 (4.25) (i.e. Spermine @ 450 ppm), and T3 (4.08) (i.e. Triacontanol @ 20 ppm), which were at par with each other. The lowest photosynthesis rate was recorded in treatment T13 (2.93) (i.e. control), followed by T9 (3.21) (i.e. spermidine @ 1000 ppm) and T1 (3.23) (i.e. Triacontanol @ 10 ppm), which were at par with each other.

At, 7 DAS, the photosynthesis rate was recorded significantly highest in treatments T10 (5.86) (i.e. Putrescine @ 100 ppm) and T8 (5.29) (i.e. spermidine @ 600 ppm) which were at par with each other. The lowest photosynthesis rate was recorded in treatment T6 (3.20) (i.e. Spermine @ 700 ppm), followed by T4 (3.27) (i.e. Spermine @ 150 ppm), T1 (3.28) (i.e. Triacontanol @ 10 ppm) and T13 (3.70) (i.e. control) which were at par with each other.

At 30 DAS, numerically highest photosynthesis rate was recorded in T10 (8.53) (i.e. Putrescine @ 100 ppm) and T12 (8.28) (i.e. Putrescine @ 450 ppm), while the lowest photosynthesis rate was recorded in T13 (4.94) (i.e. control) and T5 (6.78) (i.e. Spermine @ 450 ppm).

Photosynthesis is fundamental process. Photosynthesis rate can be regulated by Triacontanol and polyamines by activating secondary messengers that play a role in increasing the enzymatic activity of the plant, so the plant can increase vegetative growth, Triacontanol and polyamines directly activates the genes that control the process of photosynthesis. These genes in turn activate enzymes that control the chemical process of photosynthesis. Therefore plant growth regulators, given at the optimum concentration can more effectively increase the activity of enzymes to enhance the process of photosynthesis. The results recorded in present investigation with are in agreement with the finding of Zhang Yuan *et al.,* (2013) putrescine in apple, Wang Tian *et al.,* (2008) polyamines in *Cucumis sativus*, and Muhammad Shahbaz *et al.,* (2013) Triacontanol in canola (*Brassica napus* L.).

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